WPI Journal

WORCESTER POLYTECHNIC INSTITUTE AUGUST 1985

A CHANGE AT THE HELM

WANTED: MORE GRAD STUDENTS IN SCIENCE AND ENGINEERING

AN ENTREPRENEURIAL SPIRIT

THE NEW MEDICINE

WPI Journal

WORCESTER POLYTECHNIC INSTITUTE

VOLUME 89, NUMBER 1 AUGUST 1985

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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, Hartwick College, Johns Hopkins University, Rensselaer Polytechnic Institute, Villanova University, Western Maryland College, Worcester Polytechnic Institute) and appear in the respective alumni magazines of those institutions. Second class postage paid at Worcester, MA, and additional mailing offices.

Staff of the Alumni Magazine Consortium: Editor, Mary Ruth Yoe; Design and Production Coordinator, Amy Doudiken; Assistant Editor, Leslie Brunetta; Designer, Allen Carroll; Editorial Assistant, Claire E. Brown, Time Inc. Fellow, Joe Levine.

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

 Address correspondence to the Editor, *The WPI Journal*, Worcester Polytechnic Institute, Worcester, MA 01609. Telephone (617) 793-5609. Postmaster: If undeliverable please send form 3579 to the address above. Do not return publication.

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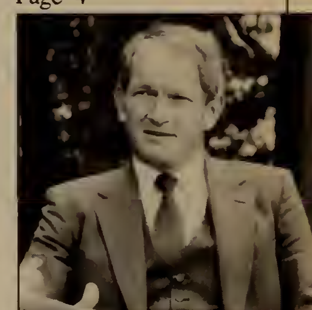

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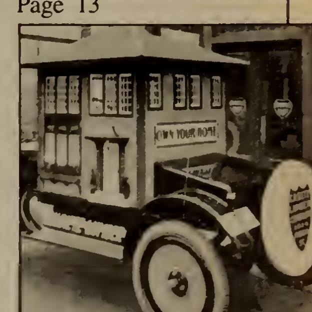

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Cover: Dr. Edmund T. Cranch, 12th president of the Institute.
Opposite: Reunion '85. See it all, beginning on page 45. Photos by Michael Carroll.

College Dedicates Stoddard Laboratories

A distinguished name for a distinguished building: Mrs. Helen E. Stoddard receives a gift from Dr. Edmund T. Cranch at the dedication of the Stoddard Laboratories, named in honor of Mrs. Stoddard's late husband, Robert W. Stoddard. Looking on are Joseph R. Carter, chairman of the board of Wyman-Gordon Co., and Robert C. Steele, chairman and president of the Worcester Telegram and Gazette Inc.

Michael Carroll

Other than Boynton Hall, no building has played a more vital role in the history and traditions of WPI than Washburn Shops. Completed in 1868 as WPI's second building, the Shops then housed commercial machining and manufacturing facilities where students served as apprentices to skilled workers, for a half century turning out products that added significantly to the Institute's reputation—and to its purse.

So successful was this enterprise that in 1892 a three-story wing was constructed to provide additional manufacturing space. Yet important as this space has always been, until recently, it was known simply as the North Wing.

But all that is history now, for at Reunion on June 1, before a large audience of alumni, trustees and friends of the college, WPI dedicated the Wing as the Robert W. Stoddard Laboratories, honoring the community leader who served the college as a trustee for 33 years before his death in December 1984. Stoddard was a longtime supporter of the materials engineering program of the Mechanical Engineering Department, which is housed in these laboratories.

"I think it's appropriate for these metallurgy laboratories to be named for Bob because he was fascinated by precision, delicacy and perfection," said Helen E. Stoddard, thanking WPI for its tribute to her late husband.

Stoddard began his lifelong career with Wyman-Gordon Company in 1929 as a laboratory helper. In 1967, he was elected chairman of the Wyman-Gordon Board of Directors, a post held earlier by his father, Harry G. Stoddard. This company, founded in 1883 by two WPI alumni, is the western world's largest supplier of forgings to the automotive, aircraft and gas turbine industries.

For the last 21 years of his life, Stoddard also served as chairman of the Worcester Telegram and Gazette Inc. He was a director of some of the region's most prestigious business firms, as well as a trustee of banks, museums, and educational and research institutions.

"In his lifetime, Bob Stoddard modestly declined any offer we made to honor him in some manner," said Dr. Edmund T. Cranch. "The one exception was his honorary Doctor of Engineering degree which WPI awarded him in 1952.

"When he participated in the dedication of the Stoddard Residence Center in 1970, and later in announcing the establishment of the Stoddard Professorship in Management, he stressed that these were to honor the memory of his father, Harry G. Stoddard," added Dr. Cranch.

Following Robert Stoddard's death, WPI officials discussed with his family the possibility of placing his name on the building which for nearly a century has been nameless. His family concurred.

The Stoddard Laboratories were completely renovated in 1983–84 during the $4.3 million reconstruction of the entire Washburn Shops complex.

Three Alumni Term Trustees Elected

Howard G. Freeman '40 ME, WPI Board of Trustees chairman, has announced the election of three alumni to trustee positions, effective July 1, 1985.

Raymond J. Perreault '38 ME, an eight-year incumbent, will serve a second term, until June 30, 1988. Robert F. Stewart '50 EE, also an incumbent with five years of Board service, will serve a second five-year term. Donald E. Ross '54 ME will serve an eight-year term, his first.

Perreault is president and treasurer of Falls Machine Screw Co. Inc., Chicopee, MA, manufacturer of precision industrial and consumer items. He has been active in alumni and college affairs as a member of the President's Advisory Council, the Connecticut alumni chapter and the 40th Reunion gift committee.

Perreault is active in organizations such as the Greater Chicopee Chamber of Commerce, of which he is a director, Chicopee Boys Club and Springfield YMCA, and

Raymond J. Perrault '38

Donald E. Ross '54

Robert F. Stewart '50

the National Association of Manufacturers. He lives in Suffield, CT.

Ross is president of MPB Corporation of Keene, NH, manufacturer of precision bearings. He has served as vice president of the Alumni Association, as a member of the Association's Executive Committee, as chairman of the Alumni Publications Committee, and as chairman of the 25th Reunion gift committee. At Reunion in June, he was given the Herbert F. Taylor Award for service to WPI.

He has served as director of the Lebanon, NH, Chamber of Commerce, the Lebanon Industrial Development Association, the Daniel Webster Council of the Boy Scouts of America and the United Way. He is a corporator of Mary Hitchcock Memorial Hospital and Keene Savings Bank, and is a director of Troy Mills Inc. He resides in Surry, NH.

Stewart is senior executive vice president for IC Industries Inc., Chicago. In 1971, he was given the Robert H. Goddard Award for professional achievement. WPI awarded him an honorary Doctor of Engineering degree in 1978. He is a member of the President's Advisory Council.

He is a director of Incom International and a former trustee of the University of Connecticut. Previously, Stewart was senior vice president for strategic planning of United Technologies Corporation and corporate vice president and group president (industrial products) for Rockwell International. He lives in Glenview, IL.

Toward More Humane Technologists

"The great engineers of the past—the Roeblings, the Eiffels, the builders of the Panama Canal—didn't see themselves as heroic figures, or as characters in the drama of history. The giants of 19th-century technology were 'civilized' engineers, whose creativity, not just their mathematical prowess, made the real difference. Besides their work, many were interested in poetry, theater, literature, even growing roses. They didn't divorce technology from the humanities. They are models which technologists today might well emulate."—David McCullough, writer, historian, and featured speaker at the inaugural Friends of the Humanities Program at WPI, held this past May 15.

McCullough came to WPI to help initiate the Friends program as well as to be on hand for announcement of the new Paris Fletcher Distinguished Professorship in the Humanities, named to honor the WPI trustee emeritus who has served the college for more than 30 years. John F. Zeugner, professor of history, was named recipient of the first Fletcher professorship.

Zeugner has twice been awarded fellowships to teach in Japan. In May he was awarded the 26th annual WPI Trustees Award for Outstanding Teaching. A specialist in American history, he has published both as a historian and as a writer of fiction.

Fletcher, a senior partner in the Worcester law firm of Fletcher, Tilton & Whipple, was a WPI trustee from 1953 until 1973, serving as vice chairman for 11 years and on the Board's executive and investment committees. A trustee emeritus since 1973, he was awarded an honorary Doctor of Science degree in 1967 and the WPI Award for Distinguished Service to the College in 1977.

McCullough is the author of four books, all of which have received wide critical and popular acclaim: *The Johnstown Flood, The Great Bridge, The Path Between the Seas* and *Mornings on Horseback,* a biography of Theodore Roosevelt that won the 1982 American Book Award. In addition to narrating the "Smithsonian World" series on public television, he is working on a biography of Harry S. Truman. McCullough received an honorary Doctor of Engineering degree from WPI in 1984.

Sigma Phi Epsilon Closed

Undergraduate members of the WPI chapter of Sigma Phi Epsilon Fraternity have been informed by their alumni board that the chapter and the chapter house have been closed and will remain closed for the foreseeable future.

The fraternity was placed on suspension by the college in March. Complaints against the chapter included violations of campus party regulations, neighbor complaints, and hazing of pledges. The membership status of individual members will remain suspended until graduation when they become alumni members of the national fraternity.

In his letter to the undergraduate members, Sig Ep's Alumni Board President, John P. Jacobson '65 wrote, in part: "We remain committed to the goals and ideals of Sigma Phi Epsilon Fraternity and fully support the WPI fraternity system. We expect to recolonize the fraternity within three to four years."

Robert S. Arnold

(L. to R.) Author-historian David McCullough, Dr. Edmund T. Cranch, Paris Fletcher and Robert Cushman, president and CEO of Norton Company, at the announcement of the Paris Fletcher Distinguished Professorship in the Humanities.

The Twelfth presidency of WPI proved golden years for the Institute.

Edmund Titus Cranch

By Roger N. Perry, Jr. '45

The walk Edmund Cranch took to campus that warm July morning in 1978, from his newly occupied presidential residence, across Alumni Field and the Quadrangle, would become an almost daily ritual for the next seven years.

He stopped to chat briefly with campus staff as he went—groundskeepers at work and faculty passing by. In short order, the entire WPI community would come to know his cordial manner.

That summer, Boynton Hall, WPI's administration building, was in the final stages of its first renovation since construction in 1868 as one of WPI's two original buildings. The office Ed Cranch entered that morning had been temporarily relocated in a modest building nearby, a building that had once served as a working foundry for the college.

As he entered this office, he was confronted by the bare polished wood surface of his new desk. And though it didn't remain empty for long, neither did it become cluttered in the next seven years. For—ever the engineer—his exacting standards kept the desk well organized, even as his presidential workload increased.

The normally slower paced campus life of summer was for Dr. Cranch a time of intensive learning about the institution he had been chosen to lead. He used the time well, assessing the job which lay ahead and the faculty and administrative staff who stood by eager to assist him.

After an academic career spanning three decades at Cornell, Ed Cranch was making a new beginning on a new campus, in a new city, and in a new role. His would be the task of fine-tuning the WPI Plan.

Forces external to the college required a president with national—indeed, international—perspectives on higher education, particularly in engineering and science. Edmund Cranch took office in an economic climate where even meeting the basic financial needs of the institution required larger budgets each year.

Cranch tackled the presidency with the thorough vigor that characterized his handling of every endeavor he'd ever undertaken. His low-keyed, "please and thank you" manner often belied the intensity of his concerns for the college.

At his inauguration in October 1978, Cranch was quoted as saying that WPI's position as a leader in quality undergraduate education was one of the most enticing reasons for his coming to WPI. And as president, he even taught a course on vibrations within the mechanical engineering curriculum.

Teaching was a way to get to know the WPI student better, he claimed. Yet, much as he enjoyed the challenge of the classroom, Cranch understood that this was no longer his primary domain. It was a presidential luxury that he soon found required more time than he could justify.

For the most part, the academic deans and department chairs enjoyed Ed Cranch's confidence in matters of instruction and academic affairs. At the same time, he followed the academic planning activities of the faculty with great interest. He put his full support behind strengthening WPI's fledgling biology program and adding graduate programs in firesafety engineering, materials engineering and business administration.

But Ed Cranch's real forte had been demonstrated several years earlier at Cornell, when he served as chairman of the President's Special Committee on Long Range Financial Planning. The committee's report, known in Cornell circles as the "Cranch Report," had been disturbing to many faculty, but the hard economic facts and planning consequences outlined in the report were right on target.

At WPI, too, with double-digit inflation a reality in 1978 and freshmen enrollments nationwide projected to turn down dramatically in the decade ahead, planning for this volatile environment rapidly became almost a full-time endeavor for Ed Cranch.

In 1982, with the professional assistance of Earl Flansburgh Associates, Cranch commissioned a frank assessment of WPI's campus facilities. The Flansburgh Report provided important guidelines on land use and student needs for the coming decade and beyond.

One key outcome of this study was a plan for a new 230-bed student residential center at the eastern end of the campus. Cranch became actively involved in this project, reflecting his well-known concern for the quality of student life. In fact, the $7.3 million residence center, Founders' Hall, to be completed for the fall 1985 academic session, is WPI's largest-ever construction project.

In addition, he oversaw the 1983–84, $4.3 million renovation and expansion of WPI's second oldest building, the Washburn Shops and Stoddard Laboratories. As a result, Washburn's tradition of excellence in engineering education has been restored in full—and enlarged to better serve future generations of WPI students.

Perhaps Ed Cranch's most challenging and ambitious planning endeavor, however, was in preparing the campus and the faculty for a comprehensive network of latest-generation computing power. While some colleges have attracted national attention for requiring freshmen to purchase their own personal computers (too often, time has shown, a premature strategy), WPI has chosen not to follow suit at this time.

In 1981, President Cranch selected Professor Owen Kennedy, Jr., '45 as Dean of Academic Computing. Under Kennedy's guidance, the Committee on Academic Computing recommended and is now managing a comprehensive plan for integrating personal computers into academic and research activities at WPI. (See "Tuning Up for the Computer Generation," WPI *Journal*, May 1985.)

WPI is bringing its students into the computer age by providing ample access to latest-generation computers in laboratories and at terminal locations across campus. Computer equipment is being upgraded continually through purchase and the generosity of companies such as AT&T, Data General, Digital Equipment Corporation (DEC), IBM and Wang. Students may, however, purchase a PC through the college at reduced cost should their individual needs indicate that ownership is in their own best interest.

Opposite: Taking the floor at a faculty meeting to outline WPI's plans for student recruitment in a volatile marketing environment. Below: Dr. Cranch met weekly with his executive academic and administrative staff to work on the pressing issues confronting WPI. In 1982, Data General selected WPI as recipient of a $300,000 DG ECLIPSE MV/8000 computer system. Bottom: Dr. Cranch is shown with Data General president Edson de Castro.

Michael Carroll

Worcester Telegram & Gazette, Inc.

Michael Carroll

On his daily walk to campus across the athletic fields, former high school baseballer and college hockey player Ed Cranch became only too well aware of the unreasonable demands placed on WPI's playing fields since their construction in 1915. As recently as 20 years ago, enrollment stood at 1,000 students, all of them men. In 1985, with an undergraduate student body of 2,500, 20 percent of it women, and another 1,000 graduate students, WPI has long since outgrown the fields' capacity to meet the growing need for sports and recreational space.

Renovation of the athletic fields had been one goal of The Capital Program, announced early in Cranch's tenure. Yet, inflation twice caused postponement of the work. Finally, in February 1985, the time was right for the Board of Trustees to authorize the sorely needed fields renovation, and work began in May.

The plan for Alumni Field calls for a synthetic surface on the existing football field, installation of an all-weather surface on the running track, regrading and sodding of the natural grass surfaces on the baseball and Class of '93 (soccer) fields, improved lighting on Alumni Field, and the addition of two tennis courts.

Long-range planning did not involve physical facilities alone, however. Again, working with expert outside consultants, Cranch and a committee of faculty and staff studied how WPI is perceived by potential students and those who influence

COLLEAGUE, TEACHER AND FRIEND

I can recall that January day in 1978 when a "news leak," as reported in the *Cornell Daily Sun*, said that Ed Cranch, then dean of engineering at Cornell, had been elected president of WPI. He was in Colorado at the time, tending to some important fundraising chores that I and others were forever putting on his plate. A few days before, he had announced a multi-million dollar gift to help the development campaign for the geological sciences. Upon their return, Virginia got hold of Mal Burton (WPI '40) and me, and had us over to dinner that night. Mal was responsible for undergraduate affairs in the College of Engineering, and I, external affairs. We were then associate dean and assistant dean, respectively, so Ed had more than his hands full with a WPI presence among his senior staff.

While both Mal and I were devoted to our work and to Cornell, each of us left the Cranches' home that night feeling especially good about WPI. We knew our alma mater would be in caring and competent hands, even though we ourselves would have to face the prospects of "breaking in" a new dean. Ed and Virginia seemed "right" for WPI—and ready for a change of their own. Their three children had been raised and were on their own, and the number of attractive opportunities that Ed was receiving, we knew, would sooner or later take him from Ithaca.

Ed was one of those rare faculty types. Whatever his ego, he has more than managed to suppress it. He was then, and remains today, an unprepossessing man. Ed is not flashy; he is not interested in cosmetic concerns or subordinate matters. *That* is what makes him fun to work with. He was a fiscal conservative, a cautious innovator, and one who seemed to recognize who had good ideas *and* were likely to run soundly with them, if supported.

He also had acquired a reputation as one of the nation's few engineering deans who were serving as chairs of key university-level committees such as minority affairs, long-range financial planning, and on the executive committee of the Board of Trustees. His thoughtfulness, balance and fairness—coupled with thoroughness—had served Cornell well through the range of key issues confronting higher education in the early and mid-1970s. In short, he was not a parochial university engineering dean, though he certainly worked hard for his college's share and more!

Ed also enjoys life's simple pleasures. He is an avid collegiate sports fan—especially hockey. And I'm told he was a different man on the ice. I'm too young to have seen him play during his palmier days. God, he even camped out overnight to be in line for season hockey tickets at Cornell. He also enjoyed teaching and worked with a group of Cornell faculty to introduce more relevance into the sophomore core math sequences for engineering and applied science students. And he increased the support staff responsible for the undergraduate engineering programs, something that isn't easy to do within a research-oriented university. In short, he cared about the undergraduate.

It was these qualities that suggested his "fit" with WPI would be a good one.

I was particularly proud as a WPI alumnus all that last Cranch spring at Cornell. For too long, I suspect, a good many of my Cornell and Ithaca area friends had listened to me wax on about the merits of WPI and of New England. I even claimed the weather to be superior (which, except for more gray skies in the typical Finger Lakes winter, wasn't so!). To me, his going to WPI demonstrated that all my posturing was really true!

Most of all, though, I guess I liked him because he taught me, by example, that there is a real difference between form and substance. He was never personally ambitious yet he was ambitious in his own quiet, unassuming way—first for Cornell, and for the past seven years here at WPI.

Donald F. Berth '57
Vice President, University Relations

Ed Cranch greets Edward R. Delano '30 (far left), at the completion of Delano's 3,100-mile, 33-day bicycle trip in June 1980: Delano, 75, cycled from California to his 50th class reunion. Left: Dr. Cranch with Mrs. Miriam Rutman, widow of Walter Rutman '30, and Cathy Kruczek Vignaly '84, at the public announcement of the Walter and Miriam Rutman Scholarship Fund, the largest gift ever received by WPI for financial aid endowment.

Roger W. Perry, Jr. '45

their choices of college. As the number of secondary school graduates declines sharply nationwide and especially in the Northeast into the early 1990s, such information is vital to WPI student recruiting efforts for the future. Ed Cranch authorized this study at a time of strength for WPI, enabling the college to actively *plan* for the future, rather than reacting too late to adverse conditions in the marketplace.

"A BOLD, IMAGINATIVE AND CHALLENGING VENTURE"

It was with these words that Edmund Cranch described his next employer—Wang Institute of Graduate Studies–when he resigned the presidency of WPI last October.

Wang Institute, located in Tyngsboro, MA, is a nonprofit educational institution. Its dual purpose is to provide graduate education to meet the growing demands of industrial software development, and to alleviate the nation's acute shortage of highly skilled software specialists.

On July 1, Cranch succeeded Institute founder Dr. An Wang as president. Wang, chairman of Wang Laboratories Inc., the giant computer company, remains the school's trustee chairman.

Founded five years ago, the Institute's School of Information Technology specializes in software engineering. It is one of the three schools in the country offering the Master of Software Engineering degree. The School has awarded about 35 degrees to date; currently about 55 students are enrolled in the program. The Institute also has a non-degree, postdoctoral fellowship in Chinese Studies, to support the growth and development of a deeper understanding of Chinese society, history and culture.

Michael Carroll

Dr. Cranch watches as Milton P. Higgins (center) and Peter Morgan officially open the renovated Washburn Shops last October.

While Ed Cranch says he views Wang Institute as a sort of laboratory for futuristic education, the school should enable him to pursue his dual convictions—to the practical and to the abstract, to practicing in the field and to teaching.

Many of the study's recommendations are already in place or are being implemented.

In his inaugural message, Dr. Cranch also referred to WPI's strong ties with industry as another inducement to accepting the presidency. Yet during his seven years in office, WPI expanded these exchanges substantially.

One of the most visible of these industrial relationships is the Manufacturing Engineering Applications Center (MEAC). In close working sessions, teams from sponsoring companies collaborate with WPI faculty and students to develop applications of programmable flexible automation. MEAC's comprehensive robotics laboratory occupies new facilities in the renovated Washburn Shops.

Founded in 1980, the Center for the Management of Advanced Automation Technology (MAAT) is an industry-college cooperative research program. MAAT brings together advanced management practices and research on flexible manufacturing, robotics and office automation. The goal is to enable industrial sponsors to effectively integrate advanced automation into their companies.

Further industrial ties take form in WPI's widely successful Cooperative Education Program. Since 1978, student interest in Co-op has doubled, and today more than 50 companies hire some 115 students for eight-week, professional-level, paid positions.

In addition, WPI maintains and continues to open new interchanges with business and government through both faculty research and student projects. In 1983–84, for example, sponsored and contract research totaled $3.45 million. Meanwhile, some 100 companies and government agencies provided sponsorship for approximately 500 students working on research projects.

A president of earlier times is reported to have once told the chairman of the Board of Trustees: "Sir, your job is to raise the money. Mine is to spend it." While this delineation of

VIRGINIA CRANCH: AT ONCE DIRECT, COMPASSIONATE AND REFINED

Virginia Cranch may have been WPI's most spirited first lady. Little escapes her sharp wit and outspoken viewpoint, and she is, according to close friends, deeply committed to humanitarian ideals and ardent in her concern for women's rights.

Her first joy will always be gardening, as visitors to the presidential family residence so amply discovered. And though a rather private woman, on campus she could be found serving regularly as a Red Cross volunteer at WPI blood drives; attending alumni, athletic and dramatic events; and accompanying her husband during the countless appearances expected of WPI's chief spokesperson.

To these activities she has made a very real contribution. She leaves us a lasting impression of a woman with a heart of gold, faithful to her convictions, and a thorough advocate of the mission of higher education and WPI's role in reaching that goal.

Michael Carroll

responsibilities may be accurate, no college president today can minimize his or her role in developing institutional support.

During the seven-year presidency of Edmund Cranch, total revenues received by the Institute doubled, and in all seven years the budget was more than amply balanced. Excess revenues over expenditures ($18 million) reverted to the physical plant maintenance and property acquisition account or as gifts to the endowment. The market value of the endowment rose from $31.6 million to more than $60 million.

In the year of his arrival at WPI, annual giving by alumni totaled just under $400,000. Results of the 1984–85 year will almost triple that level. And in the academic year 1983–84 the Annual Fund topped $1 million for the first time.

Each of these financial milestones is the result of hundreds of inspired volunteers who have contributed thousands of hours on behalf of WPI, as well as the professional staff of the Office of University Relations and prudent day-to-day management of WPI's resources—both human and material.

It can be said that the Cranch years were "golden ones" for WPI. In all nearly $30 million was obtained from fundraising efforts from 1978 through 1985. Without the support of friends, corporations and foundations, motivated largely by the character of the person "managing the shop," such material achievements would not have been possible.

By virtue of the office, college presidents are the chief spokespersons of the institutions they represent. The intellectual stature of these individuals, the wisdom of their words, the significance of their deeds in the world beyond their campuses *become* their institutions to the many who may never actually visit or attend their colleges.

Throughout his entire career, Edmund Cranch has played key professional roles nationally as well as in his academic appointments. He has been an active member and officer of the American Society for Engineering Education for many years. In June 1985 he was honored by his peers in education with his appointment as national president of ASEE. This is one of the final honors to come to him during his WPI presidency, and one which WPI can share with pride.

In recent years he has served as well on advisory commissions for President Ronald Reagan, the National Research Council and the U.S. Naval Academy. Through the years he has been a member of no fewer than ten scientific honorary societies worldwide.

Edmund Cranch learned before coming to WPI one of the secrets of successful academic leadership: One cannot be all things to all people. Thus he apportioned his time to those individuals and projects he felt were most critical to WPI's destiny.

Faculty members whose proposals for pet projects languished in the presidential in-basket may have thought him a procrastinator. They could not know the long list of other business on his agenda—a docket he addressed with care and depth of attention.

His October 1984 announcement of plans to leave WPI at the end of the 1984–85 college year to accept the presidency of the Wang Institute of Graduate Studies was anticipated by no one. It was generally expected that this popular president and his wife, Virginia, would occupy the home of the WPI presidential family until at least normal retirement time.

As Cranch explained to the WPI community in announcing his plans, he, too, had expected to complete his academic career at WPI. There were still projects here that he'd looked forward to completing and people he'd hoped to work with on them. Leaving the many new friends he and Virginia had made in their seven-year Worcester stay would not be easy. Still, this new challenge, this unique opportunity—to help set the course for a futuristic, fledgling graduate school, to be a "builder" in the Ezra Cornell sense—won out over all the reasons to stay at WPI.

As he takes leave of the post he has so ably filled since 1978, Edmund Cranch, himself an avid sailor, is perhaps mindful of the sage advice once given by WPI's seventh president, Admiral Wat Tyler Cluverius. "Always leave on the crest!"

WPI has prepared a booklet, *The Presidency of Dr. Edmund T. Cranch 1978–1985,* commemorating the twelfth presidency of the Institute.

We have set aside a limited supply of these booklets for readers of the WPI *Journal.* Should you wish to receive a complementary copy, please write or call:

Worcester Polytechnic Institute
Department of Publications
100 Institute Road
Worcester, MA 01609
Phone: 617-793-5305

Jon Calvert Strauss

Thirteenth President of WPI

Marvin Richmond

Jon Strauss's two decades in academe have been remarkable, albeit somewhat fortuitous, preparation for his present position.

Strauss, 45, has been a nuclear physicist, the director of a computer center, a professor of electrical engineering and computer science, a university financial vice president, and even a faculty master to 136 students in a college house.

"Every day," he says, "you compete against your own standards, telling yourself, 'By God, I can do it!' "

Education was top priority in the Strauss home, as both his father and mother taught school. In addition, Strauss's father was a professional cartoonist, which perhaps accounts for his quiet yet prevalent sense of humor.

He denies having been a '50s whiz kid, but he entered an experimental acceleration program at the University of Wisconsin after just two years of high school. Majoring in electrical engineering and minoring in physics, he earned his bachelor's degree in 1959.

Strauss went on to earn a master's degree in physics at the University of Pittsburgh (1962). He worked for a while as a physicist at the Bettis Atomic Laboratory and a systems engineer for IBM, then earned a Ph.D. in electrical engineering at the Carnegie Institute of Technology (now Carnegie-Mellon University) in 1965.

He brings to WPI 20 years of teaching and academic management at some of the nation's finest universities—just the sort of experience needed to lead the Institute toward the 21st century.

He went to work for a computer company, "didn't like it," and went to Carnegie–Mellon as an assistant professor of electrical engineering and computer science. There he did normal, professor-like things—taught, published, directed graduate students and consulted.

In 1970, he was lured to the top of the world. With his first wife, Joan, and their two children, he moved to Scandinavia, where he directed a computer center and taught computer science at the Technical University of Norway. Though the Strausses moved to Norway "lock, stock and barrel," they stayed for just a year before moving back to the States. In reflection, he allows that "it was an exciting and valuable experience, but it certainly convinced us that we needed to reside in America."

"In these days of tight federal policies toward higher educations and a declining high school population, I'd be crazy to lead any college that couldn't weather the storm."

Strauss returned to a visiting position at the University of Michigan, Ann Arbor, then moved to St. Louis to direct computing facilities and serve as an associate professor of computer science at Washington University there.

In 1974, he went to work at the University of Pennsylvania as director of computing activities and professor of computer and decision sciences. Six months later, he took on the additional job of budget director.

As if that weren't enough, Strauss served as faculty master to the 136 men and women living in the Stouffer College House on the Penn campus. The house was modeled after the live-in colleges of Yale and Cambridge, "where students lived, and presumably learned, together," Strauss explains.

"Living at Stouffer House," he says, "we found ourselves getting involved with those kids . . . giving advice, taking sides. It was quite an experience."

In 1978, the University of Pennsylvania appointed Strauss vice president for budget and finance.

"A college's mission is to generate and disseminate information," Strauss says, "and it runs on information. To do that well, it needs modern information systems to support its operations—its financial network, its personnel and student records, its data on alumni donors, and so on. So my years of experience with computer science and the academic world turned out to be just the background needed for managing a college or university today."

University of Southern California President James H. Zumberge apparently thought so, too. Soon after assuming the presidency, Zumberge made the first in a series of senior appointments essential to a major restructuring of the university's central administration. In the spring of 1981, he announced the appointment of Strauss as senior vice president for administration—to manage the university's business, financial and legal affairs, computer services, and personnel.

Strauss quickly set out to implement the administration's plan for a decentralized management system that would more actively involve the university's academic units and faculty members in revenue generation.

Working with senior vice president for academic affairs Cornelius J. Pins, Strauss introduced a "revenue center" concept, making academic units responsible for their income and expenses. As an incentive, deans and directors were given authority and responsibility in such areas as admissions and fund raising.

"Each school is responsible for earning revenues sufficient to pay for its total expense," Strauss explains, "so that each is aware of what it costs to pay its professors, to aid its students, to heat and light its buildings, and so on.

"The decentralized fund-raising approach may seem unconventional, but the best fund raisers are people who can articulate their programs well—especially if they have the added incentive of controlling allocation of the funds they raise."

Along with the revenue centers, a new financial accounting system was put into place, providing more accurate reports on the university's financial performance.

According to Strauss, the decentralized management system "increased the financial awareness of faculty and deans and maximized the university's use of resources." He says that operating decisions and plans are now being made "by those who can and should implement them."

The move to California seems to have suited Strauss just fine.

"I liked the weather," he says. "I like to do things outdoors, and you can do them all year round there." And though the Worcester snow-belt reputation may be a long way from southern California, he admits that he is happy to be near his Long Island roots once again.

Among the things he likes to do are running, sailing and swimming. "I've had a number of boats; but I'm not a very good sailor," confesses Strauss. "In California, I'd buy boats that needed a lot of repairs and spend most of my time working on them instead of sailing them." One time he resurrected a 37-foot motor sailer that he bought in pieces. "The mast was down, and the engine wasn't working, among other things gone wrong on her," he recalls.

Strauss did much of his running in California as a member of an international group of runners called the Hash House Harriers. "Somebody would lay a trail, marking it with chalk or flour," he explains. "Every quarter mile or so, the trail markings end, and the runners have to search around to find where they start again. The objective is to lay the trail over the most interesting terrain, up mountains, through forests, over streams. We run about five or six miles at a time."

And, an avid swimmer, he is accustomed to swimming about 1,250 meters two or three times a week. In fact, the pool he trained in at USC was the one used for the 1984 Olympics swimming competition.

Right now, WPI's "Foot Pounders," a group of 15 or 20 faculty and staff runners, are eager to have Strauss join them on WPI's spanking new all-weather running track. At least the conditions under foot may remind WPI's new president of the ideal training climate of the California he left for Massachusetts.

On June 14, Jon Strauss was married in Los Angeles to Jean Sacconaghi. The couple's honeymoon—unconventional by any measure—suited the adventurous newlyweds just fine: a trip east to their new home at One Drury Lane, with travel along the way alternating between short rail hops and bicycle touring through national parks and other points of interest. The trip culminated with the 120-mile stretch between Albany, NY, and Worcester on two wheels, a leg of the trip that got them to WPI on July 2. "Lots of time on the road," Strauss concludes, "to collect my thoughts for the voyage ahead. The Berkshires were more than we expected."

Opening Remarks

An interview with the president

Dr. Strauss, how will you rank your priorities as you enter the thirteenth presidency of WPI? We've got to give faculty and students a better sense of involvement in the Institute. This process has already begun under the leadership of Dean Richard Gallagher with the development of goals by each academic department. The next step will be to set specific implementation plans for how each department will achieve these goals with the resources that can be made available.

Most faculty I've talked to perceive a general need for greater involvement in scholarship. This self-perception is most fortunate, as it is generally recognized that the best teachers are those who are also active scholars. It is also the case that more active scholarship will lead to greater sponsorship of research and, in turn, to more distinguished graduate work at WPI.

As you know, nationwide there appears to be a downturn in the number of students majoring in the sciences and mathematics, but the improved recognition for the Institute, together with greater faculty involvement in scholarship will lead to improved student representation in these areas. Fortunately, our departments of mathematics, biology, chemistry and physics have set good goals which recognize their current strengths and their future opportunities.

From your observations to date, what are WPI's greatest strengths and needs? WPI is a fundamentally strong institution. These strengths derive mainly from the quality of its people: students, alumni, faculty, staff and, of course, the Board of Trustees. Derivative strengths include a quality physical plant in an attractive setting, a good and growing endowment, a strong fund-raising record, an exciting academic curriculum, and an excellent reputation. My job, as I see it, will be to work with our people to build on these strengths and on the heritage of the college to enrich its sponsored research and graduate education.

While I see many challenges ahead for

WPI, I would not want to give the impression that I think WPI is plagued by unsolvable problems. We have some obvious opportunities for improvement which we're going to begin working on immediately.

I might emphasize that our fund-raising endeavors have been particularly effective in recent years. Our alumni have built an almost unprecedented record of sustained growth in their annual giving. And our outreach efforts have successfully gained the attention of institutional leaders in both the private and public sectors. Still, as our academic and physical resources planning goes forward in the years immediately ahead, we will be paying even more attention to fund raising and institutional development.

As demographic projections for 18-year-olds turn against higher education in the coming decade, how can WPI best position itself for the shift? The key to recruiting in higher education is quality. WPI has got to provide what is known in marketing circles as "value added." The WPI Plan helps provide this value added to the college's academic programs in a unique and exciting fashion, and the great majority of faculty and staff with whom I have met are committed to the philosophy of the Plan. However, if we do not execute the Plan *very* well, we are much more at risk than if we were to maintain a conventional academic program. The Plan requires greater faculty commitment than do conventional programs, because of the time required to work with students in courses and projects and to coordinate project activities with off-campus sponsors. Consequently, a potential drawback to the Plan is the danger of faculty not having time to maintain their scholarly activities and remain abreast of the work of their colleagues at other institutions. But this problem can be overcome both by staffing to properly reflect the special needs of our curriculum and by encouraging our faculty to better balance their scholarship and teaching.

The Plan resembles remarkably the philosophy of education I experienced as a graduate student at Carnegie Institute of Technology in the early 1960s. There the focus was on learning through professional problem solving with little emphasis on rote memory or textbook solutions. Having just come from a more traditional undergraduate program at the University of Wisconsin, I found this Carnegie Plan an exciting revelation of how engineering, and most other disciplines, should be taught and learned. I practiced this approach in my own teaching at several institutions since then, but I generally stood out as being unconventional, if not eccentric. You can imagine my enthusiasm at finding, and now joining, an institution committed to an approach to learning that mirrors my own.

What experience do you feel you can bring to bear on the opportunities you observe at WPI? To a first-order approximation, our faculty are the Institute. They attract and teach our students, they recruit and judge their colleagues, they commit budgetary resources, they help to solicit research and gift funds, and they set the tone for, and determine the reputation of, "The risk of executing the WPI Plan poorly is far greater than is haphazard management of more conventional academic programs."

the Institute. It has been my experience that while we faculty exercise tremendous authority over these activities, we are sometimes reluctant to accept responsibility for these activities. The major emphasis of my work in higher education management these past ten years has been on bringing the faculty closer to the management issues and helping them understand and become more active in resource generation. While I am interested in faculty participation in more responsible and effective use of resources, my major interest is in faculty involvement in resource development; i.e., increasing the size of the resource pie more than slicing it finer. To do this you have to create incentives for participation—disciplinary incentives, you might call them—where you call upon the professional commitment of faculty members to initiate improvements in their own disciplines and increase resources through tuition, gifts and research support. Another major element of this emphasis on faculty involvement is in recruiting both faculty and students.

What should be the role of athletics at the Division III intercollegiate level? For some time, I've believed that athletics are out of balance with academics at many Division I schools. We must be careful not to allow athletics to distort the emphases and values of the academic process. On the other hand, athletics are fundamentally important to the education of young people, whether they participate or watch at the varsity, intramural, or club level. In lots of ways, athletics bind the various campus constituencies together. It can also act as a kind of psychological release valve at a time of immense pressure on students.

WPI seems to be forging stronger partnerships with industry. Where do we go from here and why? As you know, the federal government's sponsorship of pure research has been reduced in recent years. At a time when WPI is looking for greater sponsorship of research and graduate programs, this shift in funding suggests that we need to find alternative sources of research support. But, in our efforts to seek corporate sponsorship, we will be mindful that our research address real world problems and is not pushed too far in the direction of sponsors' financial imperatives.

Do you have plans to increase the number of women and minorities in the student body? Despite the progress of the last 20 years in interesting and attracting women to the sciences and engineering, their interest hasn't grown as quickly as society's desire to bring them into science and technology. As all colleges of engineering and science try to respond to societal pressure in this regard, accomplishing this goal continues to be an uphill battle—but we must keep at it. We must also work at increasing numbers of minorities in science and technology. But in either case, we will *not* increase the number of women and minorities in the student body at the expense of reduced academic standards.

The Greek system at WPI and at virtually all colleges is undergoing close scrutiny by administrators and alumni alike. What are your views on the fraternity system at WPI? I am a strong supporter of the fraternity/sorority concept. I was a fraternity member myself at Wisconsin, and I believe that many students can benefit significantly from the fraternity/sorority experience. The Greek system can help young men and women deal more effectively with society in lots of ways—academically, socially, professionally. Given some of our recent, well-publicized difficulties, we've now got to build on the strengths of the Greek system, and not allow a few problem houses to bring down the entire system.

When I was in a college fraternity, we consciously used that communal living experience to learn to interact and function within society both on campus and off. It would appear that some fraternities at WPI, USC, and elsewhere have lost sight of their societal responsibility. Fraternities and their members must, and will, assume responsibility for their actions.

WPI has always had a relatively large international student population. What are the challenges and opportunities confronting this program? Put simply, we've got to assure that there's interaction between students—both foreign and domestic. One of the primary reasons for having an international student population is to provide opportunities for both American and foreign students to interact socially and culturally. If the social system of the college does not facilitate this interaction, this benefit cannot be realized.

What are the challenges you see immediately ahead for you as president of WPI? First and foremost, we've got to preserve and even enhance the quality of our students in the face of demographic shifts. But this is a challenge with which we are well prepared to deal. Already this year the number of applications for admission is up by roughly 8 percent. Some might argue that this trend cannot possibly continue, but I believe WPI will fare far better than most because of the quality of our programs and our ability to relate this quality to society's needs.

Next, we've got to build on the strengths of the Plan as it applies to undergraduates and faculty so as to enhance scholarship and improve the quality and quantity of graduate studies at WPI. We don't have an obligation to be a leader in all aspects of graduate education, but we will lead in that which we attempt. It is my experience that a quality graduate program emerges from enhanced faculty scholarship; increased scholarship will lead to better teaching, more recognition, and increased resources which will lead in turn to greater opportunities for graduate study. All this will derive from, and build on, our current strengths.

Physicians know medicine. Engineers know technology. Now, the two are joining forces to bring to patient care the best of both worlds. And it's happening right here in Worcester.

The New Medicine

By Evelyn Herwitz
Photos by Michael Carroll

The patient is an elderly woman on an operating table. She is draped with sterile plastic and blue cloth, her chest cavity held open by steel retractors as the University of Massachusetts Medical Center (UMMC) surgical team repairs her damaged heart. From the patient's neck and chest, a mass of plastic tubing splays outward, connecting her body with an array of machines which support and monitor the operation.

So far, the triple-bypass procedure is progressing well. The patient's heart, restarted by a defibrillator, is pumping on its own once again, and she has been taken off the heart-lung machine. Now the anesthesiologist proceeds with a crucial test of how well her heart is functioning, using a portable cardiac-output computer.

Closely watching the visual display provided by two electrocardiograms and four blood pressure tracings on a physiological monitor, the anesthesiologist injects a 5 percent dextrose and water solution into a yellow thermo-dilution catheter protruding from the patient's jugular vein. Placed there at the start of the operation, the catheter passes through the patient's veins and heart, ending in her pulmonary artery.

At the catheter's tip, a sensor registers the bloodstream temperature change as the room temperature dextrose solution passes through the heart. Next, a computer calculates how quickly the repaired heart can pump a given quantity of blood.

Within seconds of the dextrose and water injection, the cardiac-output computer prints a measure of the heart's blood flow rate. The measurement is made at least twice, or until it is clinically acceptable. When it is, the surgeon begins to close up the patient's chest.

To the lay observer, that small sample of state-of-the-art biomedical technology seems nothing short of miraculous. But experts like UMMC's Dr. Albert Shahnarian see much room for improvement. A graduate of WPI's Biomedical Engineering program ('73 MS, '82 PhD) who is now chief biomedical engineer and a professor at UMMC's Anesthesiology Department, Shahnarian has worked with WPI graduate students to find better ways to measure cardiac output. In particular, he is trying to develop a self-heated thermistor catheter flow probe.

"Initially, you would still have to inject a solution into the catheter to calibrate the system," explains Shahnarian, who also holds a BS in Electrical Engineering ('69) from WPI and is an affiliate professor of biomedical engineering here. "Then, using a self-heated thermistor (or sensor) you would increase the current to heat the sensor above blood temperature," he continues. "The amount of heat drawn away by the blood is related to the blood flow. The more rapid the flow of blood, the more rapidly the thermistor would cool."

Such a device, says Shahnarian, would have several advantages over the current system, which relies on temperature changes produced by dextrose solution injections. First of all, he says, the self-heated thermistor would provide a continuous readout, rather than discrete measurements of cardiac output. Second, the method would reduce the amount of fluid added to the patient's system—a factor that can become critical for infants and children because of their size.

So far, the research is still at the early animal phase. But Shahnarian is encouraged by the initial findings, and says he hopes to have additional WPI graduate students working on the project in the future.

That project is just one of many each year involving WPI's Biomedical Engineering Program. Maintaining a strong link with UMMC and St. Vincent Hospital, the program allows WPI graduates and undergraduates to work closely with hospital researchers and clinicians, applying engineering know-how to a wide range of technological problems in medicine.

For all parties, the benefits of this relationship are significant. "Physicians are trained in medicine, not technology," says Biomedical Engineering Department director Dr. Robert A. Peura '64 EE. "When developing or improving medical devices, they need a knowledgeable biomedical engineer to work with."

In turn, the students gain a working knowledge of medical systems and techniques. "A lot of engineering goes into the biomedical equipment that we get," says UMMC's Dr. Robert M. Giasi, clinical coordinator for anesthesiology and an affiliate professor of biomedical engineering at WPI. "But the problem is that the engineer often just has no experience with what we're looking for. Sometimes using the equipment is as awkward as taking a straight pipe and bending it into a pretzel shape to make it usable."

"With the WPI program," continues Dr. Giasi, "the students see what the operating room is like, how we use technology in medical devices, and how patients are best served by these devices. The experience should help them in the real world, dealing with design problems."

Created in 1962 by Dr. Richard Beschle, the Biomedical Engineering Program draws together a multi-disciplinary group of faculty. Working with Peura, Professors Yitzhak Mendelson and Frederick M. Bennett make up the core biomedical engineering faculty. They are joined by two electrical engineering faculty—Professors Fred J. Looft and Marc S. Fuller—as well as three mechanical engineering faculty—Professors William W. Durgin, Allen H. Hoffman '63 ME, '67 MS, and Brian J. Savilonis '72 ME, '73 MS. Rounding out the Program are Professors James M. Coggins (com-

Seated in a wheelchair that may be the first of its kind (far left) is ME Professor Thom Hammond. Its lateral push bar attachment, to propel the chair and give some handicapped persons extra mobility, was designed by seniors Angela Frankudakis (left), Nancy Armery, and Donald DeMello. Advanced research in the UMMC lab (left) of Dr. Frederick A. Anderson, Jr. '75 MS, '84 Ph.D., is developing new methods for detecting blood clotting in veins of the legs and pelvis. For their MQP, seniors Karen McCue and Martin Travers (below) are developing a fiber optic catheter for sensing blood gases.

puter science) and Edward L. O'Neill (physics).

Granting both a master's and doctorate in biomedical engineering and a master's in clinical engineering, the Program currently enrolls about 30 graduate students. Ongoing research ranges from an electroanesthesia generator, which creates various electrical currents to induce an anesthetic state, to a non-invasive glucose sensor, which measures sugar concentrations in the blood.

Bennett's research, for example, concerns the structure and function of the respiratory control system. He is identifying the pathways responsible for the increase in breathing that accompanies physical exercise. In addition, he is developing greater understanding of how the muscles of the upper airway may play a role in sleep apnea, a cessation of breathing caused by an obstruction in that airway.

While the Program offers no undergraduate degree, upperclassmen from various disciplines can choose to graduate with an option in biomedical engineering. At present, approximately 120 undergraduates are involved in the program. The decision not to grant a BS harks back to the department's interdisciplinary approach. "You need to be a solid engineer, first and foremost," explains Peura.

Undergraduates must complete the requirements of their chosen engineering field, as well as at least three life sciences courses. In addition, they must complete their junior Interactive Qualifying Project (IQP) and Major Qualifying Project (MQP) in biomedical engineering.

Recent undergraduate projects have included a voice-activated nurse call device for quadriplegics, a ligament tension gauge for use in reconstructive knee surgery, and a push-bar mechanism for propelling a wheelchair. The breadth of Program-related research reflects the diversity of engineering applications in medicine. Development of new medical tools, computer modeling of biological systems and interpretation of diagnostic data are just a few fields of inquiry.

One area of research, image processing, involves the analysis of information gathered by sophisticated diagnostic tools. "When you're looking at pictures you get back from high-tech devices like a CAT scanner or Nuclear Magnetic Resonance (NMR) device," explains Peura, "you get a view of the body. But you need to know how to correlate that information with the patient's condition. You're trying to separate the clinical information from the extraneous 'noise'."

Biomedical engineering research is not confined to high-tech diagnostic equipment, however. Another specialty focuses on developing aids for the elderly and handicapped. While seemingly simple when compared with a CAT scanner, devices such as a nurse call system can present challenging design problems for the engineer.

This past year, electrical engineering students Mari-Agnes Flynn ('85, Arlington, MA), Anne McGurl ('85, Winthrop, MA) and Carolyn Thompson ('85, Gales Ferry, CT) continued the work of a prior year's MQP team to develop a voice-activated nurse call system for quadriplegics. Advising them were St. Vincent Hospital's biomedical engineer Stephen D. Scheufele '85 MS and EE Professor Dan H. Wolaver.

The goal of the MQP was to improve current hospital practice, which relies on an air bag placed next to the quadriplegic's head. To summon a nurse, the patient must depress the air bag with his or her head, thus triggering the call system.

As an alternative, the students worked on developing a way for the patient to activate the nurse call by simply saying the letters "S-O-S." Their design involved placing a microphone near the patient's bed. The microphone would be connected to a microprocessor capable of recognizing the correct sound pattern and then switching on the nurse call device.

That system would involve several components: an automatic gain controller would adjust the volume of sound being analyzed, while a feature extraction system would develop and store a pattern of phonemes comprising the trigger phrase S-O-S. That patient's speech would then be compared to stored standards within the microprocessor. When a match was found, the call signal would be switched on.

This year the students were able to get each of the system's components to function independently. "We could probably get it to work for selected patients," says Thompson. "It was a real challenge for us."

While often related to research on aids to the handicapped, another biomedical engineering specialty—biomechanics—deals specifically with the forces and stresses on the body's skeletal, muscular and circulatory systems. Working on a biomechanics problem related to sports injuries, ME students Douglas Miles ('85 Northboro, MA) and Joseph Mooney ('85 Warren, MA) furthered research of a previous MQP to design a ligament tension gauge device for reconstructive knee surgery.

Guided by WPI's Hoffman and St. Vincent Hospital orthopedist Dr. Dudley Ferrari, the students created a small, three-pronged tool. Still in the development phase, the device, when perfected, would be hooked onto the damaged anterior cruciate ligament (ACL) inside the knee joint during exploratory surgery. By measuring the force and deflection applied to the ACL, the surgeon would be able to determine how badly the ligament was damaged. If reconstructive surgery were necessary, the surgeon could then use the device to set the reconstructed ligament or a tendon which replaces the ACL at the proper tension, facilitating a faster recovery.

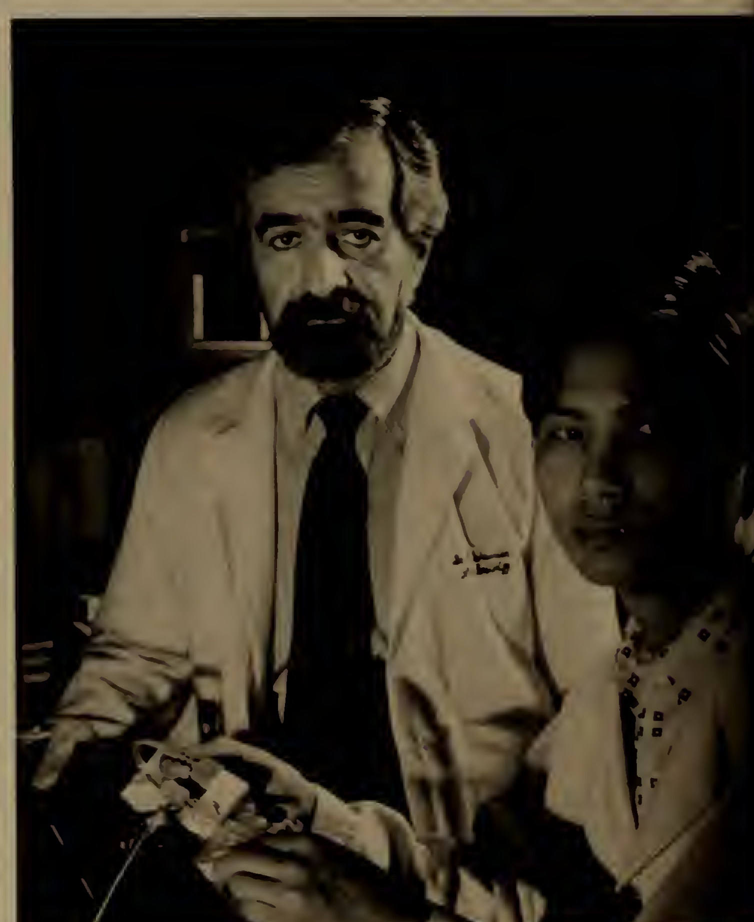
Exploring another biomechanics problem, Hoffman is looking into prosthetic devices for hip injuries. "When there's a fracture in the hip, the orthopedist puts a rod through the femur to stabilize the bone," says Hoffman. "But the rod doesn't always fit tightly—or fit at all." To solve that dilemma, he is creating a mathematical model of the process of inserting the rod into the bone. "We're analyzing the stresses and loads on the system."

Hoffman's background in non-Newtonian fluids and viscoelastic materials has also prompted him to do research in biological fluid mechanics. To learn more about the effects of arterial sclerosis, he is working with WPI's Savilonis and UMMC Pathology Department chair Dr. Guido Majno (also an affiliate professor at WPI) to investigate the dynamics of blood flow through constricted arteries.

"We're looking at the interaction between blood flow and cells of the inner walls of the blood vessels," says Hoffman. Modeling flow patterns on a computer, his students relate findings about stresses along vessel walls to pathological changes in rats on high-cholesterol diets. "We're modeling animal experiments conducted previously by Dr. Majno and correlating our data with biological findings."

Biomedical instrumentation is another specialty within biomedical engineering that is absorbing much faculty and student interest. In particular, Professor Mendelson has developed a non-invasive sensor—called a transcutaneous reflectance oximeter—to measure oxygen in the blood.

Trained as an electrical engineer in Israel and the United States, Mendelson became interested in biomedical applications when his father became very ill. "I was forced to spend a lot of time in hospitals," he says. "Among other things, I witnessed the inconvenience and pain of drawing blood samples. It occurred to me that if that process could be eliminated, it would help the patient and also provide continuous monitoring of blood chemistry."



Mendelson's device, still in the prototype phase, uses a small sensor containing two light-emitting diodes that can be placed on the skin. Two different wavelengths of light—one red and one infrared—penetrate the skin and are partially absorbed by the blood. The light which is not absorbed is reflected back to a silicon photodiode, which senses the percentage of reflected light. That information is then converted by the oximeter into a measure of oxygen saturation of the red blood cells.

While non-invasive oximeters have been on the market since 1975, Mendelson's device has the advantage of small size (20mm in diameter) and light weight (less than 3 grams). In addition, the sensor can be placed anywhere on the body where there is sufficient blood circulation close to the skin, whereas commercially available oximeters are limited to use on the earlobe or fingertips. Designed to help diagnose misfunctions of the heart or lungs, the instrument will help physicians determine how well cells in the body receive oxygen.

In a related effort, research on invasive blood sensors initiated by UMMC's Shahnarian resulted in an MQP which used fiber optics, fluorescent technology and colorometric technology to continuously monitor blood gases. Working with Shahnarian, Mendelson and Dean Emeritus of Graduate Studies Wilmer L. Kranich, chemical engineering students Michael Deshaies ('85, Holyoke, MA), Karen McCue ('85, Worcester, MA) and Martin Travers ('85, Nutley, NJ) built and tested three fiber optic sensors designed to measure oxygen partial pressure (pO_2), carbon dioxide partial pressure (pCO_2) and hydrogen ion concentration (pH) in the blood.

Just as litmus paper changes color in the presence of acids or bases, certain dyes will change color and intensity depending on the pO_2, pCO_2 and pH concentrations. The sensor developed by the students was based on this principle, using a fiber optics cable containing a reagent chamber at its tip. When placed in a test solution, the dye inside the chamber is illuminated with a specific wavelength of light. Changes in the reagent's optical properties as it reacts to the solution form the basis for a measure of blood gas concentration.

"This is a really new technology," says McCue. "Eventually, the sensor would have to be miniaturized and incorporated into a catheter." Another problem involves finding a way to prevent blood clotting on the catheter while in use. But once those problems are solved, Shahnarian says, the device will have significant applications, particularly during surgery and in other critical-care settings, such as intensive-care units.

"You would have a single, in-dwelling catheter that could continuously measure patient blood gases in real time," he says. "It would enable the anesthesiologist to respond immediately, rather than wait for an analysis from the blood gas lab."

Still in the early phases of research and development, another blood sensor is also under investigation at WPI. Working with graduate students, Mendelson and Peura are trying to devise a non-invasive optical sensor that would continuously measure glucose levels in the blood. Of great value to diabetics, the sensor could be used in conjunction with an insulin pump to deliver insulin.

As part of that research effort, second-year graduate student Gus Glaser of New Bern, NC, has made his thesis project the

By using the "patch-clamp" technique to measure the current flowing through single ionic channels in smooth muscle cell membranes, Drs. Michael Kirber and Michel Vivoudou of the Physiology Department (top left) investigate the electrical activity associated with transmission of information in nerve cells and contraction of muscle cells. The frequency response of disposable blood pressure transducers and associated pressure tubing is studied by UMMC's Albert Shahnarian '69 BS, '73 MS, '82 Ph.D., and graduate student Wei Chyun Yang (bottom left). Oxygen in arterial blood can be measured with a new non-invasive transcutaneous oximeter developed by Professor Yitzhak Mendelson (near left), who compares its readings with those of an ear oximeter with graduate student Burt Ochs.

Chief of biomedical engineering at UMMC, Michael F. Whelan '76 (above). Biomedical Engineering Program director Robert A. Peura '64 and graduate student Been-Chyaun Lin at work on an experiment to develop a non-invasive sensor to measure blood gases.

development of a non-invasive palpebral conjunctiva glucose sensor. "It's an electrochemical sensor which fits under the eyelid to detect the flux of glucose across the inner eyelid," explains Glaser. "The vascular cell bed is only two cells thick underneath the inner eyelid, so you can get really close to the blood supply without having to invade it."

While projects like the glucose sensor are still at the conceptual stage, other research has led to commercially viable products. Starting as a volunteer at UMMC while still a biomedical engineering graduate student, Dr. Frederick A. Anderson, Jr., ('75 MS, '84 Ph.D.) has spent the past 13 years working with chief of surgery Dr. H. Brownell Wheeler on a test to detect blood clotting in major veins of the legs and pelvis.

The subject of a half dozen MQPs, several master's theses and two Ph.D. dissertations, their method of impedance plethysmography (IPG) is now performed with an instrument called an IPG-200 Impedance Phlebograph, manufactured by Johnson and Johnson's Codman Division. More than 800 of the IPG-200s are now used by hospitals around the country.

"We developed a simple, painless and inexpensive way to detect blood clots in the vein before they get large enough to break off and cause a pulmonary embolism," says Dr. Anderson, who is now an affiliate professor at WPI and chief biomedical engineer of UMMC's Department of Surgery. Using a pneumatic cuff around the thigh, the test involves obstructing circulation to the veins until the venous pressure equals that under the cuff. The cuff is then released, and the rate of blood flow from the veins is measured. If blood clots are present and blocking flow, the blood volume takes longer to regain equilibrium—much as a partially clogged drain increases the time it takes to empty a full sink of water.

"You can bring the IPG right to the patient's bed and the results are 95 percent accurate," says Anderson. "In addition, the cost of an IPG test is less than $50 in most hospitals. That represents a considerable cost savings over existing alternatives." To train technicians in the use of the IPG, the Medical School runs a special training program. "People come from around the country to learn," he says.

Even as clinicians are still finding out about the IPG-200, however, work is already under way to develop the next generation of machine, the fully computerized IPG-300. With some support from Johnson and Johnson, WPI graduate student Katherine Graham ('85 MS) has written a software program, and a prototype has been constructed and is currently being debugged.

While the IPG system has been the bread and butter for Department of Vascular Surgery research, Anderson is also searching for ways to detect cerebral vascular disease. By assessing blood flow in the neck arteries using a technique called Doppler Ultrasound, he is evaluating a test to screen likely stroke patients.

"It's like using sonar," explains Anderson. "The signal reflects back from the blood cells. Because the blood cells are moving, you can process the frequency shift to detect the blood flow. You see an image of the vessel and walls moving and can measure the velocity of the blood flow within the vessel."

That information is used to tell if the blood vessels are clogged. "The majority of strokes seem to result from plaque in the carotid artery in the neck," continues Anderson. "That's an easy place to get at surgically. If you can clean out the plaque, the incidence of strokes is much less than if you do nothing."

In spite of the creativity involved in that research, Anderson says none of their findings were "major breakthroughs." A machine selling for $100,000 that performs the tests has been available for four years and is in use at UMMC.

"The technology is moving so fast," says Anderson, "that for every idea you have, probably after a good night's sleep you're left with only one in ten worth pursuing. Then only a small percentage of those are scientifically successful. And the pace of technology may pass by your idea before you've developed it."

Fueling that race is the ever increasing demand for sophisticated, easy-to-use diagnostic equipment. "The trend is to have as much data available as possible to the physician at the patient's bedside," says Mendelson.

That trend means not only saving lives in intensive-care units or by such technology-intensive operations as open heart surgery, but also, ideally, avoiding the need for people to come to the hospital in the first place. "Instrumentation can help in aiding screening techniques," says Mendelson. "You could take the devices out of the hospital and bring them to the patient's home.

"It might make medicine more readily available to those who might not receive it otherwise."

Evelyn Herwitz, a free-lance writer living in Worcester, is also senior writer at Business Digest.

FIRST IN A SERIES

THE ENTREPRENEURIAL SPIRIT

Of Miracle Berries, Second Skins and Plastic Hearts

The Rise and Fall and Rise of Dr. Robert J. Harvey '70 Ph.D.

By Michael Shanley

Bob Harvey mounts the stairs to his second-floor conference room two at a time. Like Thoratec, the company he founded, this energetic 53-year-old travels in leaps and bounds.

From a seat in that modest conference room, part of an attractive but unprepossessing building on a quiet side street in Berkeley, CA, Harvey tells a story. It is a tale of miracle fruit berries, artificial hearts and synthetic skin; of backroom politics, and fortunes won and lost overnight. But more than anything, it is a tale of this remarkable man's ingenuity and perseverance.

The story begins in the late Sixties, when Thermo Electron Corporation of Waltham, MA. which started out as a small research company, went public. Harvey, who had been associated with the firm since its beginnings, became, as he puts it, "a small millionaire."

A graduate of the U.S. Military Academy and Drexel Institute of Technology (now Drexel University), Harvey decided to enroll full time as a doctoral student in biomedical engineering at WPI, where he had been taking courses off and on. "At that time," Harvey says, "WPI was one of the few schools with a biomedical engineering program."

In 1968, while attending a seminar at Clark University, he met Dr. Linda Bartoshuk of the U.S. Army Research Laboratories in Natick, MA. Bartoshuk, a physiological psychologist, first introduced Harvey to the miracle fruit berry—a remarkable, cherry-sized fruit that would change his life.

Bartoshuk was leading a Natick research team that was investi-

gating the startling effects of the berry, whose juices interact with the taste buds, making bitter or sour substances taste delightfully sweet. The effect lasts up to two hours after eating just one berry. Unlike artificial sweeteners, the fruit is organic and completely safe. (The term "miracle berry" was coined in the 1850s by a British doctor stationed in Africa. The Latin name is *Synsepalum dulcificum*.)

Harvey decided to do his doctoral thesis on the miracle berry, a plant indigenous to West Africa, where its taste-altering effects have been recognized for more than 250 years. The natives there use it to sweeten gruel and wine.

Besides working on the berry's scientific aspects (his thesis involved the electrophysiological effects of the berry on hamsters), Harvey began to investigate its commercial applications.

The possibilities, he sensed, were staggering. The obese or simply weight-conscious could enjoy a sweet taste while eating sugarless foods. The berry could be used to sweeten drinks, snacks, jellies, sauces, salad dressings—virtually the entire food spectrum. But diabetics, who generally must avoid sugar, would benefit most.

Convinced that he could develop a commercial product with tremendous potential, Harvey formed a company called Meditron in 1968, based in Wayland, MA. He acquired several miracle berry plants from a Florida State University biophysicist who also was studying the plant. From there, things moved quickly.

Harvey secured a greenhouse to begin growing the plants. He lined up several investors and assembled a world-class board of directors and consultants, including nutritionists Jean Mayer (now president of Tufts University) and Robert Harris, then professor emeritus at Massachusetts Institute of Technology. A laboratory was set up and a small cadre of assistants hired.

By the time Harvey received his Ph.D. from WPI in 1970, his company, now called Miralin, had established a procedure for extracting the plant's active principle and transforming it into concentrated tablets. Agreements had been made with the Jamaican government, and soon miracle berry plantations were established in that country and in Puerto Rico.

Through all this, Harvey and his associates had been keeping the U.S. Food and Drug Administration (FDA) abreast of their activities. Since extensive tests commissioned by Miralin unfailingly showed the product to be completely safe, FDA officials had expressed little concern about commercial production of the miracle berry.

In 1974, Miralin marketed a series of products aimed primarily at diabetics: chewable fruit drops, snacks and salad dressings, to be used as part of a comprehensive diet plan. The response was tremendous.

Then—and, in hindsight, perhaps this was the turning point—students from Harvard Business School conducted a double-blind taste test comparing regular sugar-sweetened popsicles with popsicles coated with miracle berry extract. Children from New England playgrounds were the arbiters.

"They preferred our popsicles almost two to one," says Harvey. But this great bit of news signaled the beginning of the end for Miralin. "People in the sugar industry heard about it," he says. "They mounted a multimillion dollar campaign to reduce the threat. Using scare tactics, they sent lobbyists to the FDA."

This two-page ad that appeared in such publications as The New York Times Magazine is part of Thoratec's $3 million campaign to promote its Bion II fabric, which competes directly with long-established Gore-Tex. Creating an environment where creativity and productivity are rewarded is a key element of the entrepreneurial genius of Robert J. Harvey '70 Ph.D.

In September 1974, just weeks before Miralin was to mount a major marketing campaign (with all its financial resources committed for inventories), the FDA ordered miracle berry products off the shelf. Expensive, time-consuming tests were ordered.

The directive was equivalent to a death sentence. "At that point, we didn't have the time nor the money to follow through," Harvey says. "The FDA had regulated us out of business."

Miralin, with 285 employees in three countries, went under.

I was broke," says Harvey. "I went from being a millionaire to being in debt to the bank. Fortunately, I had enough good contacts to get some consulting work with technology companies." Soon he was back on his feet again.

Then, late in 1975, there was more bad news. "Polyps formed on my vocal cords, became infected and began to bleed," Harvey says. He and his wife, Sue, at that time a teacher at Tufts, were faced with the terrifying prospect of cancer. "I thought I was going to die," he says, matter-of-factly.

The polyps, which doctors later termed stress-induced, were removed. They were benign.

In February 1976, while Harvey was at home recovering from the surgery—unable to speak but with a new zest for life—one of his old friends from Thermo Electron came to town from Berkeley. Harvey invited him to stay at his house. The night he arrived, they stayed up late, the friend talking and Bob writing out responses on a pad.

Harvey learned that Searle Cardiopulmonary Systems Inc., wanted to sell its research and development division. It sounded interesting.

"Sue and I decided to get away and spend a week in California and maybe do some business."

While there, Harvey met Dr. J. Donald Hill, chairman of cardiovascular surgery at San Francisco's Pacific Medical Center, who had been associated with Searle's research products. By the end of the week, Harvey and Hill had made an offer to buy Searle's R&D division.

A few days later, Harvey packed his bags. He was now president, chairman of the board and chief executive officer of Thoratec Laboratories Corporation (newly named to reflect "thoracic technology").

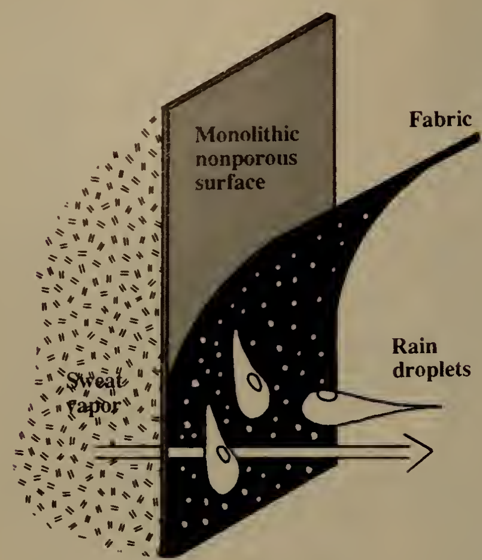
As he had at Miralin, Harvey quickly got things rolling. "We planned to concentrate in the cardiopulmonary area, especially artificial heart devices, because both Dr. Hill and I had done work in this area for several years," he says. Harvey holds a number of patents, including one for a nuclear-powered heart.

In the early years, Thoratec sought to establish a technology base in blood compatible polymers and biomedical devices. As Harvey puts it, "Before we could develop products we had targetted, a whole new generation of biomaterials was needed."

They did a good deal of research for the National Institutes of Health, as well as for private companies. The latter resulted in several licensing agreements.

In recent years, Thoratec, which went public in 1981, has developed a number of products in the areas of blood conservation, circulatory support and respiratory monitoring. Last year, they introduced BloodStat™, an autotransfusion system that allows a patient's own blood to be reinfused, in place of banked blood.

Thoratec's work on artificial heart devices reached a milestone



Although Bion II is nonporous, sweat vapor still diffuses outward through the film; but rain can't penetrate.

last fall when Dr. Hill implanted a Thoratec-manufactured Ventricular Assist Device (VAD) in a patient with acute heart failure. The VAD took over the work of the diseased heart, saving the patient's life. For two days, the VAD kept the man alive—time enough for a suitable donor heart to be found.

In March, another Thoratec-produced VAD kept a 16-year-old boy alive for the five days it took to locate a donor heart.

Nine centers in the U.S., as well as several abroad, now use Thoratec's VAD and related equipment.

The National Heart, Lung and Blood Institute has concentrated much of its research funding on development of a long-term VAD, rather than an artificial heart. An estimated 80 percent of all heart disease centers on weakened left ventricles. Also, VADs are smaller, less expensive and easier to install than complete artificial hearts.

Thoratec is the only company that currently markets VADs.

Bob Ward was bummed out," Harvey is saying now, by way of explaining the early history of Bion II, Thoratec's newest and most spectacular product.

Ward, now president of Thoratec's subsidiary in specialty polymers, had developed a new family of wound and burn dressings. The material allowed water vapor to escape through the dressing, while keeping the wound safe from moisture, bacteria and other outside contaminants.

At the center of the process was a thin (less than one thousandth of an inch) polyurethane film that provided a transparent membrane coating—a "second skin." (See figure above.)

But problems emerged after a marketing study found the wound-dressing field to be highly competitive—"all the biggies were in it," as Harvey puts it. So a decision was made not to run with the wound dressing product. At the time, Ward was disappointed.

"We've got a couple gallons of that goop," Harvey said jokingly to Ward. "Get your 60-40 parka and let's see what it does to fabric."

"After we tried it," Harvey says, "we stopped joking." It made the jacket completely waterproof without compromising its breathability.

Harvey knew instinctively he was on to something big again.

A textile subsidiary was organized, and intensive market research was begun. Unlike the wound dressing study, this one struck gold. Gore-Tex, the only "breathable" sports fabric on the shelves, had a major, worldwide market all to itself.

While Bion II was officially launched at the company's annual meeting in 1983, only recently has it fully emerged into the spotlight. A $3 million advertising campaign was kicked off in a big way last fall with a series of two-page spreads in major national magazines.

Perhaps the most impressive indication of Bion II's early market acceptance is the list of endorsements the product has received. The Outward Bound U.S.A. program, which had never before endorsed a commercial product, spoke up enthusiastically for Bion II. *Field & Stream* called it "a dream come true."

Gerry sportswear signed an agreement and is using Bion II fabric in much of their line of skiwear and outdoor wear. And an expedition of Americans climbing Mt. Everest was outfitted with Bion II-coated gear.

Since the "second skin" can be applied to any kind of fabric without changing the material's color or appearance, Harvey figures that so far they've just scratched the surface.

"We're increasing our business base every week. We plan to move into fashion raincoats, shoes and gloves."

To an entrepreneur, knowing what to give up is as important as knowing what to pursue. To simply believe in a product is not enough; mere conviction can be destructive, even if the product is a good one. Like a poker player, an entrepreneur must know when it's time to cut losses and move on. More important, knowing that you are bound to lose more often than win, you must have the resilience to take a high-stakes beating and not be emotionally crushed.

Bob Harvey still believes that the miracle berry, now marketed in Japan, will be proven safe and made available in this country. Yet he was able to leave behind the miracle berry and other projects (he holds several patents from his days at Thermo-Electron) when he sensed the time had come.

Patience, too—the ability to move at a painstaking pace when you want so badly to rush headlong—is a vital trait in successful entrepreneurs. For example, the start-up of Miralin, the miracle berry company, was more exacting a process than the thumbnail sketch presented here indicates. And Thoratec has required enormous investments of time and capital while building a strong technological foundation on which to grow.

All this requires a certain attitude, a certain set of priorities. Glancing down the list of strategies for Thoratec's future, you'll find a clue to why Bob Harvey is the consummate entrepreneur. Near the top, you'll find this one: "Promoting a climate within the company in which creativity and productivity are rewarded."

Michael Shanley is director of the WPI News Bureau.

What makes your life worthwhile?

Your family, your friends, your job? Having enough money? Having enough time? Enough time for what?
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Quality of Life is—well, what life is all about. It comes down to one question: What makes life—your life, or Life—worthwhile?
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Those whose essays are chosen to appear in these pages will receive $100, if they promise to put it to worthwhile use. We'll accept essays until October 1, 1985. Please send them to the magazine, in care of the editor, and marked "Quality of Life".

WANTED: More Graduate

Each year, more students seek advanced degrees in science and engineering. But the numbers aren't rising fast enough, say some observers, to meet the needs of academe or industry.

By Sharon Begley

Photographs by Bill Denison

The odd thing is how reassuring the numbers all seem: enrollment in graduate programs of science and engineering increased an average of 2.7 percent annually between 1976 and 1983 (the last year for which the National Science Foundation has records). And there is no obvious sign that the growth is tailing off: enrollment rose an even higher 3.7 percent between 1982 and 1983. But as educators and industry look into the future, they see a grim picture: undergraduates turned away from popular classes like computer science because there are not enough qualified instructors to teach them, American industries unable to match Japanese innovations in electronics and robotics because too few students aspire to the PhD, the ticket to cutting-edge research.

"The risk of having too few students going on to graduate school is that the country will not be regenerating its seed corn," says Daniel Berg, president of Rensselaer Polytechnic Institute. "A decline in the number of grad students undermines the unique competitive strength of the United States—namely, that by exposing undergraduates to leading-edge ideas and people, we have the best educational research system in the world. If we lose that, the students will lose out and so will the country."

Such concerns are born of the realization that the overall numbers are deceiving. For one thing, a sharp increase in, say, graduate enrollment in computer science and electrical engineering camouflages decline or stagnation in PhD enrollment in other fields. And even an increase in the popular disciplines is not necessarily sufficient to meet the soaring demand. For another, graduate enrollment now includes a high proportion of foreign students—as high as 50 percent in some fields—many of whom are on temporary visas and thus are likely to return home instead of giving the United States the benefit of their education. Overall, foreign students account for almost all of the increase in graduate enrollment; without them, the numbers would have remained stagnant since 1977.

Now that the U.S. is competing with its strategic allies on the economic front almost as intensely as it is competing with the Soviet Union on the political one, federal

Sharon Begley is science editor at Newsweek.

Students in Science and Engineering

agencies track science and engineering manpower as assiduously as the CIA tracks Soviet missile counts.

The news is disconcerting: Europe and Japan outpace this country on, for instance, the number of years of calculus students take and on the percentage of the federal budget allocated to research and development. According to the National Science Foundation (NSF), the number of scientists and engineers engaged in R&D increased 25.5 percent in the U.S. between 1965 and 1979. Meanwhile, Japan boasted a 139 percent increase, the Soviet Union 140 percent, West Germany 100 percent, Britain 76 percent, and France 74.4 percent. Admittedly, the U.S. started from a greater base than did many other nations. But there is no small irony in this country's beating a retreat, relative to other nations, on the science and engineering front in what is widely hailed as the age of the computer and the technology revolution.

Laments about a dearth of scientists and engineers have been heard before, of course, most often when the roller-coaster cycle in the supply of engineers hits bottom. But this time the worries run deeper, and there is a sense that factors dissuading seniors from enrolling in graduate school will only become stronger. Moreover, the accelerating pace of technological change gives a new urgency to the problem. In the past, even if there were, for example, too few aerospace engineers-to-be in the educational pipeline, the shortage would create a plethora of available jobs, drawing enough students to the field to meet the demand within four years or so. But nowadays, points out Lester Gerhardt, chairman of electrical, computer and systems engineering at RPI, technology changes so fast that "it has become more difficult to be responsive to new developments." Just as the generation time for new technologies has shrunk, so the time required to educate people proficient in them has lengthened. Because of that lag time, a system that merely responds to shortages once they develop will forever run behind.

To be sure, not all fields of science and engineering are feeling the same shortfalls of graduate students. Here's a breakdown by disciplines:

• That most basic of sciences, mathematics, has been faring poorly. According to the American Mathematical Society, the number of doctorates conferred on American citizens has declined steadily for the past decade, from a high of just over 700 in 1975-6 to fewer than 500 today. The number of doctorates awarded to foreign nationals has remained roughly constant, at around 200 per year for the past 15 years.

• The number of physics PhDs awarded climbed throughout the 1960s and peaked at around 1,500 in 1970-1, reports the American Institute of Physics. But then the numbers fell steeply, falling to 900 or so by the end of the 1970s. Each year since then, it has hovered below 1,000. During that time the foreign component has increased while the U.S. share has dropped: in 1982-3, foreign nations accounted for 40 percent of first-year graduate students in physics. That figure, of course, predicts their share of the PhDs awarded in the next year or so.

• Chemistry doctorates awarded in 1984 increased for the fifth year in a row, reaching 1,777 from a low of 1,532 in both 1978 and 1979, according to the American Chemical Society. But this increase should be seen more as a recovery than as unqualified good news: universities conferred 2,145 chemistry PhDs in 1970; then the numbers declined precipitously until the nadirs in 1978 and 1979.

• Engineering has indeed been as cyclical as the conventional wisdom says. The rise and fall is most obvious in freshman enrollment in the field, reports the American Association of Engineering Societies, reflecting the influence that the job market has on students' choice of a major. The peaks in enrollment have fallen roughly ten years apart—in 1946, 1956, and 1966—with lows coming in 1951, 1962, and 1972. Graduate enrollment, in contrast, has shown a steady overall growth during the past 40 years, but lately the curve has turned downward: 3,600 students earned a PhD in engineering in 1970, but only 2,800 did so in 1981. Foreign students account for an increasing proportion of those advanced degrees—today they earn roughly half of them.

In fact, the difference among disciplines offers clues to why spot shortages exist. For starters, engineering graduates can secure good research positions without a PhD. They thus have to balance the lure of a good job straight out of college against the potential prestige, better position, and—sometimes—better salary available to the PhD engineer four years or so later.

But "bachelor's degrees in chemistry,

Even for engineers, the employment picture varies from discipline to discipline: civil engineering is down, mechanical engineering is up.

physics, and biology are not regarded the same way as bachelor's degrees in engineering," says James Pavlik, chairman of the chemistry department at Worcester Polytechnic Institute. For science majors, the undergraduate degree is rarely a ticket to university teaching; it seldom qualifies the graduate for a job in industry at anything higher than the technician level, at least to start. Pavlik sees another reason why job offers from industry tempt undergraduate science majors less than they do undergraduate engineers: "Science students go into the field because they're really interested in it," he says. Engineers, he observes, are often more interested in job prospects.

Traditionally, a soft job market has encouraged greater enrollment in graduate school. For example, in 1980, 243 students earned doctorates in chemical engineering; in 1984, 357 did so. One major reason: the demand for chemical engineers with bachelor's and master's degrees roughly matched the supply through 1981, but then plummetted badly. From essentially no unemployment in 1980–1, nearly 60 percent of the seniors graduating in 1983 were not getting job offers. "When jobs are tough," says RPI's Berg, "the students figure they might as well go on to graduate school. But if they can immediately get a well-paying job, they ask themselves, 'Why should I go to grad school, lose out on four years of pay, and then struggle with a low-salaried academic position when I could do better in industry [which seldom requires PhDs of its engineers]?' " Unfortunately, the best students aren't always the ones who elect grad school—because they are ones who usually have the easiest time finding a desirable job.

Financial considerations play a larger role now that undergraduate tuition has risen into the five-figure range. "At Villanova," says Robert Lynch, dean of engineering there, "many seniors are in hock up to their ears. When they have to pay back loans for their undergraduate education, the idea of graduate school seems impossible." Although students can postpone loan payments if they are enrolled in a PhD program, their debts, in some cases growing larger, still hang over them. And now that the Reagan Administration is trying to cut back on student aid, financial pressures on students can only become worse.

Indirect financial factors also influence graduate enrollment. In the heyday of the post-Sputnik era, federal support for graduate education soared—such support is, of course, subject to the whims of the federal budget. Graduate students in the sciences generally are supported out of grants to their professors. The number who win such financing therefore depends on total federal support for the sciences.

But graduate students can also be awarded fellowships, teaching assistantships, research assistantships—among other types of support—directly by such federal agencies as the Departments of Defense (DoD) and Health and Human Services (HHS), which includes the National Institutes of Health (NIH). The trends are none too encouraging for financially strapped grad students:

- The number of full-time doctoral students supported by federal funds dropped 1.8 percent between 1975 and 1983, according to figures tabulated by the NSF late last year. The distribution of support indicates how federal priorities changed: DoD supported 36 percent more students and NSF grants went to 8 percent more students; HHS supported 28 percent *fewer* students. NIH cut its graduate support so that it funded 11 percent fewer students in 1983 than it did in 1975.
- Not surprisingly, physical and mathematical sciences, which receive the bulk of DoD money, fared better than biology, where NIH and HHS funnel their grants. The number of students in physical sciences supported by federal sources increased an average 3 percent per year from 1975, the number in mathematical and computer sciences grew at an average 3.8 percent and the number in engineering rose 1.1 percent. Meanwhile, the number of biology grad students receiving federal support went up only .2 percent per annum. (Psychology and the social sciences were struck hardest: the number of grad students receiving federal support in these fields actually fell.)
- Congress is currently considering legislation, as part of the reauthorization of the Higher Education Act, that addresses the need for federal support for graduate schools and students. Although the number of students receiving such support has risen lately, many educators feel that it has not kept pace with the need for trained PhDs.

Several academics point out, however, that "the number of students going on to graduate school is influenced by more than whether their education is paid for," as Gordon M. Wolman, chairman of geography and environmental engineering at Johns Hopkins, puts it. For example, "one of the crying needs right now is for state-of-the-art equipment in universities," he continues. As financially pressed colleges cut back on capital expenditures, the quality of their lab equipment is falling seriously behind that available to researchers in private industry.

Other frequently cited deterrents to graduate education in the pure sciences are cultural. "When students hear about Bhopal, about Love Canal and other toxic dumps," says chemist Don Jones of Western Maryland College, "they think, 'chemistry is not an area I'd like to work in.' " Aaron Martin, who was trained in chemistry at Franklin and Marshall College and is now chairman of Advanced Microcomputer Systems, believes that student perceptions of how "hot" a field is also influences enrollment. "In the movie 'The Graduate' the advice was 'Get into plastics,' but now the perception is that chemistry is not making the advances today that it had been in the heyday of nylon, Teflon, and other breakthroughs," he says.

One venue for communicating the excitement in the sciences is the high schools. But because of the well-publicized shortage of qualified teachers, as well as the setbacks that science suffered during the back-to-basics movement (when schools emphasized reading, writing, and mathematics at the the expense of science), students are not getting the early exposure to science that could sow an abiding interest in the field. Marvin Goldberger, president of the California Institute of Technology, comes down hard on the job the high schools do in fostering an interest in science. "I want to emphasize, in the current debate over science and technology, that all aspects of high school education are lousy . . . The whole thing is rotten."

Finally, longtime professors speculate that the current crop of students is, in general, less driven than their predecessors. "To pass up the chance to earn a great deal of money straight out of college in favor of going to graduate school, you have to have a real drive to enter teaching or to become a top-flight researcher," says chemist J.L. Zakin of Ohio State University, who has served on the Council for Chemical Research's manpower committee. "Lately, we have been seeing a stronger drive and greater interest in getting the PhD among foreign students than among American ones."

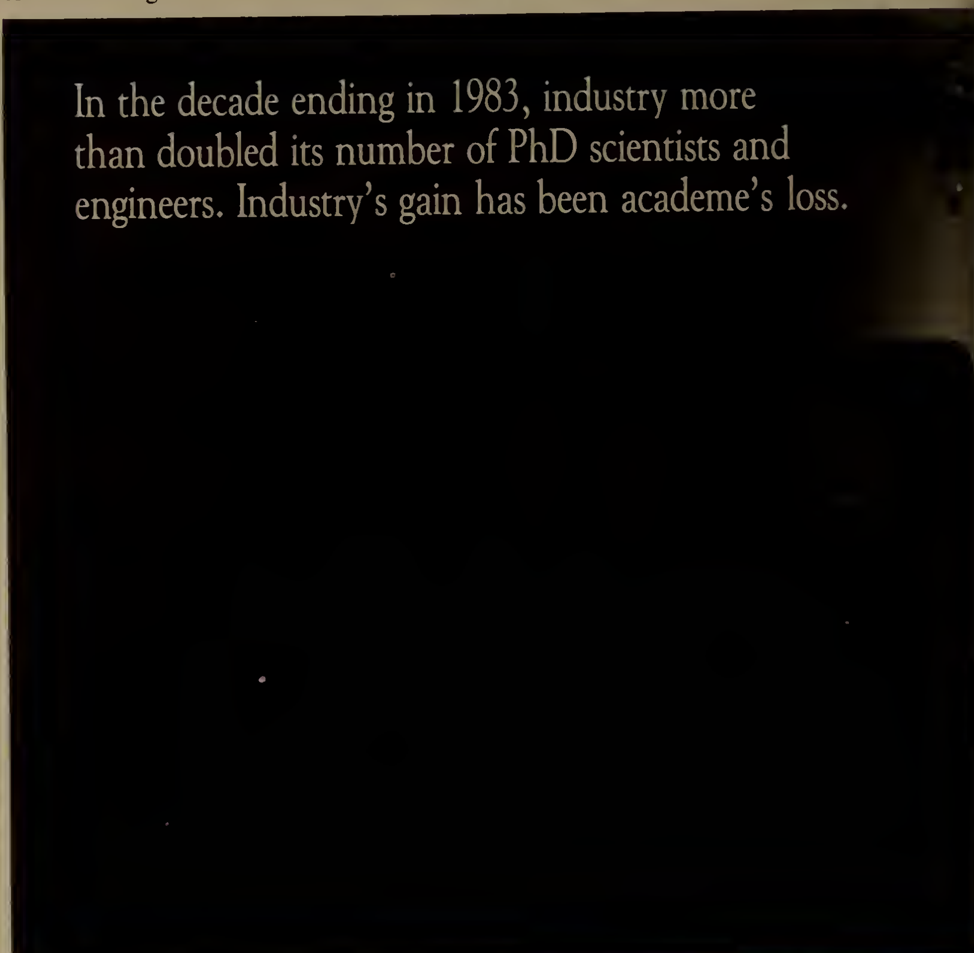
The frequent allusions to the high numbers of foreign students in doctorate programs should not be interpreted as xenophobia. Although that may be an element in some people's uneasiness, by and large both academics and businessmen view the foreign nationals as a valued but lost resource. Because graduate departments need a certain number of bodies to support research—the students serve as anything from glorified bottle-washers to de facto principal investigator in their adviser's laboratory—they have increasingly made up the shortfall of American students by accepting foreign nationals.

Most of these students are on temporary visas and are legally obliged to return to their native countries before seeking employment in the U.S. (There are numerous exceptions to and loopholes in the law, including graduates in computer science whose skills are valued enough for them to be considered "special cases".) "There is an inconsistency here," notes RPI's Gerhardt. "The recent increase in PhD enrollment over the last couple of years has been almost solely due to foreign nationals, and almost half of the doctorates in engineering are awarded to foreign students. Since a fair number of them want to remain in this country, it would seem wise to let them stay here as a national resource."

This is particularly true considering both the time and money the U.S. invests in the students: according to a survey by the Electronic Industries Association, when foreign students accounted for 20.4 percent of all science and engineering graduate students in 1980–1, only 3.3 percent of them showed their major sources of financial support as foreign. F. James Rutherford, chief education officer at the American Association for the Advancement of Science, has written of the irony in the U.S.'s "spending its dwindling resources to support foreign graduate students in the science and engineering fields. . . . The United States neglects the science education of its students and makes an investment in the graduate education of foreign students."

Concern about the dearth of PhDs tends to be greatest in engineering—specifically, computer, electrical, and mechanical engineering, all now regarded as hot fields. That has affected not only the quantity but also the quality of students in other disciplines, much as the increasing popularity of professional schools has caused "the best of a generation of scholars [to be] lost forever to our colleges and universities," as Columbia University President Michael Sovern put it in his annual report this spring. "The really good students are siphoned off," notes WPI's Pavlik. "As soon as they matriculate they hear about the great jobs available in, say, electrical engineering, so I lose 50 percent of my chemistry majors before they've even had a chance to register. Years ago, the best undergraduates were in my labs. Now they're in engineering."

Industry has an insatiable—or, at least so-far unsated—appetite for students with bachelor's degrees in these fields, and therefore is prepared to offer generous salaries to graduating seniors. The most extreme case seems to be in electrical engineering and computing. A bachelor's degree in electrical engineering commanded an average $26,556 in 1984, while a master's brought $30,684. Although it might pay a student to invest the extra year for a master's degree in return for an extra 10 percent in salary, the numbers don't argue for a four-year investment in a PhD in return for the average $38,868 starting salary. Whether money *should* be the determining factor is a moot point; that it is a strong influence is undeniable.



As a result of skimming off students early in the game, it is estimated that computer manpower shortages will plague the industry for at least the next decade: there will be enough students to fill jobs requiring two-year degrees, but only half the number of bachelor's graduates, one-sixth the number of master's and one-fifth the number of PhDs required by industry, let alone by academia.

The shortage is already severe enough that Intel Corporation, the giant semiconductor manufacturer, has opened design facilities in Israel, France, and Japan, where the company finds the requisite supply of skilled technical talent. The firm emphasizes that its overseas operations have been forced upon it not out of a desire for low-priced labor, but because the U.S. does not have enough trained technical workers to fulfill Intel's needs. (It should be noted that when industries project their manpower demands, it is in their own best interest to overestimate the need. If the word gets out to students that, say, fermentation chemists are going to be writing their own tickets five years from now, that helps assure a greater pool of talent from which the industry can choose.)

Even for engineers, the employment picture varies from discipline to discipline. Civil engineering is experiencing less-than-robust times because construction has slackened off across the nation. Mechanical engineering, on the other hand, has experienced a renaissance of late because of the interest in robotics and CAD/CAM (computer-aided design and manufacture).

The demand for PhD chemical engineers peaked in 1980–1 before falling again and is expected to reach the record high levels again in 1985. In 1986 and 1987, demand is projected to outstrip supply, according to a survey of 86 companies by the American Institute of Chemical Engineers. It is not hard to see why: average salary offers to new graduates with a bachelor's degree in chemical engineering reached $27,420 in 1984 (petroleum engineers topped the list at $29,568).

Shortfalls in the pure sciences vary from field to field as well. Chemistry PhDs might soon become too scarce to meet the demand if the current spot shortages are any indication. Du Pont predicts that there will be no problem for the next couple of years, although the market for PhD chemists is currently tighter than it is for chemical engineers. But Dow Chemical has been struggling to fill vacancies in certain specialties: Flooded with organic and inorganic chemists, Dow never has enough polymer scientists, physical chemists, or ceramics experts.

In general, however, the supply of chemistry PhDs is about in balance with the demand. "Students have no difficulty getting jobs, but employers are not banging on their doors either," says John Gryder of the Johns Hopkins chemistry department. Nevertheless, Gryder worries about the long-term prospects for university chemistry research because "chemistry is no longer getting the best and brightest. They are going into biology or medicine instead."

That may be a mistake. Unlike chemistry, physics, and engineering, biology has no national organization to track manpower supply and demand, so biology majors seem unaware that there is an oversupply of biologists. The publicity given to the emerging biotechnology industry may have fostered this oversupply, but in fact biotech needs very few research biologists. Once the fledgling companies begin production, the industry will have a much greater need for technicians, fermentation chemists, and chemical engineers that it does for research biologists. As for academic employment, there are more biologists than jobs, according to the Scientific Manpower Commission (SMC).

Every two years, the National Science Foundation conducts an employment survey. Its latest installment presents a striking picture of industry's appetite for PhD scientists and engineers. Between 1981 and 1983, employment of scientists and engineers with advanced degrees increased 7 percent a year—compared to only 2.4 percent in academia. This shift continues a trend, begun in the early 1970s, toward nonacademic employment: in the decade ending in 1983, industry more than doubled its number of PhD scientists and engineers. As a result, it now employs 31 percent of these graduates (up from 24 percent in 1973). Industry's gain has been academia's loss: schools and universities employed 59 percent of the PhD scientists and engineers in 1973 but only 53 percent ten years later.

What explains the declining growth in academic employment of PhDs in science and engineering? The NSF mentions such possibilites as demographics, particularly the shrinking college-age population, and tenure practices—the hesitancy of financially pressed institutions to offer permanent positions—as well as "financial incentives offered by industry."

Left unsaid is whether the slow growth in academic jobs reflects too few openings or too few qualified candidates. In fact, a recent survey found that one in four positions in engineering colleges was going unfilled for lack of acceptable applicants. Two years ago, 2,500 posts in science and engineering at all colleges remained unfilled for the same reason. The fields with the most severe shortages are engineering, computer science, and, to a lesser extent, mathematics. Since about 1981, according to the Scientific Manpower Commission, there has been a chronic 10 to 12 percent shortage of qualified PhDs to fill university positions in these disciplines.

"The reasons are perfectly clear," says Betty Vetter of the SMC. "Salaries offered to those who have just gotten their bachelor's are about equivalent to what a university can offer a PhD." In addition, the traditional lures of academia are vanishing. With undergraduate enrollment in computer science and engineering soaring—Lester Gerhardt of RPI estimates that student-faculty ratios have increased 30 percent in these popular fields over the past five years—professors are teaching more and larger classes and thus have less research time. "The things that made the ivory tower worth taking a pay cut for no longer exist in these fields," says Vetter.

The recruiting problems reported by various universities bear out Vetter's gloomy assessment. Although first-class institutions can still compete for the very best PhDs, their needs may soon exceed the supply—if they haven't already. "Virtually every engineering school has a greatly expanded faculty need because of greater undergraduate enrollment in these fields," says WPI's Gallagher, "and that's independent of the competition from industry." WPI has had particular trouble filling openings in electrical engineering, mechanical engineering, and computer science. Since it does not restrict course enrollment, the result has been bigger classes. At Villanova, says graduate school dean Bernard Downey, "the people we're hiring in the sciences are extraordinary. But the opposite is the case in engineering—they're not of poor quality, but it is becoming harder and harder to attract the best before industry gobbles them up."

RPI, too, is falling short when it comes to recruiting for electrical engineering positions, and as a result has been forced to curtail matriculation in that and other understaffed fields. According to admissions director Chris Small, "We try not to limit admission based on the student's stated preference of major, but what we might do is deny admission in engineering but offer it in the school of science."

The irony is that by limiting undergraduate enrollment, schools are also restricting the potential numbers of future PhDs and, therefore, professors. To escape that vicious circle, many schools are hiring the foreign nationals who make up so large a proportion of the new engineering and science PhDs. Few see that as an ideal solution. At Villanova, where about 10 percent of the science and engineering faculty are now foreign nationals, "we've seen some problems of communication because of the language barrier," reports Lynch. Other schools report the same thing, but Lynch sees another, more serious problem, looming on the horizon. He notes that Villanova, a Catholic university, was established with the goal of both educating and transmitting cultural values to its students. "This additional mission makes the situation different here," he explains. "If, in five or ten years, the engineering program were cut off from that mission because so many of the faculty were people with quite different cultural identities, it might raise questions about whether we should continue to have that program."

There is no dearth of ideas about how to reverse the trend away from university teaching, or about how to increase the pool of science and engineering PhDs generally. The ideas tend to focus both on practicalities, like increasing and sustaining financial support for graduate work, and on PR campaigns intended to get the word out that exciting opportunities await the new PhD. More and more educators emphasize that such a campaign has to begin early, and they are adding their voices to the many raised on behalf of improving science education in the secondary schools. But that, obviously, is a task of national proportions, so there are smaller-scale efforts under way, too. WPI, for instance, has a summer program in which high school students work at the university's labs and see how scientific research is done.

Industry, too, has a fear of eating its own seed corn and, as RPI's Gerhardt puts it, "wants to support universities, for its own good, even if it is in direct competition with us for scientists and engineers." Corporations are plowing millions of dollars into efforts to keep bright young investigators in universities so they can train the industrial scientists of tomorrow.

Without foreign students, graduate enrollments in science and engineering would not have changed since 1977.

About 30 companies, for example, offer fellowships to RPI faculty: IBM has a faculty development program dispensing about $30,000 to support the research of new faculty members and keep them in academia; General Electric guarantees consulting work for faculty in an effort to narrow the salary disparity between industry and academia.

Nationally, Du Pont awards "young faculty grants" of $25,000 for each of two or three years to encourage new professors in their research. In addition, the chemical giant is trying to encourage graduating

seniors to resist tempting salary offers and opt for graduate school: Du Pont awards about 25 grants of $4,000, plus guaranteed summer employment, to doctoral candidates nominated by a consortium of participating schools.

In a similar vein, the National Science Foundation has a Presidential Young Investigators program aimed at keeping young scientists and engineers on campus. It awards a basic grant of $25,000 for each of five years to 100 scientists and 100 engineers (the budget crunch will reduce those numbers by half next year). Then, if the investigator can attract industry support, NSF will match up to $37,500 of those funds. So far, industry has indeed been coming through: the first group of scientists and engineers (in 1984) got 70 percent of the total possible matching funds. "Industry has a deep awareness of the contributions academic institutions make in providing them with trained manpower," says NSF's Michael Frodyma.

Can such programs divert some of the new graduates from industry into grad school? Can the new PhDs be sold on university life? The awareness of the problem on the part of professional organizations, industry, and universities offers hope, as witnessed by the spate of programs that have sprung up to deal with the shortages. But such programs, however well-intended and well-funded, are up against some very imposing cultural and market forces. In the end, the most disturbing question is how seriously the current dearth of faculty will curtail the training of science and engineering undergraduates. For unless an adequate supply of such students gets into the academic pipeline, today's shortages will only grow worse.

Before cars, the standard American house (1) had a formal entrance—and no garage. Early cars were messy, smelly, and topless—so garages, like the portable model from 1911 (center), were necessary but not pretty.

Soon, detached garages became more elaborate: a catalog (2) from the 1920s features half-timbered, three-car, and brick versions. Estate garages (3) were as large as some homes. Whether simple or luxurious, styles did not reflect the new machine.

But some architects began to think of houses, like cars, as machines for living and to integrate the two. Architects like Le Corbusier put the garage up front (6), in streamlined, seemingly machine-made houses. In the U.S., the Prairie School followed suit (7).

Conservative architects were shocked, but entering from the garage was so practical that the style caught on. Such houses (5) often added traditional devices—a peaked roof and an ornate, if seldom used, front door.

Today, such homes symbolize suburbia; in fact, when BEST Products held a design competition for its retail stores, the Chicago architects Tigerman Fugman McCurry proposed a larger-than-life house (8). Customers would enter through the garage. The ultimate integration may have been proposed by Dan Scully (4). In "'55—Staying Alive," a '55 Chevy pickup backs into the garage; there it serves as a double bed and its radio as a stereo.

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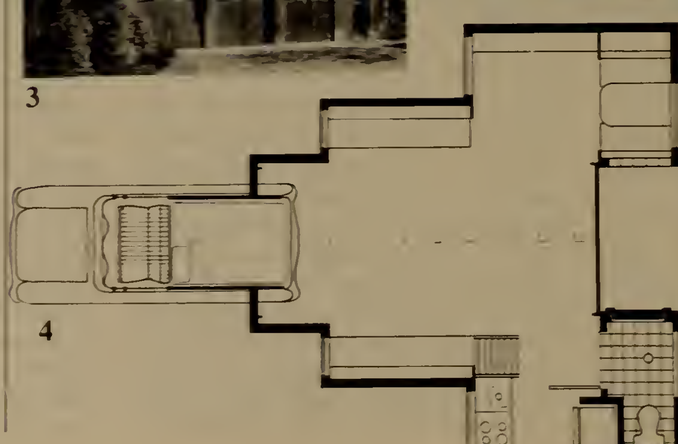

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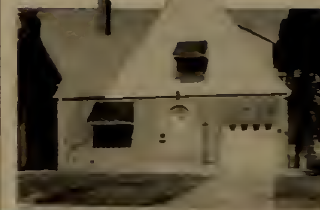

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Garage War

First came cars, then came garages. But what kind? In the 1920s architects debated the issue furiously. Their battle, says art historian Folke T. Kihlstedt, is only one example of the automobile's influence on modern architecture.

By Robert Kanigel

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Step inside the traditional suburban house. There's the formal living room, and beside it the formal dining room, and together they make up about 40 percent of the first floor. And nobody ever uses them. "Oh, maybe to entertain the boss's wife" once in a while, says architectural historian Folke Tyko Kihlstedt, but that's all. For the most part, those formal spaces are vestigial organs, holdovers from an earlier age when houses were designed for an orderly and regular progression of use from the outside in—from a semi-public porch out front, to a formal front parlor, back to the inner, private recesses of the house, where the family really lived.

But then the automobile came along and changed the American house forever.

So says Kihlstedt, professor of art at Franklin and Marshall College and a student of world's fair architecture now at work on a scholarly treatise, *The Wheels of Modernism*, about the automobile's influence on modern architecture. It's his contention, he writes in a precis of the book, "that the response of architects to the automobile age gave direction to the development of Modernism and subsequent architectural tendencies in America."

Kihlstedt came to his interest in the automobile circuitously. While struggling to find a dissertation topic at Northwestern University—he'd previously considered, and discarded, such topics as the influence of Art Nouveau on Swedish architecture—he was captivated by the daring architecture of the Century of Progress Exhibition at Chicago in 1933. "This was architecture, yet it transcended architecture," he says today. "These buildings reflected issues and ideas as well as forms." He had found his doctoral topic—"Formal and Structural Innovations in American Exposition Architecture: 1901–1939."

While researching his thesis, he was struck by the pavilions erected by the big automobile companies. Why, he wondered, was all the best architecture coming from them? The curved walls, the sweeping lines, the sense of movement and power, of the Chrysler pavilion in Chicago. The elaborate dioramas of the General Motors pavilion at the New York World's Fair in 1939, a pavilion which took streams of visitors and funneled them forward 30 years into a world of great highways, modernistic bridges, and sleek skyscrapers, then deposited them into a full-sized Intersection of the Future like the one they'd just seen in miniature . . .

Innovative stuff. Bold. Futuristic. "They were fabulous buildings," says Kihlstedt. "They prophesied new directions." Nor was it just big bucks chasing top architects so that *of course* the buildings would be the best. Other exhibitors had as much money, hired equally, if not more, prestigious architects. Yet beside the General Motors and Chrysler pavilions, their work looked more fussy, less powerful.

He concluded that the automotive pavilions were as distinctive as they were because they'd been designed not by architects, with all their old aesthetic baggage, but by industrial designers. Beginning in the 1920s, this new breed of commercial artist had begun taking refrigerators, gas stations, cars, and making them, well . . . seductively beautiful: Raymond Loewy's treatment of the Coldspot refrigerator for Sears, Roebuck and Co. was said to have boosted its sales ten-fold. The industrial designers, says Kihlstedt, were the advance guard for Modernism. And the big auto companies were some of their biggest customers.

Soon Kihlstedt was looking not only at auto company pavilions, but at the automobile's impact on modern architecture generally. The technology-mad Italian futurist critics in the pre-World War I period, he learned, had seen the automobile, in his words, as "the paradigmatic object of modern technology," its beauty rivaling that of the Venus de Milo. It was, says Kihlstedt, "a whole new beauty of speed and dynamism"—an aesthetic to shape the 20th century.

The automobile's proliferation in the 1920s changed the face of the American road, littering it with gasoline stations, diners, motels, drive-in establishments of all kinds. Even early during this period, you could stop at a roadside barbecue stand and get served a meal without ever stepping from your car. Shopping centers got their start in Los Angeles in the late 1920s. The first drive-in movie theater appeared in Camden, New Jersey, during the Depression. Motels first appeared around 1925—evolved in part, says Kihlstedt, to serve dusty, tired travelers intimidated by formal hotels where the help were better dressed than they were. Motels became common in the 1930s (which is when the word itself caught on) and only later, in the 1950s, did they become dominated by national chains.

For at first, the roadside culture amounted to little more than widenings in the road, distinctly local in look and feel. But by the 1930s a change could be discerned—the first hints of nationwide standardization.

The railroad, that earlier destroyer of barriers of distance, had failed to produce standardization. Through the great portals that were the vast central stations, trains deposited travelers into the city center, smack up against the existing urban fabric. Automobiles, on the other hand, left travelers out in the countryside—to many city slickers' sensibilities, at least, in foreign territory—craving all that was clean, efficient, safe, and familiar. By the mid-1930s, as Kihlstedt has written, they began to be served, architecturally, through buildings that functioned "as nationally recognized emblems of a corporation or its product . . . , early examples of the antiregional and nonindigenous architectural forms that we take for granted today."

The homogenization of the American landscape brought with it a new aesthetic. Back in the mid-1920s, the elaborate, mausoleum-like gas stations erected by Atlantic Refining Company and others were throwbacks to the Beaux Arts training of conventional architects. But as automobile-driven modernism took hold across the country, that traditional, ornamental look was swept away by the rounded curves and streamlining of industrial designers—their enameled steel surfaces. Kihlstedt suspects his research will show, influenced by automobile door paneling, fenders, and hoods.

Roadside strips, and fast-food establishments, and gas stations, and parking garages, and mobile homes and motels and shopping malls—the automobile, of course, had a hand in shaping all of them. Even as established a form as the traditional American house did not come away untouched.

In "The Automobile and the Transformation of the American House, 1910–1935," an essay which appeared in *Michigan Quarterly Review*, and which forms the basis for a chapter in his book, Kihlstedt elaborates on his findings. Before the automobile, he writes, "the front porch still functioned as the buffer zone between the privacy of the house and the communality of the neighborhood. It was the place where family, friends, and neighbors communicated in an easy and informal way. Likewise, the parlor was always the front room of the house—the next important zone between the public and the private worlds. It was in this formal living room where members of the family met and entertained visitors who were

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Folke T. Kihlstedt

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not close or accepted intimates."

The automobile overturned this neat and formal sociological order. Picnics by the side of the road began to replace formal Sunday afternoon dinners. Aimless weekend drives and unannounced visits made for a more spontaneous way of life, breaking down the stiffness of city ways and replacing it with easygoing suburban informality. The very sense and logic of the traditional house was called into question. What use a porch? Why a parlor? And where was the new family car to go?

In the garage, certainly. But where should the garage go? For a quarter century, ending only in about 1935, architects debated the question, the pages of the nation's architecture journals soon becoming piled high with polemical debris. Should garages be kept pristinely distant from the main house, as the conservatives insisted? Or integrated into it, as the radicals demanded?

At first, the garage was just a stable for cars. After all, your Model T was smelly, noisy, and dirty—just like a horse; so keep it as far from the house as possible, preferably at the rear of the property. Some early garages, in fact, stashed cars and horses in adjacent stalls. Garages for the new car-owning middle class were often primitive, prefabricated affairs lacking all aesthetic pretense and requiring trellises and vegetation to make them look respectable. The better-off, meanwhile, could open up a home builders' catalog of standard plans and find garages of half-timbered stucco Tudor design, tiled roofs, handsome window treatments . . . anything they wanted.

However elegant, the garage was still invariably off by itself. Gradually, though, some architects began trying to integrate it with the house; Frank Lloyd Wright was one of the first, designing a house with basement garage as early as 1904. Conservative architects, however, pointed out inherent aesthetic problems: How, onto a house of modest scale, do you stick a 400-square-foot, two-car structure and have it come out looking decent?

"The aesthetic shock

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Hedrich-Blessing

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Sleek, curvaceous, gleaming—the automobile became for many 20th-century designers the paradigm of beauty, the Venus de Milo of its age. Its metallic curves, like those photographed by Hein Gorny (1), inspired both architects and the new wave of industrial designers.

Striking examples of automobile-influenced buildings appeared in world's fair architecture. For Chicago's Century of Progress exhibition in 1933, Holabird and Root designed a pavilion (center) whose entrance lines resembled a car's hood. As a side view (3) shows, the towering walls were not so much structural as symbolic.

At the 1939 New York World's Fair, the General Motors pavilion (4), coated with silver automobile paint, had rounded curves and a sense of motion. The Chrysler pavilion (2) at that exhibition had fins to suggest motion and modernism.

A few private residences (5) also borrowed curves and materials (in this case, 20-gauge rolled steel) from the car.

Early gas stations, like this one in New England (1), borrowed local styles and materials. But, by their nature, gas stations wanted to catch the motorist's eye. One way was to borrow from history: an "English country cottage" (2) in Waupun, Wisc., and a monumental station (center), part of a series Atlantic Refining Co. commissioned.

Another way to get attention was to emphasize the logo. Shell built shell-shaped stations (3) and commissioned a building (5 and 6) that was illuminated at night. For Texaco's building at the 1937 Dallas Exposition, W.D. Teague made the logo a focal point (7); the same star graced Texaco stations (8).

Today the building is less important than the sign, a move presaged by Bertrand Goldberg's 1938 station (4) in Chicago.

of large, blank doors," as Kihlstedt writes, was the sticking point. One architect, Hedley V. Sevaldsen, pronounced the integrated garage, with its massive doors squarely facing the street, an aesthetic abomination on a par with that "other pestilence, jazz-music," and he bemoaned its enthronement as "modern".

Modernism, as a movement, had come in with the influential Swiss architect Le Corbusier. In his 1923 treatise, *Towards a New Architecture*, Le Corbusier proclaimed that a house is "a machine for living in," and that the machine age justified rejection of past aesthetic dogma. The theoretical basis for integration of the garage and the house was thus laid. Le Corbusier's own Villa Stein was, as Kihlstedt writes, "a perfect model." Built in 1927, its garage-dominated facade is virtually indistinguishable from designs of half a century later. "By mid-1930," writes Kihlstedt, concluding his account of the Great Garage War, "progressive-minded architects were designing houses for clients of all social levels with integrated garages, which they made no attempt to conceal. Conservative architects such as Sevaldsen had lost their battle." And today's suburban house had gained a key marker of its identity. "For better or worse, an old way of life, represented by the deep front porch and the parlor, had succumbed" to the implacable forces of the motor age.

For better or worse: Kihlstedt doesn't indicate which he thinks it is. "I have trouble making value judgments about historical developments," he says. The cultural setting from which the automobile sprang so differs from today that it is hard to balance losses versus gains. He will say, though, that "I don't think we can try to nostalgically recover the visual appeal of the past. I don't want to make Williamsburgs all over America. One is enough."

And yet, he notes, traces of that pre-automobile past still linger in American housing. For example, people today don't much use the front door, preferring to enter instead through the garage. Still, a formal Front Door, complete with heavy, brass knocker and over-the-transom eagle, graces

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Folke T. Kihlstedt

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Hedrich-Blessing

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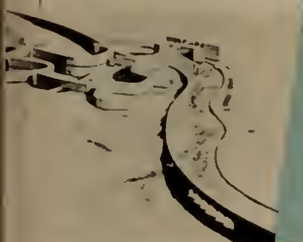

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many a suburban house. Why, he's asked, does it linger? An atavistic impulse, perhaps, the rock at the mouth of Mr. and Mrs. Neanderthal's cave?

No, Kihlstedt replies, he doesn't think so. "People generally have little architectural thoughtfulness," he says. "They don't feel much about their architectural spaces. . . ." He does, however, find a parallel for suburbia's eagle—in 19th-century England.

The Industrial Revolution thrust the English countryside into turmoil. Giant mills replaced cottage industries. The iron regimen of the factory left workers with diminished control over their lives. It was this setting, says Kihlstedt, that nurtured the Gothic Revival, that flowering of interest in the medieval past championed by critic John Ruskin. To Ruskin, says Kihlstedt, the Industrial Revolution meant "social disruption on a mass scale that led to degradation of taste and ultimately to moral decline." The Gothic Revival expressed a yearning for a vanished, more holistic past.

Kihlstedt sees similar forces at work in vestigial forms still seen in suburban tract housing. "Maybe society wants the house to be a refuge from the fast-paced, busy world outside," with moldings and shutters and eagles and the rest presumably recreating the past.

"Of course," says the professor, "I don't think it really works."

Kihlstedt, while eclectic in his stylistic orientation, admits to being heavily influenced by Robert Venturi, the maverick architectural theorist of distinctly post-modernist bent. (Like Venturi's, his research has been supported by a grant from the Graham Foundation for Advanced Study of the Visual Arts.) Venturi, best known for his book *Learning from Las Vegas,* argues that architects have much to learn from vernacular forms that may seem superficially "ugly"—such as, for example, Las Vegas strip development. The strip has become part of the architectural vocabulary, Kihlstedt sees Venturi as saying. You can't get away from it. It's there, everywhere. So learn from it. Respond to your culture's vernacular forms.

For Kihlstedt, one such vernacular form, truly indigenous to America, is the mobile home. Back in the 1930s, futurists had embraced the notion of prefabricated housing. Low-cost, factory-made homes were "just around the corner," one of their champions predicted in 1936. "It won't be long now before houses will be punched, pounded and pressed out at factories precisely as Henry Ford ground out the Model T—millions of 'em."

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Visitors to the 1939 New York World's Fair loved the General Motors pavilion and its Intersection of the Future (1), designed by Norman Bel Geddes.

In those days before traffic jams and exhaust fumes, architects prophesied structures to mesh roads and buildings: Raymond Hood hypothesized a Manhattan bridge with apartments (center), Charles Morgan a skyscraper bridge for Chicago (2). For Algiers, Le Corbusier proposed a horizontal skyscraper (3). It had a high-speed road on top, homes and shopping below.

Integration of roads and building became reality in the Connecticut headquarters of Union Carbide (4), designed by Kevin Roche John Dinkeloo and Associates. A worker drives into the building (parking is in its center) and gets out on the level nearest his office.

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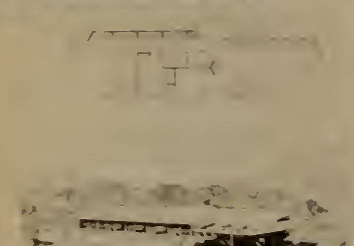

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While machine-made prefab homes didn't immediately catch the American imagination, mobile homes did. Over the years, they were developed and expanded, influencing today's prefab housing.

Kihlstedt sees in the mobile home much more than its superficial charmlessness. For him, it is the first example of plug-in architecture: the mobile-home owner need only drive in to the trailer park and plug it in for access to water and utilities. In this respect, the mobile home presages such bold projects as Moshe Safdie's Habitat, designed for Expo 67 in Montreal, and built up from 70-ton reinforced concrete modules, each with its own garden, each with substantial air, light, and privacy. Indeed, in how it serves, at least conceptually, as building block for larger structures, architect Paul Rudolph has dubbed the mobile home "the twentieth century brick."

Rudolph's proposed Graphic Arts Center for lower Manhattan, Kihlstedt writes, grows "like a coral reef." The project, comprising more than 4,000 dwelling units along with industrial, commercial, and office space, appears "composed through a process of accretion . . . infinitely extensible by merely 'plugging in' more units." Yet being asymmetrical anyway, it remains always a visual whole.

Such a structure possesses a different *kind* of beauty, Kihlstedt warns, one far distant indeed from the Renaissance ideal of a harmony of design so perfect that nothing can be taken from or added to it without destroying it. He calls the aesthetic embodied in Rudolph's project an "aesthetic of indeterminacy."

In such an aesthetic, no longer is the individual dwelling unit the object of the architect's creativity and loving attention, but rather the larger, organic whole, built up from an endless, indeterminate number of modules—the trailer park splayed out in three-dimensional space. No more the set proportions of a Greek temple, or the cool, controlled elegance of a Miës van der Rohe high rise. No, this new architecture, Kihlstedt writes, "embodies concepts of growth and change," functioning almost organically, as a repetition of fixed units, piling atop one another, growing, with no end point, multiplying, like cells in a culture dish—

Or like automobiles across America.

Robert Kanigel lives in a Baltimore rowhouse with a front porch and no garage.

Almost from the beginning, attachments turned cars into beds (1). In the 1920s, an Omaha lumber merchant advertised with a "house on wheels" (2).

Today Skyline Homes (center) is the leading U.S. seller of homes, and mobile homes are harder to distinguish from conventional housing (4).

Architects quickly adapted the concepts behind mobile or modular housing—machine production, take-apart assembly. Frank Lloyd Wright designed a mobile home (5) far removed from the stereotype. Paul Rudolph used it as the basis for the Masonic Oriental Gardens (3), low-cost housing in Connecticut, and for his proposed Graphic Arts Center (6).

For Montreal's Habitat '67, Moshe Safdie replaced the mobile home with concrete blocks (7).

The Major Qualifying Project (MQP) and the Interactive Qualifying Project (IQP), two of four degree requirements at the Institute, are for undergraduates often the most distinctive, the most demanding and the most rewarding elements of their WPI experience. They challenge students to use what they learn to solve real problems with the kinds of real deadlines, budgets and accountability they will face in the professional world. Projects address problems in students' major fields—the MQP—and in areas that define the interaction between science/technology and societal needs—the IQP.

Dan Laprade's following accounts of student projects appeared earlier this year in *Newspeak,* the student newspaper of WPI. A civil engineering major at WPI, Dan is from Holyoke, MA.

PROJECT UPDATE

SECOND IN A SERIES

By Daniel Laprade '85

Studying Storm Runoff Settling Basins

Whenever land is to be developed, the environmental impact of the proposed project must be addressed. In Worcester, for example, the Massachusetts Biomedical Research Park, to be built on the western shore of Lake Quinsigamond, is gaining the attention of engineers, environmentalists and the public alike. One of the most interested parties in these proceedings has been civil engineering senior Virginia Roach, of Worcester.

Stirred by public concern as well as her own career interests, the WPI student approached the planners of the Biotechnology Park, Sasaki Associates of Watertown, MA.

Sasaki Associates felt they could use Roach's background in environmental engineering to study a vital aspect of pollution—site runoff. So she designed her Major Qualifying Project (MQP) around four preliminary tasks: assessing site-runoff characteristics, analyzing site soils, studying the literature on runoff settling basins, and suggesting design considerations for settling basins on site.

Roach, with CE Professor Fred L. Hart as her project advisor, started collecting runoff samples from the site in the spring of 1984. Although her sponsors required data after only one heavy rainfall, testing the runoff required that she be at the site within ten minutes of substantial rainfall. Once there she had to gather the samples from three different points. After securing the samples she was faced with days of tedious lab work.

Each sample was to be tested for pH, turbidity, bacteria, BOD-COD, nitrogen, oil, grease, phosphates, sulphates, suspended solids, and total solids. It was not until after the third rainfall that her persistence was rewarded with promising data.

Next, after analyzing soil samples for erosion characteristics, she examined the possible use of sedimentation pools at the site. These devices, as Roach explains, are used to settle out particulate matter—and the phosphorous, heavy metals and hydrocarbons attached to it—in the runoff before it is discharged into a receiving water body. Aside from their settling applications, pools aid in flood control by retaining initially heavy storm runoff and allowing it to flow more slowly into a river or lake.

Examples of such basins can be seen along Route I-190 north of Worcester. These settling basins are intended to cut down on road-salt runoff, but, says Roach, maintenance has been neglected, and the basins no longer operate efficiently.

As she points out, "Pollution is normally greatest in small, frequent floods, and that is what the basin designers usually have in mind. However, when a big flood comes along these small basins don't do a good job in flood or pollution control because water just flushes through them." In her report, she will suggest a design that serves a dual purpose by having large settling pools with varying outlets so both conditions can be met.

Much of Roach's laboratory data is being included in the environmental-impact statement prepared by Sasaki Associates. Her findings will help the company provide for a design safety factor in one of Worcester's most talked-about developments.

Robotics: Friend or Foe?

People sometimes find that buried beneath the excitement of technological progress are anxieties and fears over the advancing wizardry of science. Many shudder as we approach a "Star Wars" era, while others fear losing their jobs to the rapidly expanding use and sophistication of robotics and flexible automation.

Industrial robots tend to be a great deal more efficient and reliable than people in some jobs, say many experts. It's the intrigue of the issues surrounding robotics that has gotten Susanne Firla ('86, Needham, MA) and Cheryl Ann Fay ('86, Framingham, MA) to select robots as the topic of their Interactive Qualifying Project (IQP).

For the most part, says Fay, America's blue-collar workers in, for example, assembly or inspection, fear robotics most. But if you're a manager, Firla continues, you are also interested in productivity and economies of scale—just the kinds of things robots are *very* good at improving. "There's no doubt that robotics brings with it lots of trade-offs," she says. "What's got to be done is to maximize the benefits and minimize the drawbacks."

Firla and Fay have sorted through stacks of literature on the topic, everything from sensationalized magazine stories to the reams of data generated by the U.S. Bureau of Labor Statistics. What they have found is that no one source has been able to juxtapose both sides of the issue for rational analysis. Some studies are done by interviewing people whose jobs are at stake, while others simply reinforce the benefits of robotics. The task of the two women has been to try to read through the bias and to draw a clearer picture.

While the fate of robotics in the United States remains uncertain, the situation abroad—particularly in Japan—is often altogether different. In that country, robots are being used on a much larger scale. Several factors contribute to the Japanese dominance, says Fay: less unemployment than in the U.S., strong financial backing by the government to help implement robotics technologies, and the fact that Japanese workers are trained in several different skill areas, letting them move into new positions much more easily.

"Today," says Fay, "there are only about 5,000 robots in use in the U.S. Normally, they are extremely expensive, and often the time and money spent buying them, installing them, and programming them simply isn't worth the change."

One aspect of the robotics evolution, rather than revolution, has become clearer to the two women. "A slower, more deliberate increase in the use of robotics, which won't displace hundreds of thousands of workers, as so many had feared, is more likely to occur," Firla contends. "There is evidence that the new jobs for technicians and servicers will mean that all but 10 percent of affected workers will be retained and relocated."

Michael Shanley

Hands in Space (Almost)

Nine WPI students traveled to Washington, DC, in May to present their design for a new space glove and almost came home with the brass ring. Armed with videotapes and an actual prototype of the glove, the students defended their design before a crowd of about 70 NASA officials, contractors, scientists and engineers. And while they didn't win (Kansas State University did), by all accounts they finished a close second.

"The presentation was just superb," said ME Professor William R. Durgin, who oversaw the project. "The contractors who are developing gloves for NASA spent a lot of time examining our design."

In fact, the quality of the presentations was such that the grand prize—a VIP trip to Cape Kennedy to witness a shuttle launch—was awarded to students from all four schools (the other two being MIT and Oklahoma State University).

The intent of the national competition, sponsored by NASA and administered by the American Association for Engineering Education, was to provide NASA with fresh ideas. Students were asked to design a glove that could withstand a pressure load of 8 pounds per square inch (psi), yet still be flexible enough to allow astronauts to perform complex tasks. The current glove works only at 4 psi, and while that's fine for now, NASA will need the sturdier model when it starts constructing space stations in the early 1990s.

Although the competition is over, WPI's ties with NASA remain strong. Durgin, who heads the aeronautical engineering section of the ME Department, is in close touch with officials at the Johnson Space Center in Houston, where research on new space suit design continues.

Meanwhile, the first canister of WPI/MITRE Corporation space shuttle projects has been shipped to Cape Kennedy, where the projects are currently undergoing safety testing by NASA in preparation for a 1986 shuttle flight. A second group of projects is now being sketched out.

Above, Edward L. Ryan, '85, Alexandria, VA, looks on as Michael A. Mongilio, '85, Oxford, MA, runs the WPI-designed space glove through a battery of flexibility tests. The special chamber, which simulates a high-pressure atmosphere, was constructed as part of the project. —*Michael Shanley*

Blowin' in the Wind

Recently, three senior civil engineering students, Gary Smith (Natick, MA), David LaBranche (Newmarket, NH) and Jonathan Kaplan (Charlotte, VT), each with a great interest in architecture, embarked on a project to better understand the nature of wind and its effect on building design.

"Many investigators," says Smith, "are looking at how buildings bend and deform in the wind and the effects of eddies on the backside of buildings. What our MQP does is to see what happens at the base of the structure when wind works on the upper stories."

The team was faced with trying to simulate real wind situations in a long but narrow three-foot-square wind tunnel at WPI's Alden Research Laboratory.

Dave LaBranche explains: "You can't just stick a scaled-down building in the tunnel and flip on the fan and measure what happens, because that's not how it works in the real world. In an actual setting, the turbulent characteristics of the wind are important, and big gusts create very interesting effects."

"We were at Alden at least 10 hours a week," says Kaplan, "and it wasn't research you can work on for just a couple of hours at a time. Once you start, you stay."

After a thorough literature search, the group was able to use well-known physical laws to establish the best possible velocity profile. Next, they created the base structure that measures the forces caused by the simulated wind. The team decided to construct two of the base units, known as the "force balances," because they wanted to measure torsion as well as forces in the x and y directions, a task which they felt would be too complicated for one force balance alone to do.

Once they had attained the proper wind simulations, scale models were placed on the force balance. Strain measuring devices were attached to the base to measure the effect of the wind. Unfortunately, the metal force balance was too thick, and the minute deformations could not be measured accurately by the gauges. They chose to cut pieces off their force balance to stimulate gaugeable strain data.

The group emphasizes that the real value of their work was not really the measured strain values they obtained but rather the analyzing techniques they have established during their project. A great deal of work went into getting the whole apparatus set up correctly and functioning.

Says LaBranche: "The tunnel is pretty complicated. Now we realize it's going to take another project team to actually collect the data needed to complete this research."

At Alden Research Laboratory, seniors Gary Smith (left) and David LaBranch prepare a wind tunnel as part of their MQP on the effects of wind on buildings.

Music by the Numbers

On almost any day last spring you could walk by the windows of Room 109 in Atwater Kent and see computer science student Richard Caloggero of Medford, MA, hard at work on his MQP. He insists that he's behind schedule, but it's hard to believe, watching him crouched intently over his computer terminal. Caloggero's project is fascinating in its own right, but this MQP has a unique feature: Caloggero is blind.

Professor Mark Ohlson (CS) is the advisor of the project, entitled "Digital Sound Recording and Synthesis." As Caloggero explains, his work is centered on understanding and experimenting with the software realm of digital sound.

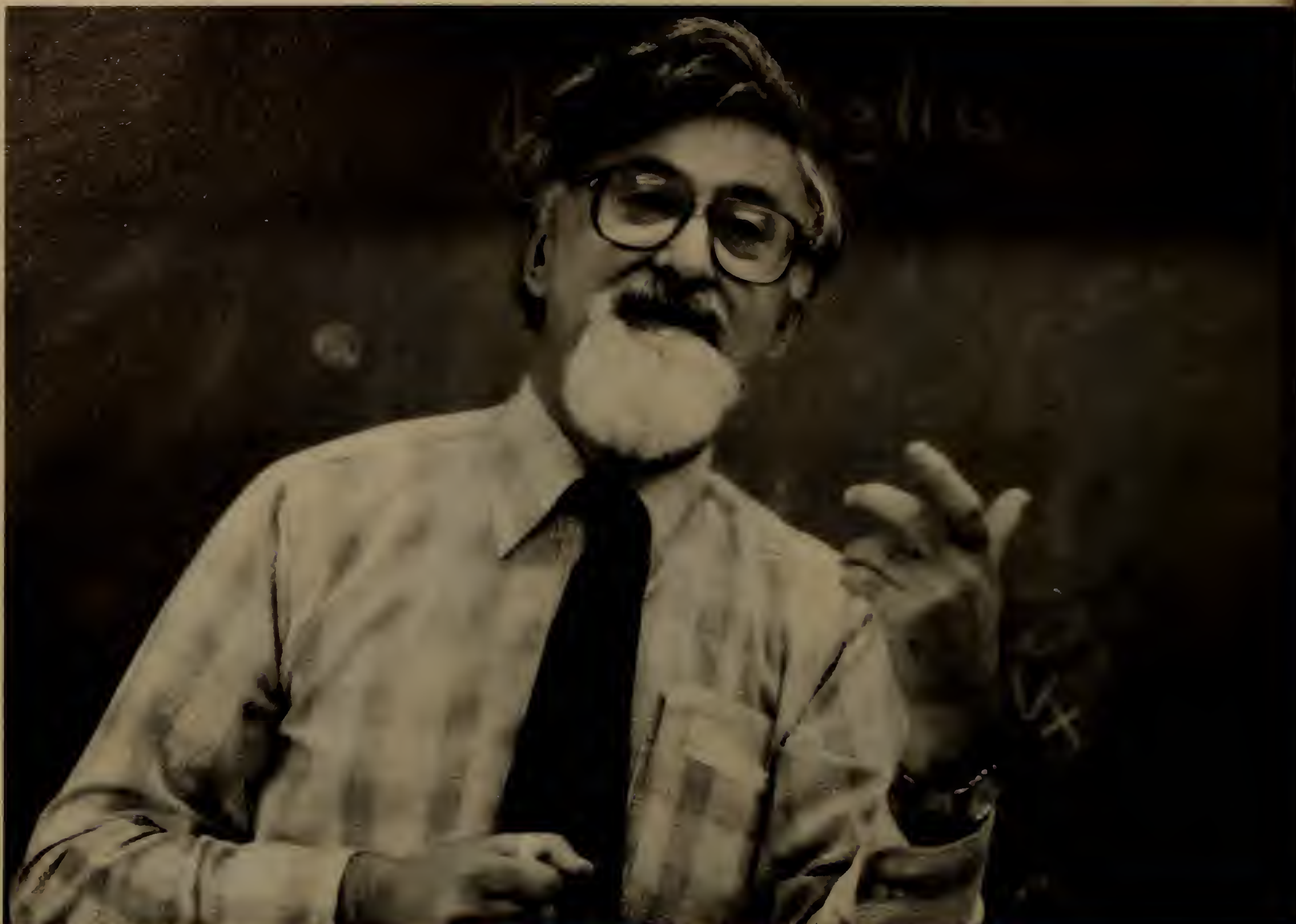
He confesses that much of his work is not theoretically very innovative. Digital recording systems were introduced to the commercial market some time ago, and their use is spreading rapidly. Perhaps the best known applications are digitally recorded discs and disc players.

Caloggero envisions possibilities beyond the recording uses of digital sound. "Right now," he explains, "what my work has accomplished has been synonymous with having a singer sing into a microphone, recording the sound digitally and then being able to reproduce the sound exactly—even on an instrument. In the future I'd like to be able to create the waveforms without use of a microphone. *That's* where the challenge lies."

But how does the computer fit into the scheme? Caloggero clarifies it this way: "All the electronic pieces are in the machinery: the resistors, capacitors, chips, wires, etc. They are collecting, converting and transporting the sound, but there's got to be a brain telling the components how and when to work. The programming becomes the intelligence system. The computer tells all the circuitry when to work and what to do with the data it works on. Changing the commands in the program has the power to alter the performance."

Because of his blindness, Caloggero has a unique computer terminal on loan from the Massachusetts Commission for the Blind. When asked how he managed to keep track of everything he has programmed, he shrugs off the apparent difficulties by revealing that he has a firm knowledge of where everything is entered in the computer.

Although the project hasn't carried Caloggero into unexplored regions of digital recording, he concedes that it has been a tremendous learning experience. He has been able to grasp many aspects of this up-and-coming technology and, as he points out, "I've always been excited about this kind of work; so for me, it's been a great project."



New Answers to an Old Puzzle

By Kenneth McDonnell

The research of Physics Professor Michael Klein is shedding a clearer light on old friends glass and ceramics.

What are glasses, or ceramics—or more formally, amorphous materials—doing for us these days?

They are being used, according to Physics Professor Michael W. Klein, for rotating parts, such as turbochargers, in automobile engines to help withstand higher temperatures than ever before. Their densities, he notes, are much lower than steel, the conventional material for these components, resulting in less tension in the rotating parts.

Elsewhere, other glasses play a vital role in making the best integrated circuits. They are used to generate electricity for calculators using solar energy. They can increase the hardness of grinding wheels by an appreciable factor. And researchers believe that, compared with crystalline solids, glasses are much better suited for use in space when a spacecraft is exposed to large amounts of radiation.

The list of current and potential applications for amorphous materials goes on and on. As it grows longer, more and more physicists are turning their attention to these exotic materials in order to understand their fundamental properties, thus leading, it is hoped, to an ever widening range of uses.

Klein is an expert on amorphous materials. The research he has been conducting for the past five years is making a real contribution to understanding these fields.

Klein is a theoretical—as compared with an experimental—physicist. He has no laboratory, save for a blackboard in his office, a computer and the laboratory of his mind. He says that the understanding of amorphous materials is today on about the same level as the understanding of non-amorphous, or crystalline, solids was 50 to 60 years ago. It was the fundamental research on these crystalline solids (also called *ordered* solids) that has resulted in many of the great technological advances we are experiencing now.

The American Nobel Laureate John Bardeen, for example, is one of the best-known solids researchers. Bardeen worked for many many years on understanding semiconducting solids—with no guarantee of a payoff. But it was this work that culminated in the invention of the transistor, without which the great advances in modern computers, in communications and in scientific instrumentation would have been impossible.

In order to understand what amorphous materials are, a brief review of non-amorphous, ordered solids may help.

Today, the study of ordered materials is well understood by physicists and occupies entire chapters in textbooks on solid state physics, the branch of physics concerned with the study of solids. But 60 years ago, very little was known about ordered materials. Then, in the 1930s Felix Bloch, Frederick Seitz and others introduced remarkably simple principles for solving problems involving a very large number of atoms which have periodic, or repetitive, structures. It is this repetitive nature which helped the physicists reach a fundamental understanding of these materials and unlocked their technological potential. As we'll see later, it is the absence of periodicity which makes the study of amorphous materials so very difficult.

But first, it will be useful to understand better what periodic structures are. Consider an array of points, or atoms, placed on an infinite plane. Each point is *exactly* equidistant from the other, as shown in Figure 1. Now, place yourself on one of these atoms. In whichever direction you look, you will see an endless row of atoms. Now move yourself over, or displace yourself, by an atomic distance *d* in the x or y direction. You are now at another atomic site; but again if you look around yourself, the array of atoms looks exactly the same as it did before. Consequently, in the language of physics, you displace yourself by a fixed distance and your new view of things is exactly as it was before. The structure is said to be periodic, or ordered, or repetitive. This is a convenient designation, because every time you displace yourself by an integer multiple of *d*, you again land on an atom from which you'll see the structure, or environment, precisely as you did before. "It is this periodic nature of the crystals which makes the mathematical solutions for ordered solids easy," says Klein.

How, then, do amorphous, or non-ordered, solids, differ from ordered solids? Consider Figure 2. The atoms in an amorphous solid are positioned randomly, and no fixed distance exists between the atoms. This characteristic

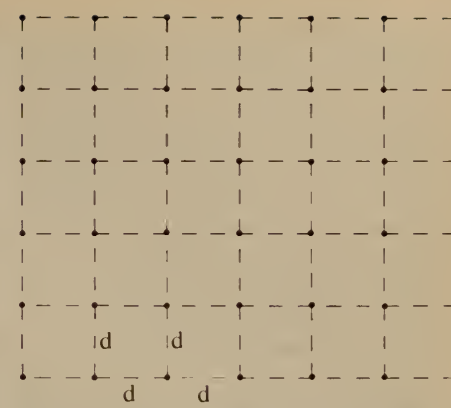


Figure 1. Periodic, or ordered, structure. The atoms, shown as circles, are placed at a distance d *from each other. Every time we move up or to the right by a distance* d*, we see exactly the same surrounding or environment as before.*

Figure 2. Nonperiodic, or amorphous, structure. The atoms are placed in random positions and the distance between them is no longer d.

alone, says Klein, prevents use of the powerful mathematical techniques scientists can employ to solve problems of periodic structures. And rightly so, he adds, because nonperiodicity brings new physical phenomena into the picture. In short, amorphous materials have completely different physical characteristics from their ordered counterparts.

For physicists to study non-ordered materials, Klein explains, they must "idealize" the problem. "In this case," he says, "one would ideally like to separate out the effects which arise because of the unordered nature of the glassy solid from all other effects which are occurring." One way to accomplish this is to cool the solid sufficiently so as to freeze out the usual temperature-dependent properties of crystalline solids. This technique was first developed in experiments of the early 1970s, which uncovered the special properties of amorphous materials.

It has been a real surprise to physicists that, at these very low temperatures, amorphous materials exhibit a large low-temperature specific heat which is proportional to the temperature, and a thermal conductivity proportional to the square of the temperature. In addition, anomalous results show up in the way amorphous materials absorb sound waves and how they respond to an electric field, a property known as the dielectric constant.

What is even more surprising, says Klein, is that these characteristics are common to most amorphous materials.

"Clearly," he adds, "these universal characteristics, which show up regardless of the substances used in the material, arise from the amorphous nature of the solid, for when the solid is made to undergo crystallization, thereby turning the amorphous material into an ordered one, the unusual properties disappear."

Based on experimental observations of the properties of amorphous materials, physicists long ago suggested that the curious properties of amorphous materials are caused by what scientists call "tunneling states." The concept of a tunneling state is involved in quantum mechanical theory, and probably requires further explanation.

First, consider a "potential well." Think of this well as a depression in the ground. This idea is illustrated in Figure 3, which shows two depressions, or wells, in the ground. Now if you were to place a ball in the depression to the right, it would remain there forever, unless someone or something gives the ball enough kinetic energy—i.e., energy of motion—to move it out of the depression, or well, across the barrier.

Notice that, since the depths of the two wells are equal, once the ball is somehow moved into the left-hand well, the ball's energy will be exactly the same as when it rested in the right-hand well. However, since nothing and no one has moved the ball to the left well, the only way for it to get there is for it to obtain enough energy to actually pass *through* the barrier.

Now let's replace the ball with a molecule—the smallest particle of a compound that has all the chemical properties of that compound. A molecule, compared with a ball, has a very small mass. The theory of quantum mechanics tells us there is some small probability that, though this molecule does not contain enough energy to climb over the barrier, it may still penetrate the barrier and get to the other well. Physicists, then, refer to this activity as tunneling across a barrier to get to the other well. The particle combined with the well is thus called a "tunneling state."

At first, if you consider Figure 3 a model, tunneling may appear improbable. But, says Klein, it becomes less so when you realize that the distance between the atoms in a solid are of the size of the molecule doing the tunneling. All the atoms move as the temperature increases, giving the molecules a fair chance of actually getting beyond the barrier.

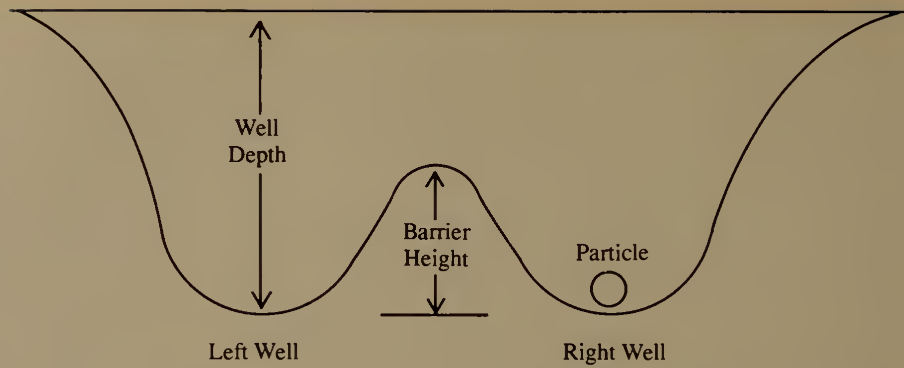


Figure 3. The particle can be in either the left or right well. Either way, it can "tunnel" through the barrier rather than moving over the top of the barrier.

Not only are there such tunneling states, but the energies of the tunneling states are random. The puzzle Klein has been working to solve concerns what actually is doing the tunneling. This puzzle aside, physicists have found that tunneling can explain the experimental observations—"provided," Klein adds, "that you assume that the number of tunneling units which have a certain energy is the same as the number having any other energy."

In other words, the density of states, or number of tunneling units per unit energy, is a constant. This assumption is necessary to explain the experimental results, and without it, there is no plausible interpretation of what happens in amorphous materials. Yet for 15 years, research that struggled with this riddle was unable to unravel the reason for a constant density of states at low energies.

Klein has been working on this puzzle for about five years. He first examined the nature of the best understood tunneling states, cases in which scientists knew the exact nature of tunneling states. How, he wondered, do these well-known tunneling states interact, or see, or feel, each other when placed into a crystalline solid? Using fundamental principles of physics, Klein identified the interaction between pairs of the well-known tunneling states. That is, he determined how they "feel" each other at a distance r apart. What he found was that, for the tunneling units he considered, this interaction was proportional to the inverse cube of the distance.

He next worked out the thermodynamic properties of such interacting tunneling states and found that the density of excitation energies is in fact, at low energies, a constant for each energy.

Klein has also been able to show that the constant energy density arises from the strain interactions in the solid, a property which is expected to exist for all amorphous materials.

Michael Klein's research has shed new and revealing light on a problem that has puzzled scientist for 15 years. He has found that tunneling units which interact via a strain interaction give a constant density of states.

Contributing to the understanding of many amorphous materials, Klein's work may help predict how amorphous materials will change their properties when various tunneling states are mixed with them. It's not that he couldn't care less about whether his theories contribute to applied uses of amorphous materials. "That's not the primary concern of theoretical physicists," he contends. Still, if Michael Klein's ideas continue to be verified experimentally as well as they have been so far, his work may well contribute to a more fundamental understanding of amorphous materials.

The scientific world is fascinated by his theories. In fact, much of the next year's sabbatical for Klein will take him to laboratories at the University of Illinois and to Kammerlingh Onnef Laboratories in Leiden, Holland, where scientists will try to verify his solution to a physics puzzle that has been baffling scientists for a long time.

Editor's Note: Born in Hungary, Michael Klein emigrated to the United States shortly after World War II. A survivor of the Holocaust, at the age of 13 he was taken with his parents to Auschwitz, where his mother, father, and most of his family perished. Recently, he began giving lectures on the history of the Holocaust.

It was a weekend made for photography. Except for a brief spat with a passing shower on Saturday morning, the warm, sunny days and pleasant evenings brought a sigh of relief from past years' drenching weather.

So have a look, won't you, at some highlights of Reunion—on these pages and through the Class Notes section that follows.

We kept our photographer busy that weekend—so busy, in fact, that he couldn't capture *everything* on film—events like fraternity get-togethers, the Boston Pops concert, campus and city tours, Institute Day, brunches, departmental open houses. So . . . what you see here is not quite everything alumni got at Reunion.

At Reunion Luncheon on Saturday, besides the traditional presentation of Goddard, Taylor and WPI Awards to outstanding alumni, anniversary class gifts were presented to Dr. Edmund T. Cranch representing the college. Totaling more than a half million dollars, these three gifts have been designated largely to supporting the renovation of WPI's outdoor athletic facilities, which is now nearing completion.

Class totals were: 1960 25th Reunion: $263,485.35—a record for all anniversary class gifts; 1945 40th Reunion: $103,661.14; and 1935 50th Reunion: $176,635.89—the largest 50th Reunion class gift ever. WPI is grateful for these most generous investments in the future of Institute students.

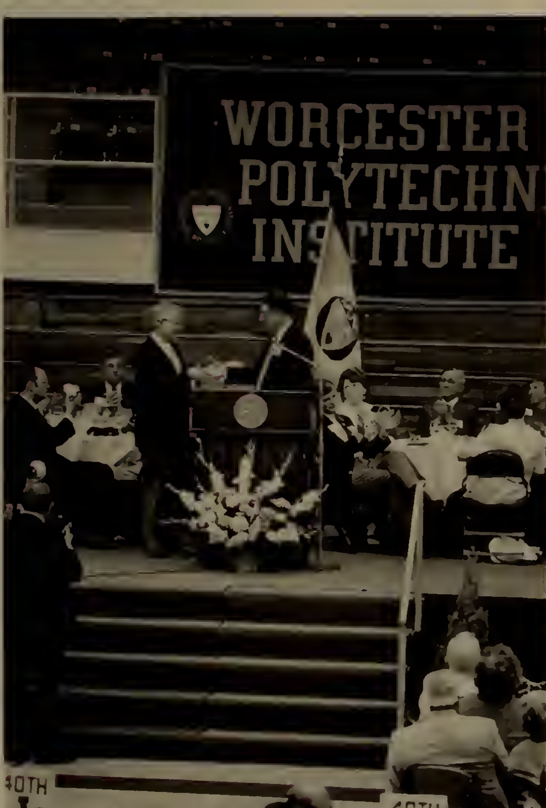
In addition, at the Luncheon Harry W. Tenney, Jr. '56 passed the gavel representing Alumni Association leadership to Paul W. Bayliss '60, who will serve as Association president for a two-year term.

And finally, Dr. Edmund T. Cranch's annual message to the Luncheon assemblage, his last as president of WPI, was greeted with a standing ovation. It was a moment neither alumni—nor, we guess, Ed and Virginia Cranch—will not soon forget, filled with the emotions of goodbye at a time in his distinguished career that marks both a conclusion and a new beginning. It was an exchange between a group and a man who have come to know and respect each other well indeed in the last seven years—a period of unprecedented development for WPI alumni relations and for the college itself.

Reunion photos by Michael Carroll unless otherwise indicated.

REUNION '85

A weekend for pictures.



Goddard Award winner Paul N. Kokulis '45 is congratulated by outgoing Alumni Association president Harry W. Tenney, Jr. '56 (above). Gordon Crowther '37 and Richard Connell '50 (right).

Calligrapher Peggy Isaacson (right) discusses a question with student Edwin Tucker '32.

This year's outstanding alumni are Alumni Association past president Harry W. Tenney, Jr. '56; WPI Award winner David F. Ploss III '70; Herbert F. Taylor Award recipient Richard B. Kennedy '65; Robert Goddard Award winner Paul A. Allaire '60; Taylor Award winner Donald E. Ross '54; Goddard Award recipient Paul N. Kokulis '45; with Dr. Edmund T. Cranch (right).

Francis Doyle

The Class of 1955's Peter Horstmann, Earl Bloom, and Hal Sauer (left).

At a packed Reunion Luncheon (center), Dr. Edmund T. Cranch receives a standing ovation. The Class of 1965 on parade (above). Clark Goodchild '40 in his 1931 Ford Model A leads the Reunion Parade (left).

WPI CLASS NOTES

1908

Sumner Davis's sense of humor hasn't dulled in a century. When he recently passed his 100th birthday he wrote, "I was born over 100 years ago. There isn't a place on earth I do not know. I played 'ring around the roses' with Peter, Paul and Moses. And I'll lick the guy who says this isn't so!"

1930

The recent killer tornado which ripped through Venice, FL, missed **Roscoe Bowers'** home by 650 feet. "There was a double funnel that struck almost at the same time. Winds reached 200 m.p.h. About 340 houses were severely damaged." A woman died when she was blown 300 feet away from her trailer. On a happier note, the Bowerses recently returned from a memorable trip to Las Vegas.

Carl Backstrom, Class Secretary

1933

Francis Doyle

REUNION '85: The Class of 1925 gathers for a group portrait (left); members of the Class of 1930 (below).

Francis Doyle

Kenneth McDonnell

REUNION '85: Class of 1940 golfers Ken Blaisdell, Fritz Johanson, Dick Messinger and Ray Forkey.

Ken Gleason reports that he is in good health except for an accident which took place in church, where he serves on the building committee. While supervising renovations, a ladder fell, hitting his head and elbow. He says stitches took care of his head, but the bone chips in his elbow still leave him somewhat incapacitated.

After many years in Brigham City, UT, where he worked for Thiokol Corporation, **Don Haskins** and his wife, El, sold their home in May and moved near their daughter Diana and family on the outskirts of Flagstaff, AZ. Don is an accomplished skier and expects to ski Utah's lofty mountains again.

In February, Madeline and **Tony Kapinos** moved from their house in Chicopee, MA, ("We'd lived there all our married life.") to a garden apartment in South Hadley, MA, the home of Madeline's alma mater, Mt. Holyoke College. They have not done much traveling lately, but the world seems to have come to their door in the form of two houseguests. One, a young woman from Poland, is an outstanding university student majoring in chemistry. The other is an electrical engineer, Gaosh Yang, the son of a college classmate of Madeline whom she has not seen since 1939.

Al Laliberte and his wife, Marian, aren't traveling much these days due to his visual impairment, but Marian did go to Albuquerque, NM, last fall to see their granddaughter, Kendra, represent the state of Wisconsin in the

Crawford Named Senior Citizen of the Month


Eugene Kennedy

Monitoring the greenhouse

Dr. Raymond Crawford '33CH can certainly spell "r-e-t-i-r-e-m-e-n-t." But you'd have a hard time believing that he knows the meaning of the word. And that's precisely why he was recently named "Senior Citizen of the Month" by the *Barre* (MA) *Gazette.*

Although Ray is most noted locally for his weekly gardening column, "One Man's Garden by A. Gardener," which appears along with his correspondent's column in the *Gazette,* he writes a gardening column called "Garden Gab" for the *Hamburg* (NY) *Sun,* as well.

On the side, he operates a 21-by-48 ft. greenhouse specializing in potted and bedding plants, grows an enviable garden, chairs the Oakham (MA) board of selectmen, serves as president of the local historical society, belongs to the North American Lily Society and the American Begonia Society, and edits the New England Regional Lily Group bulletin. Until its recent demise, he was lecturer for the Oakham Grange. He continues on the executive committee of the Rutland (MA) Grange, and is chairman of the flower committee of the Oakham Congregational Church.

"Up until last year I taught as a substitute and part-time teacher at Wachusett High School, Quabbin High and North Brookfield High," he says. His subjects included math, biology, agriculture, English and French. "I felt I'd really 'arrived' when I substituted in the girl's gym class," he quips.

During his career Ray was a research chemist for Allied Chemical in Buffalo, NY, where he also served as a group leader and senior scientist. He holds a master's degree from WPI and a PhD in organic chemistry from New York University. He and his wife, Emily, have a daughter, Janet, and three granddaughters.

Gardening is currently his chief joy. He likes to hybridize lilies. "To see something come into bloom for the first time that has never been seen before—that's special," he comments.

If Ray ever does slow down, he figures he won't get bored. "I'm a nut for buying books," he confides. "Have got enough books upstairs to keep me reading for another 30 years. At least!" With Ray's schedule ("I don't even have time to watch TV!"), the books may have to wait.

national "Miss Teen" contest. He sends this problem along to his classmates: Three boys, A, B, and C went to sell their eggs. A had 10 eggs, B had 30 eggs, and C had 50 eggs. They each sold their eggs at the same rate and received the same amount of money. How much did they sell their eggs for? (Al and his neighbor **Wes Reed** know the answer but your secretary is still working on it!)

Weldon McFarlane and his wife, Jean, own a Lincoln-Mercury dealership, a Ford truck agency, and a lease fleet of 1,200 vehicles in Vancouver, BC, Canada. During the depression, Weldon worked in a Chrysler dealership in Nova Scotia. In 1937, he joined Ford Canada and after 20 years and four transfers he found himself in Vancouver, where he and Jean decided to start a family dealership.

Instead of golfing on a recent trip to Montgomery, AL, with his wife, Elizabeth, **Al Parker** caught up on some computer magazine articles and tried to find some "hackers" in the area to visit with. For two years he's owned an IBM-PC and enjoys the challenge of writing programs for it. Al and Elizabeth each have three children and a total of ten grandchildren, which provides a real incentive to visit them in five states in the North, South, and Midwest. Every two years, they take a trip to Portugal.

Wesley Reed highlighted the Ladies Day meeting of the Tech Old-Timers in May. His main hobby is collecting and repairing antique musical instruments. His presentation, "Music from the Attic," proved popular. He displayed and played several of the 250 instruments in his possession.

Franklin Roberts reports a visit with **Harry Clarke** and his wife, Helen, who live in Deltona, FL, in a lovely home on a lake. Besides a screened-in pool, there is a lawn which is well kept "thanks to Harry's ride-on mower." Before retiring, Harry worked for Raytheon and Hughes and had some of the computer responsibilities for the Apollo lunar project at Cape Canaveral.

Last November, **Jack Shabeck** and his wife, Elaine, left Florida for a 70-trailer caravan, six-week, 9,000-mile trip through Mexico and return. They visited, among other places, Mexico City, Guadaljara, Puerto Vallaarta, and San Carlos, exiting in Douglas, AZ. The Shabecks said the scenery was spectacular and the people friendly, but the roads were "absolutely terrible, narrow, with large potholes and no shoulders." Their summer address is Wayland, MA, but winters they are at Travelers Rest, Johnstone Rd., Dade City, FL 33325. Jack says they would welcome classmates, trailers and all!

Carl Silverberg and wife Mabel recently returned from a ten-week trailer holiday from their home in Sturbridge, MA, to San Diego, Los Angeles and San Francisco, CA, and other points west. Carl wasn't able to attend our 50th reunion, as he was recovering from surgery, but we expect he'll be at our next one after hearing good reports from **Al Laliberte** and **Bud Jackson**.

Bertha and **Charlie Smith** spend their winters at Deerfield Beach, FL, but return to Westbrook, CT, summers where they are closer to their children and their families. They recently went on a trip to Alaska with a Shriners group.

Al Brownlee, Class Secretary

1935

Robert Cape, formerly on the "lost classmate" list, is temporarily residing in Vista, CA.

Maurie Day, a longtime employee of the Bureau of Reclamation, whose civil engineering career took him around the world (Panama, Hawaii, Saigon) retired and worked as a consultant starting in 1970. In 1974 he consulted in Lebanon just before civil war broke out. From 1962 to 1981, he taught piano, organ and flute. He enjoys language as a hobby and has translated many technical articles in Russian, French and Spanish. He also has studied Japanese.

Sam Ehrlich is no longer in the furniture manufacturing business with his son, Richard. In 1979 a fire destroyed their firm, Metro Manufacturing Corporation. They tried starting up again, but the 1981 recession caused them to close. When Richard recently tried once more, Sam decided to "take a back seat so I can allow enough time for 18 holes of golf daily." He's taking dancing lessons.

From **Sam Hakam** comes a 44-page "Saga" starting with the war years. A merchant seaman, his ship was torpedoed enroute with cargo for Africa and had to be abandoned. Later he was on a ship taking high explosives to Murmansk. Prior to active duty with the Army, he went on one more voyage, this time to Iceland. He liked the Army, but was enticed back into the Merchant Marine, where he technically became a war correspondent.

Herb Hoffman retired from General Electric in 1978 following 42 years of service. Early on he became a gear design specialist at GE's Lynn (MA) plant. His most novel gear unit was a step-up model for the 30,000 HP-12,000 RPM top speed test stand at Wright Field used for testing propellors. In the 1950s, he was in charge of the advance design section for turbine generator sets for Navy and Marine service at GE's Fitchburg (MA) plant. During his career GE took out patents on 20 of his designs.

George Mitchell has been living in Fort Myers, FL, for ten years. Another "lost classmate" heard from.

Roland Nims, a member of the Steering Committee, was sufficiently recovered from his operation (ruptured aortal aneurysm) to attend the committee meeting at WPI in September.

Homer Morrison, Class Secretary

1937

Bob Powers, former secretary of the New York Board of Fire Underwriters and charter member of the New York Chapter of the Society of Fire Protection Engineers, received the Manhattan College Fire Engineering Institute Award for Outstanding Contribution to Fire Engineering at the Second Annual Fire Engineering Conference held at the college last year.

1940

Noel Maleady writes that he's been "essentially retired since 1973." He has traveled widely throughout the U.S. and has been on Caribbean cruises eight times and to Europe six times. His favorite city is Vienna. He and his wife, now deceased, were in Rome in the Pope's audience in 1981 when the assassination attempt was made. "A startling experience." Noel, who has four surviving children and seven grandchildren, has served as his church organist and choir director for more than 30 years.

1941

Sidney Clark has attained life membership in the ASCE and AWS.

Dr. **Charles Smith,** professor of mechanical engineering at Rose-Hulman Institute of Technology, Terre Haute, IN, has been named to a six-year term as a member of the Accreditation Board for Engineering and Technology, which evaluates the quality of engineering programs at colleges and universities nationwide. Recommended for the post by the Design Education Committee of the Design Engineering Division of the ASME, Smith was one of 20 engineering faculty selected from more than 100 nominated. He has been honored nationally for his contributions during a 39-year career in the field of engineering education and is a frequent lecturer at conferences in the U.S. and Europe.

1942

Boyd Abbott, Jr., has retired as manager of plant engineering for Armstrong World Industries' research and development organization. He had been with Armstrong more than 39 years, having spent his entire career in R&D. In 1946 he joined the firm as a physicist. In 1950 he became chief of the engineering section, and in 1951 he was named plant engineer. He has managed plant engineering facilities for R&D for 34 years.

1946

Albert Rawdon, Jr., formerly vice president of engineering for Leighton Industries, Phoenixville, PA, is now a staff consultant for Riley Stoker in Worcester.

Manuel Renasco writes that he is fully retired and annually spending five months in Little Compton, RI, and seven months in Jupiter, FL. He had been a partner in the consulting engineering firm of Renasco Associates in Little Compton.

1949

Henry Ezen has retired from Polaroid after 16 years as a principal engineer. Besides doing home maintenance, he skiis in the Alps, bikes and hikes.

Prof. **Mack Prince** retired in June after teaching electrical engineering at the University of Rhode Island for 30 years.

John Walsh, commander of the police juvenile division (Worcester), was recently promoted to deputy police chief for the city. After studying at WPI, he enlisted in the U.S. Navy. He was appointed to the Worcester police force in 1953 and became a sergeant in 1963, a lieutenant in 1967 and a captain in 1975.

1950

Philip Nyquist is now a consultant on industrial safety with the Ministry of Interior at Riyadh, Saudi Arabia. Recently, he presented a paper on Industrial Safety Training at a symposium on safety held at King Saud University in Riyadh.

1951

G. Albert Anderson, former vice president of Collier-Keyworth Company, Gardner, MA, has been named a consultant to the firm and will be self-employed. He was one of the mainstays of Collier-Keyworth during the formative and growth years of its office chair mechanism and base business. His efforts spanned a wide spectrum of activities including management affairs, manufacturing, product development and customer relations. He is a former chairman of the WPI Alumni Fund Board. In 1982 he received the Herbert F. Taylor Award in recognition of his outstanding service to WPI.

In September, **Richard Brow** will retire from Westinghouse Defense Center in Baltimore, MD.

1952

Raymond Bartlett, Jr., serves as manager of quality and process control at Sandvik Inc., Scranton, PA.

Dick Bennett has been named manager of

Francis Doyle

REUNION '85: The Class of 1930 (left) poses for their Reunion portrait; families from the Class of 1935, attending their 50-year reunion.

the Richardson-Greenshields Securities office in Florida. He writes, "It's great here on the banks of the Loxahatchee River and the Jupiter Inlet."

Charles Thrower is western regional sales manager for Ingersoll-Rand in Walnut Creek, CA.

1953

Raymond Peterson holds the position of technical director at American Shoe Machinery Corporation, Woburn, MA.

George Saltus is now vice president and treasurer of C/S Consultants in Boulder, CO.

1954

David Gilbert serves as plant manager in the chemicals and pigments department of Du Pont in Edge Moor, DE.

Gordon Walters is now associated with A.D. Tech, Advanced Dielectric Technologies Inc., Middleboro, MA.

1956

Ray Lussier was first in the senior division of the *Worcester Telegram & Gazette* 10-mile road race held in Worcester on Mother's Day. Nearly 1,000 runners participated. Ray is a manager of the Boston office of Sprague Electric.

John Taylor applies artificial intelligence to flight deck design evaluation at Boeing Airplane Co., Seattle, WA.

John Wake is now general manager of Warner & Swasey, Worcester.

1958

Donald Hayward has been named manager of West Penn Power Company's Loyalhanna Division in Latrobe, PA. He is responsible for company operations in Latrobe, Ligonier, Derry and surrounding areas. He joined West Penn in 1958, then had two years of military service. Later, he held planning posts for the firm and was promoted to supervisor of engineering in the Lincoln Division in 1971. An elder of the local United Church of Christ, Hayward also serves as treasurer of the Kiwanis Club and the Boy Scout troop.

James Johnson has been advanced to assistant comptroller of New Jersey Bell. Previously, he served as division manager of security. In 1958 he started with the company as an assistant engineer and has since held various posts, including district plant manager, general personnel supervisor and division manager of buildings and motor vehicles.

Raymond Johnson was recently appointed to sales manager of the Killeen Machine Tool Company of Worcester. His background includes posts as vice president of sales and president of the former Johnson-Claflin Corp., Marlboro, MA, a metal-stamping company founded by his grandfather and father.

1959

Joe Bronzino, professor of applied science at Trinity College, Hartford, CT, has been elected president of the Engineers in Medicine and Biology Society. The 10,000-member society is a national organization of engineers who apply technology to biology and medicine in such ways as developing new instrumentation and finding clinical applications for new technology. Since 1969, Joe has been director of a graduate program in biomedical engineering jointly sponsored by Trinity and the Hartford Graduate Center.

1960

In January, **Jay Alpern** retired from the Central Intelligence Agency after 24 years of service. During his career, he received a number of awards (some with stipends), including the Certificate of Distinction for Courageous Performance, the Intelligence Medal of Merit, an Exceptional Accomplishment Award and Meritorious Officer Award. This year he received the Distinguished Intelligence Medal, the highest honor of the U.S. intelligence community. Upon retirement, he became a co-founder and vice president of Zeta Associates Inc., an engineering consulting firm.

Douglas Bryant has been named president of Foseco Inc., a Cleveland-based manufacturer of chemicals for the steel and foundry industries. He has also been named a regional chairman of Foseco International Limited, with responsibility for Foseco companies operating in the U.S., Canada and Mexico. He joined the firm in 1971 as sales director of the foundry division. Since then, he has headed the foundry division and has served as resident director of company operations in Mexico and Canada. Before joining Foseco, Bryant managed the catalyst/absorbent division of Norton Co. He has a bachelor's degree and a PhD from WPI.

1961

Thomas Heefner has been promoted from assistant manager of Norelco Service Inc., in Washington, DC, to manager of the branch in Houston, TX.

1962

David Cohen has been promoted to professor in the mathematics department at Smith College, Northampton, MA. With the Smith faculty since 1974, he received his MS and PhD from the University of New Hampshire, where he had served as an instructor.

Bernard Dowd has been appointed director of plant operations and services at Western Massachusetts Hospital, Westfield, MA. With 20 years of experience in plant operations of hospitals, previously he was an administrative engineer and risk manager at Worcester's Hahnemann Hospital. Earlier, for ten years he was with Lawrence Memorial Hospital, Medford, MA.

Dr. **H. V. S. Rao,** principal of the National Institute of Engineering in Mysore, India, was awarded an honorary doctor of engineering degree by the City University of Los Angeles in December. While in the U.S. for the conferral ceremony, he visited Worcester and took a tour of the WPI campus.

Stephen Winer has been appointed business director of the Performance Chemicals Products Group of J. T. Baker Chemical, Phillipsburg, NJ. Since joining the firm in 1977, he has served as product manager of fine and industrial chemicals, marketing manager of process chemicals and market development manager. He has an SM in industrial management from MIT's Sloan School.

1963

Charles Beck is now an analytical chemist at GTE Laboratories Inc., Waltham, MA.

REUNION '85: At the Center for Holographic Studies, ME Professor Ryszard Pryputniewics (kneeling) explains research; at right, Ron Pokraka and Zim Zimmie, both '60.

Ed Kalinowski has been elected president of the Roanoke (VA) Valley Science Museum Board of Trustees. He has served on the board since 1978 as chairman of the long-range planning committee and administrative guidelines committee, as well as a member of the executive committee and finance and audit committee. Still director of industrial relations and engineering at Eli Lilly's Roanoke plant, Ed also continues to serve as a member of the board of trustees of the local Mill Mountain Zoo.

1964

Dr. Mason Somerville, dean of the College of Engineering at Texas Tech University, spoke on the topic of SMART-Lab, a research and development project related to the high tech industry, at the 1985 Venture Capital Seminar held in March in Lubbock, TX. The seminar dealt with ideas for economic development of the Lubbock area. Dr. Somerville went to Texas Tech last summer after having served as chairman of the department of mechanical engineering at the University of Arkansas.

1965

James Hammett, Jr., writes, "Having a great time running the Entre Computer Center in Timonium, MD."

Robert Stow was recently named director of C3I systems at Kearfott Division of the Singer Co. In 1967 he started with the firm as a project engineer. Prior to his promotion he was manager of C3I systems. A member of the AIAA and the National Security Association, he holds a master's degree from MIT.

1966

Philip Hopkinson has been promoted to manager of large transformer engineering for GE's large transformer operation in Pittsfield, MA. He had been manager of engineering for the specialty transformer business department since 1978. In his new post he will be responsible for large transformer product design and development engineering, engineering documentation activities and the materials and high-voltage laboratories. Originally he was with GE's small motor and generator department in Schenectady where he was an engineering trainee. Later he served in Pittsfield and in the distribution transformer plant in Hickory, NC. He holds a master's in system science from the Polytechinic Institute of Brooklyn.

Albert LaPrade received the Portsmouth (NH) Naval Shipyard Engineer of the Year Award during observance of National Engineers' Week. A mechanical engineer in the waterfront facilities design section of the Production Engineering Department, LaPrade was selected by a panel of fellow engineers based on his "professional achievement in design and development of unique facilities." During the past year he designed facilities for the application of special hull treatment for the upcoming overhaul. He also designed an in-dock steaming facility to accommodate the process. A professional engineer, he was cited for being responsible for "significant improvements in schedule adherence of nuclear submarine overhauls."

Rosborg Incorporated of Newtown, CT, has promoted **Earle "Skip" Sims** to vice president of operations. He joined the firm in 1983 as vice president of marketing. Previously, he had been employed by the Farrel Company of Ansonia, CT, as manager of roll grinder sales.

Malcolm White, no longer at Polaroid, is now director of manufacturing at IMI, Inc., Andover, MA, a fast-turnaround manufacturer of prototype printed circuit boards.

1967

BORN: to Dr. and Mrs. **Steve Luber** twin daughters, Sarah Nichole and Kristin Elizabeth, on October 27, 1984. Steve continues practicing pediatrics at the Mollie Scott Clinic in Sun Valley, ID, where he is a city councilman.

Linda and **James Shea,** proprietors of Rotary Antiques in Hudson, MA, spoke on the topic, "Antiques—Fun or Profit?" at the February meeting of the Hudson Historical Society. Shea, who holds an MBA from Clark and who until a few years ago pursued an electrical engineering career with Raytheon in Burlington, MA, now devotes full time, along with his wife, to their special interest in antiques.

1968

BORN: to Ellen and **George Landauer** their third son, Glenn Harris, on August 8, 1984. Last February, George's company, GDC Medical Electronics, was acquired by TRW Inc., becoming part of TRW's Customer Service Division. GDC is a New York-based firm that

A Big Step Forward in Feet

The "Seattle Foot"

In the near future someone wearing a prosthetic foot may well win a marathon, that is if he or she is wearing the "Seattle Foot," which recently won a National Endowment for the Arts Presidential Design Award.

Don Poggi ME '51 and his team of designers, engineers and craftsman at Model & Instrument Works Inc. (MIWI), Seattle, WA, came up with the final design of the foot, which a skeptical bilateral amputee tested, then testified for it at Congressional hearings for the Veteran's Administration.

Poggi reports, "The fellow even challenged members of Congress to race him around the block while wearing the foot!"

The Seattle Foot is not only something different, it is literally something else. First off, there's nothing mechanical about it. Inside the foot is a specially designed keel that works like a cantilever spring. When the foot is flat, the keel compresses, bending up at the toe. As the foot continues moving, the keel extends, releasing energy. Such a forward and upward thrusting movement is critical in walking or running.

Made of microcellular polyurethane foam, similar to a dashboard or running-shoe soles, the interior keel is made of thermo-plastic. The load is distributed by a toe pad.

"The whole thing works like a leaf spring in a car," explains Poggi.

Not only does the Seattle Foot work well, it looks terrific—almost like a real one. A woman patient was delighted that she could at last wear sandals, and a veteran patient told Poggi, "My wife thinks my feet look great!"

When approached by Dr. Ernest Burgess (M.D.) and his Prosthetics Research Study (PRS) with a request for a prosthetic foot for sports-minded amputees, Don Poggi and his wife, Shirley, president of MIWI, and their engineers found themselves "in the right place at the right time." The Boeing Co. (Poggi's full-time employer), with VA rehabilitation research-and-development funding from PRS had done some work on a more flexible foot, but there were problems. PRS and MIWI found each other and the first artificial foot to make use of kinetic energy was born.

Last January during ceremonies at the White House, President Reagan handed Don Poggi '51 and Dr. Margaret Giannini, director of R&D for the Veterans Administration, one of the first of thirteen Presidential Awards for Design Excellence. The "Seattle Foot" was cited as a prosthetic that rivals the original.

provides maintenance and repair services to users of biomedical technology. George continues as an officer of the company. . . . Mr. and Mrs. **Scott Wilson** their second child, Thomas Scott, on March 11, 1984. Scott is now chief of the technical design section at McGuire AFB, NJ. "I'm replacing **Ed Dion '49,** who's retiring."

David Gumbley serves as supervisor of maintenance for Texaco Refining & Marketing in Bellaire, TX.

Joseph Hilyard has been promoted to manager of planning and evaluation at the Gas Research Institute in Chicago.

Jack McCabe was recently appointed chief financial officer of Automated Assemblies Corp., Clinton, MA. Prior to his appointment, he had been executive vice president and treasurer of Carl Gordon Industries, Worcester. A member of the Worcester Industrial Development Finance Authority, Jack holds an MBA from Clark University. He is a former president of the WPI Alumni Association.

Dr. **Michael Paige** has assumed the post of vice president for engineering at the Gerber Scientific Instrument Co., South Windsor, CT, a major producer of CAD-CAM systems. Michael and his family reside in Glastonbury, CT.

1969

Anthony Bergantino is now sales manager at Bedford Real Estate, Bedford, MA. He writes, "I've just made a major career change by taking over a real estate firm which specializes in property in the Bedford, Lexington and Concord, MA, area."

Joel Cehn, radiation protection advisor for the Pacific Gas & Electric Company (PG&E) in San Francisco, was the author of "Temporary Radiation Workers: Who, Where, What, and How?," which appeared in the January issue of *Radiation Protection Management*. He joined PG&E in 1980 after having been employed at Pilgrim Nuclear Power Station in Plymouth, MA, and at Teknekron Research Inc., in Washington, DC. In 1982, he suggested a study of temporary radiation workers to the National Environmental Studies Project and later chaired the industry task force that managed the study. The holder of an MS in nuclear engineering from North Carolina State University, he is certified by the American Board of Health Physicists, is active in the Health Physics Society, and serves as a director of the California Radioactive Materials Management Forum.

Peter Nott continues as a clinical engineer for Hospital Services Inc., Concord, NH.

Kimball Watson works as an advisory engineer for IBM in Burlington, VT.

1970

Reunion September 28, 1985

Herbert Coulter has been named general manager of the silicone manufacturing department at GE's silicone products division in Waterford, NY. In 1976, he joined GE as a project engineer, progressing through a series of manufacturing and engineering management posts. Most recently, he was manager of manufacturing for the room temperature vulcanizing products department.

Francis Doyle

REUNION '85: The 35th Reunion class on their way to lunch (left); Evelyn and Warren Fitzer '45 (below left); Clark Goodchild '40 with Management Professor Helen Vassallo '82 MBS, a featured speaker at the first annual Institute Day (below right).

Jim Cronin was recently named the consortium project engineer for B&W International in Jakarta, Indonesia. He and his wife, Kathy, have three children: Kristen, 9, Paul, 2, and Scott, 1.

Paul Himottu, who was married last year to Carolyn Blinn of Holden, MA, is a production planner for hybrid systems. Currently, he works for Telex in the product support department.

1971

MARRIED: Robert Mills, Jr., and Angela Leary in Framingham, MA, on December 29, 1984. A graduate of Clinton High School, she is a legal assistant at State Mutual in Worcester, where Mills is an actuary. He has a master's degree from Northeastern. . . . **Robert Wright** to Marie LaFrancis in Agawam, MA. She graduated from Becker and Westfield State College and plans to attend graduate school. He has an MSEE from RPI and is employed at Narragansett Electric Co., Providence, RI.

BORN: to Mr. and Mrs. **Francis Scricco** their first child, Alexandra Marie, on February 28, 1985. Scricco writes that he is continually challenged as general manager of GE's Commercial Electronics Products Department in Portsmouth, VA.

Bruce Bosserman serves as operations engineer at Yemen Hunt Oil Co., Dallas, TX.

Norman Johnson serves as program manager for GE in Pittsfield, MA.

Michael Latka has been named deputy director of the Worcester city manager's Office of Planning and Community Development (OPCD). Since 1981, he has served as OPCD contract and financial management coordinator. Previously, he was contract management coordinator. In 1975 he joined the office as financial management staff assistant. He holds an MBA from Western New England College.

Gerald Parrott continues with Rock of Ages Corp. in Barre, VT.

1972

Pat Lafayette serves as vice president and treasurer of Cummings & Lafayette, an engineering consulting firm he co-founded in Norwich, CT, in June 1984. The company is concerned with road, drainage and utilities design, as well as site development, water and wastewater, structural analysis and construction management.

David LeBlanc was recently promoted to distributor sales manager for Phalo Corporation's telecommunication cable division in Westboro, MA. He is now responsible for nationwide sales of the firm's line of telephone and high-temperature data cables through distri-

Hallock (center) receives Rockwell's "Engineer of the Year" award

David B. Hallock: "Engineer of the Year"

David Hallock '53EE has been named "Engineer of the Year," the highest honor for engineering achievement awarded by Rockwell International Corporation. A design engineer for Rockwell's Collins Defense Communication organization in Cedar Rapids, IA. Hallock was one of 14 selected for the award among the company's 17,000 engineers and scientists.

At ceremonies held in Los Angeles in February, in conjunction with National Engineers' Week, Hallock was cited for distinguished and sustained contributions toward the design of state-of-the-art military communications receivers in the HF through UHF frequency bands.

Born in Chicago and the holder of four patents, Hallock earned his B.S. and M.S. from WPI in 1953 and 1954 respectively. He joined Collins Radio Company in 1954, taking time out for a stint with the U.S. Navy in 1955. Earlier he had been a graduate assistant at WPI and a transmitter engineer at WAAB Inc., Worcester. He has served as a class agent for the WPI Alumni Fund.

Currently a ham radio hobbyist and a member of the American Radio Relay League, Hallock is also active in church work and Boy Scouting. He enjoys gardening at his five-acre homesite and taking occasional family camping trips to the Rockies. He and his wife, Karen, who celebrated their 25th anniversary with a trip to Hawaii, are the parents of two daughters, Susan and Gail, and two sons, Alan and Eric.

Before becoming associated with Rockwell International, Hallock had been a group head and design engineer for Collins Radio Co. Cedar Rapids, prior to its merger with Rockwell. Rockwell is a multi-industry company applying advanced technology to a wide range of products in its aerospace electronics, automotive and general industries businesses.

bution. Previously, he served as eastern regional sales manager.

Jack Zorabedian, formerly with Digital Equipment Corp., has joined ATEX Inc., Bedford, MA.

1973

BORN: to Pat and **John Barry** their first son, Matthew Thomas, on November 11, 1984. . . . Bonnie and **Chris Broders** a son, Adam Christopher, on June 5, 1984. . . . Rhonda and **Ray Cherenzia** a son, Damon Louis, on April 26, 1985. . . . Arlene and **Gene Franke** their second child, Ryan Scott, on March 26, 1985. . . . Cheryl and **Steve Martin**, a son, Eric Michael, on March 1, 1985. Eric joins his brother Benjamin, who is now 2½. Steve, who has just completed his ophthalmology residency at the University of Rochester Strong Memorial Hospital, began a retina-vitreous fellowship in Atlanta, GA, in July.

Marsha Maxwell has been appointed manager in charge of business information services for the Foxboro (MA) Company. She will administer ongoing support for computer services required throughout the company. With Foxboro since 1971, previously she was systems consultant for customer services in the sales division. She holds an MS from WPI and a BS from the University of Rhode Island.

1974

BORN: to Karen and **Bill McBride** a daughter, Megan Kathleen, on September 16, 1984. Bill is now the electrical engineering manager for PRICE/CIRI in Alaska. Besides being a professional electrical engineer, Bill is also an electrical administrator for inside wiring and communications in Alaska (contractor's license). He continues to consult for Northern Energy Research and Development.

Gerald Buzanoski has been named as a senior project manager for the engineering and land surveying firm of Schofield Brothers Inc., Framingham, MA. He is responsible for the design and management of environmental engineering, commercial and residential development projects. Formerly assistant director of public works in Framingham, Buzanoski has an MSCE from the University of Connecticut.

George Cho is now manager of clinical research for Kontron Inc., Everett, MA. Formerly, he was a senior technical specialist at the University of Massachusetts Medical School, Worcester.

Jay Thayer continues as an assistant project manager with Yankee Atomic Electric Co. of Framingham, MA. He is a former president of the Westboro (MA) Jaycees. The Thayers have two sons, Benjamin and Andrew.

Travenol Laboratories Inc., of Deerfield, IL, has appointed **Lee Turner** as director of technical resource planning. With the firm for more than two years, previously he was manager of cost planning and development. He has an MBA from Amos Tuck School, Dartmouth College.

1975

Reunion September 28, 1985

Bruce Altobelli and his wife, Jean, are the parents of a son, three-year-old Jason. Bruce is production engineering manager for Nashua Corporation, which makes memory disks for computers. He enjoys working on his house and playing softball and racquetball.

Joel Angelico, who works for Polaroid, holds an additional job collecting tickets at Sullivan Stadium for Patriots games and special events. The Angelicos have a two-year-old daughter, Laura Frances.

Cliff Ashton serves as a senior engineer for Northeast Utilities. He owns a three-family house in New Britain, CT. During the summer, he races his sailboat on Long Island Sound. He also likes to ski and play tennis and softball.

Bob Bradley, a senior product manager with DEC, has been with the firm for seven years. He and his wife, Cherie, enjoy camping in Maine. Bob is working for his MS in computer science at WPI.

Mark Candello works for Frederick A. Farrar Inc., an electrical engineering consulting firm in Keene, NH. The Candellos have a four-year-old son, Nick.

Anne McPartland Dodd and her husband, **Charlie Dodd '74**, moved to Maine last Sep-

REUNION '85: Class of 1940 families (above); "How have you been?"; tennis players Pete Horstmann '55 and Bill Firla '60.

tember. They have two daughters, Emily, 3, and Laura, 1.

Michael Dudas holds the post of vice president of Electrodes Inc. He also serves as bulletin editor and treasurer of the New Haven (CT) Society of Manufacturing Engineers. Michael and his wife have two sons.

Randy Haagens is currently an engineering project manager at the Roseville (CA) Networks Division of Hewlett-Packard Co. (HP) near Sacramento. He joined HP in Cupertino, CA, in 1978 after receiving his MSEE from MIT. The Haagens have two daughters, Rebecca, 3, and Dara, 2.

Bruce Hutton, who has been with Data General since 1976, is now senior manufacturing engineer. The Huttons have two children. For the past three years, Bruce has been working on their house in Hudson, MA.

Fran Kiernan has completed his training as a cardiologist and is now at Hartford Hospital working on the special procedures of cardiac catheterization and angiography.

Gary Kiontke, who has completed two marathons, is active with the Southern Congregational Church in Springfield, MA. He is a volunteer on the WPI Admissions Committee.

Bob Martin is director of customer marketing for a new company, Banyan Systems, which makes communications products for connecting personal computers, work stations and mainframe computers. The Martins are the parents of two daughters.

Tom McGowan, who has been with DEC for three years, is taking a graduate course at WPI.

Beth Pennington, a self-employed management consultant (computer installations), received her MBA from Emory University in Atlanta last year. Beth recently soloed for her private pilot's license. She is married to Birge Sigety.

Dick Perreault continues in sales for Hewlett-Packard. He plays softball and tennis. The Perreaults have two daughters, Maressa Anne, and Jenna Marie.

Ed Pietraszkiewicz has recently been on assignment for Pratt-Whitney as a job shopper. He and his wife, Anna, reside in Palm Beach Gardens, FL, and "just stay out in the sun."

Jean Reny Runge works for Upjohn Pharmaceuticals in Kalamazoo, MI. Last fall, she and her husband vacationed in Southern Germany, Switzerland and France.

Capt. **Douglas Sargent** has completed a year at Thule AFB, Greenland, and is presently assigned to headquarters, U.S. Air Forces, Europe, where he is responsible for the design and construction management of operations and maintenance projects throughout Europe.

Bob Simon, with Allied Chemical Corporation for seven years, now serves as market development manager. He works on the development of new products from research commercialization. He and his wife, Debbie, have two children.

Walter Skiba is now plant metallurgist for United Tech Diesel Systems, Springfield, MA.

Jim Sweeney continues with the family business, Playland Arcade, in Buzzards Bay. He and his wife have purchased a 150-year-old house in Rochester, MA. Jim likes to play softball, golf, hockey and volleyball.

Paul Varadian and his wife, Vartus, are Bostonians. Paul holds the post of president of Trans-Continental Development Corporation, which deals in real estate development in the U.S. Also, he owns Chiaro Trading Company Ltd., which acts as broker and matches American and foreign companies for business ventures.

John Watkins has been flying an experimental airplane which he built.

Last year, **Dave White** was named a vice president of R. H. White Construction Co., which is constructing a $20 million condominium project in Northbridge, MA. His responsibilities include marketing, new ventures, engineering and estimating. The Whites have two daughters.

Recently, **Jeff Wnek** was promoted to plant manager of Lilly Industrial Coatings in Templeton, MA. He has been working on his MBA at WPI.

Pat Flaherty, Class President

1976

MARRIED: Lance Sunderlin and Melinda Ashley on March 10, 1985, in Tarboro, NC. She graduated from Kansas State University and is with Hardee's Food Systems. He serves as a technical-quality assurance manager for Ericsson Inc. Tarboro.

BORN: to Susan and **John Fairbanks** a son, James Earl, last May.

Catherine Hogsett holds the post of Navy contract administrator at GE in Fitchburg, MA.

Thomas McAloon, who was married to Beverly Slater last year, is now chief engineer at Pennichuck Water Works in Nashua, NH.

1977

MARRIED: Edward Acciardi to Jayne Thyden in Worcester on March 9, 1985. She attended Becker and is a legal secretary at Fletcher, Tilton and Whipple. He serves as a senior design engineer at Data General Corp., Westboro, MA. . . . **Adolfo Chandeck** and Luz Gomez of West Lawn, PA, on January 24, 1985. Luz holds a BS in elementary education from Penn State University. Adolfo, who is with IBM UK Ltd., is currently working on the design and implementation of a national electronic funds transfer network for the United Kingdom. He is located in Portsmouth, England.

BORN: to **Brian** and **Tina Perry Buckley** their second daughter, Meghan Chase, on February 10, 1985. Brian is the chief test engineer of the *U.S.S. Simon Bolivar* currently undergoing overhaul at the Portsmouth (NH) Naval Shipyard. Tina was formerly employed by the Kimball Chase Company in Portsmouth.

Steven Fine has a new post as a research scientist with Poly Solar Inc., a small semiconductor solar cell research company in Garland, TX.

Robert Hurd has received his professional engineer license for the State of Virginia.

John Osowski recently took and passed the "Principles and Practice of Engineering" exam in Illinois and says he is "finally a professional engineer."

1978

MARRIED: Richard Egerton, Jr., to Deborah Cota in Warwick, RI, on February 9, 1985. A teacher at Bradley Hospital, Deborah has a BS from Rhode Island College and received a master's degree in special education from RIC in June. Richard is studying for his master's at URI. He is a product manager at Taco Inc., Cranston, RI. . . . **Walter Teal, Jr.,** and Shelley Grenier recently in Leominster, MA. A rental manager for Glick Management Corp. in Virginia Beach, VA, Shelley graduated from Assumption College. Teal, who attended the College of William and Mary prior to graduating from WPI, serves as a chemical engineer for the U.S. Navy Department at Yorktown, VA.

BORN: to **Leonard** and **Liz Papandrea**

Competing at the Edge

They don't care much for cameras in Silicon Valley.

Security is tight at the dozens of high-tech companies that line the freeways near Santa Clara, CA., Silicon Valley's ground zero. Visitors don't get far without an escort and a special pass. Signs warn of dire penalties for trespassers, especially those with cameras.

"Each company is only as good as the edge it has over the competition," explains Robert M. Malbon '63, head of semiconductor research and development for Avantek, a microwave telecommunications company.

A physics major at WPI, after graduation Malbon headed west to Stanford University. He earned a master's in physics and a Ph.D. in electrical engineering, then went to work for Hughes Aircraft in Los Angeles.

In 1971, he and his wife, Virginia, joined the Peace Corps and went to Chile for two years. While Malbon was teaching electrical engineering at the University of Valparaiso, Chilean president Salvador Allende was being overthrown in a bloody coup that many believe was led by the CIA.

"The media really misrepresented what life was like there at that time," says Malbon, referring to news reports and movies such as *Missing*. "There was a curfew, but no real danger. Missing the curfew just meant spending the night in jail. We never feared for our lives."

After returning from Chile, Malbon worked for Hughes for another three years. In 1977 he joined Avantek, first as manager of the materials division, then as head of research and development in the microwave semiconductor group.

—Michael Shanley

Lariviere, '76, a son, Alexander James, on February 20, 1985. Alexander joins sisters Christine, 5½, and Rebecca, 3. Leonard is a planning engineer in microwave radio path engineering for AT&T Technologies, North Andover, MA. Liz writes that she's a full-time mother. . . . **William** and **Patricia Tracy Walton** a daughter, Meredith Tracy, on December 16, 1984. Meredith has a brother, William, who is 2 years old.

Stephan Mezak is now a field applications engineer for CAE Systems, Sunnyvale, CA.

Patrick Nicholson continues as a fire protection engineer with EPM Inc., Framingham, MA.

Andrew Tannenbaum serves as a software engineer for Masscomp in Westford, MA.

1979

MARRIED: Brian Trudel to Nan Towle on January 26, 1985. Nan, who graduated from Becker, is a physical therapist. The Trudels reside in Louisville.

John Arnold is now with the Artifical Intelligence Technology Group at DEC in Hudson, MA.

Mary Farren McDonald was recently promoted to staff product assurance engineer at IBM in Poughkeepsie, NY. "My job involves a lot of travel, which I love. I go to Europe every other month!" She has completed degree requirements for an MS in industrial administration at Union College.

Dave Szkutak is currently manager of the assembly department of the Massive Optics Division of U.S. Precision Lens Inc., Cincinnati, OH. The firm manufactures plastic optics for projection televisions, as well as a variety of small optical products, including fiberoptic connectors.

Johann Thalheim of Old Greenwich, CT, writes, "Am making money buying and selling cars and boats."

1980

Reunion — September 28, 1985

MARRIED: William Jones and Karen McGann on April 13, 1985, in Agawam, MA. Karen, a graduate of Central Connecticut State College and AIC, teaches in Somers, CT. Jones, who graduated from AIC, as well as WPI, teaches in Springfield, MA. . . . **Theodore Linn** and Katheryn Helms on February 23, 1985, in Old Lyme, CT. She is an economics student at Connecticut College in New London, CT. He is a senior engineer at Electric Boat. In June he received his MSME from the Hartford Graduate Center.

BORN: to Eve and **Robert Berlo** their first child, Jacqueline, on March 26, 1985. . . . Michael and **Elaine O'Neill Yarnall** their first child, Matthew Scott, on March 3, 1985.

Robert Cummings was recently promoted to associate at FIREPRO Incorporated, Wellesley Hills, MA. He will be concerned with building design, construction projects and the reconstruction of major fire incidents. Prior to joining the company in 1982, Cummings was a systems engineer for Fenwal in Ashland, MA. An associate member of the Society of Fire Protection Engineers, he is studying for his MS in fire protection engineering at the Center for Firesafety Studies at WPI.

Michael Gardella is a senior engineer in the strategic weapon support systems area at General Dynamics Electric Boat Division. The Gardellas and their two children reside in Jewett City, CT.

Joseph LeBlanc serves as a research scientist for Union Camp Corp. in Princeton, NJ.

John Manning, who holds a PhD in environmental engineering from Notre Dame, is currently a postdoctoral fellow at Harvard.

Maryellen McLaughlin is a senior design engineer in the Microwave Systems Division at Aiken Advanced Systems.

1981

MARRIED: Cynthia Atkins and Toby Palmer on June 9, 1984. Cynthia is studying for her PhD in inorganic photochemistry at Purdue University. Toby is a chemistry postdoc . . . . **Joseph Gionfriddo** and Mary Fox of Cincinnati, OH, on September 1, 1984. Joe continues as a manager for Procter & Gamble in Mehoopany, PA. . . . **Peter Hinckley** and Barbara Duszak on April 20, 1985, in Thomaston, CT. Barbara graduated from Thomaston

Frances Doyle

REUNION '85: The Class of 1955 gathers for the traditional photograph.

High School and Central Connecticut State University. She is a department manager for G. Fox & Co., Waterbury. Peter is a product engineer for the Torrington (CT) Co. . . . **Jeffrey Smith** and **Catherine Culnane '84** on April 14, 1985. Catherine is a systems analyst for American Management Systems. Jeff is an MIS-microcomputer manager for Dresser Atlas, Houston, TX. . . . **Robert Wright** and Marie Lafrancis on February 16, 1985, in Agawam, MA. She graduated from Becker and Westfield State College and plans to attend graduate school in Rhode Island. He works for Narragansett Electric in Providence.

John Brady III serves as an electronic design engineer at Texas Instruments in Dallas.

John Preli, who completed his MBA degree at Cornell in June, plans to return to IBM in Poughkeepsie, NY, as a financial analyst.

Geoff Wadge serves as applications engineer in Union Carbide's Coatings Service Division, North Haven, CT.

1982

MARRIED: **J. Victor Benson** and Sharon Kane recently in Bethel, CT. She attends Western Connecticut State University in Danbury and is a millwright apprentice at General Motors in North Tarrytown, NY. He works for Mitchell Oil Co., Danbury. . . . **Jeffrey Gross** to Debra Schultz in Ft. Lauderdale, FL, on December 21, 1984. A systems engineer at Intel Inc., Ft. Lauderdale, FL, Debra is a graduate of Bloomsburg State College in Pennsylvania. Jeffrey is a design engineer at Racal-Milgo, Ft. Lauderdale. . . . **Maureen Seils** and Kyle Brown in Upper Red Hook, NY. Maureen is an associate programmer at IBM in Endicott, NY. Kyle attended MIT and received a BA in journalism from the University of Georgia. He serves as an associate communications specialist at IBM in Endicott.

Dan Frey serves as a senior development engineer at Honeywell Electro-optics Division in Wilmington, MA.

John Kemp has been promoted to senior foreman of assembly and package at Miniature Precision Bearings Division of MPB Corp. in Keene, NH. He joined MPB in 1983 as an engineering-management trainee and most recently was foreman of standard bearing assembly and package.

Carl Lindegren III is a sales engineer at Lindco Incorporated, Worcester.

Peter Millett has been promoted to associate engineer at Northeast Utilities (NU). He started at the company in 1984 as an assistant engineer. Currently, he is studying for his master's degree in chemical engineering at UConn.

Robert Mitchell has been named an associate of the Society of Actuaries (ASA). He is a group dental actuary with Union Mutual Life Insurance Company, Portland, ME.

Timothy Stone was recently promoted to senior systems analyst at State Mutual in Worcester.

Joel Swan works on automated test systems at RCA Government Systems Division in Burlington, MA.

Lisa Katz Wadge is employed as a consulting engineer with TRC Environmental Consultants, East Hartford, CT.

1983

MARRIED: **Timothy Horan** and Michele Raia on January 5, 1985, in Bristol, CT. Michele, an executive secretary, graduated from Becker. Tim, an industrial engineer, is a lieutenant with the U.S. Army in West Germany. . . . **Mark Millay** and Karen Landry in Athol, MA, on January 19, 1985. An accountant, Karen graduated from Nichols College, Dudley, MA. Mark is a mechanical engineer at GTE Products Corp., Westboro, MA. . . . **Mark Rossmeisl** and Laurie Farrell on Sep-

DeMeo Captures Presidential Award

When John DeMeo '68MA made a career change back in 1972, he never dreamed it would lead him to the steps of the White House. But last fall, during White House ceremonies, he received the 1984 Presidential Award for Excellence in Science and Mathematics Teaching—after first having been named the top math teacher in Connecticut.

A faculty member at Coginchaug Regional High in Durham, CT, DeMeo joined with master teachers from other states during four days of ceremonies in Washington, DC.

DeMeo's unplanned trek to the White House began in 1972. "I was an analytical engineer at Pratt & Whitney at the time," he says. "After working as an engineer for four years, I decided what I really wanted to do was to teach."

To further his goal, he earned his MSMA from RPI, took education courses at Central Connecticut College and completed his certification in educational administration at Southern Connecticut State College.

Besides teaching calculus and computer programming, DeMeo is in charge of developing the computer curriculum in District 13. Active in numerous local, state and national professional societies, he requires that students make commitments at the beginning of each new course regarding homework, attendance and responsibility for their own education.

DeMeo (right) receiving Presidential Award from Dr. George Keyworth, science advisor to President Reagan.

"Students put demands on me," he says. "Some require me to be an entertainer, some need individual help, and others work best by themselves. I'm challenged and find excitement in trying to meet their needs." As a top math teacher in Connecticut and as the recipient of a presidential teaching award, John DeMeo has ample proof that he has met those needs in superb fashion!

tember 30, 1984, in Winchester, MA. Laurie graduated from Becker with an associate degree in retail management and is manager of the Carriage Square Specialty Shop in Burlington, MA. Mark serves as a robotics design engineer in R&D at Dyna/Pert, a subsidiary of Emhart Corp., Beverly, MA.

Ray Haarstick is a communications consultant for Network Strategies, Burke, VA.

Thomas Hoblitzell works as a terminal service support analyst for United States Lines in Cranford, NJ. He has been studying for his MBA in finance at Rutgers.

Maura Mastrogiovanni is employed as a thermal engineer with DEC in Maynard, MA.

Bill McMullan serves as an electric power instrument engineer with EXXON in Baton Rouge, LA.

Scott Menard is now a project engineer with C.L. Peck, Contractor, Los Angeles, CA.

John Moore received his MSME from RPI in December. Currently, he is with IBM General Products Division in Tucson, AZ.

Mary White is an urban planner with the Peace Corps in Yemen Arab Republic, where she will be situated for two years. She was awarded a scholarship in urban planning and international development by Clark University. Her address is: American Peace Corps, c/o Yemen Desk, 806 Connecticut Ave., NW, Washington, DC, 20526.

1984

Paul Ahlijanian works as a consulting engineer at Environmental Resource Assoc. in Warwick, RI.

William Alcusky, who holds an MS from WPI, is a senior engineer at Yankee Atomic Electric, Framingham, MA.

Deborah Allen is studying for her MS in chemical engineering at WPI.

Kimberly Allen is a process engineer II at DEC, Hudson, MA.

Jeffrey Andrews is a senior sanitary engineer for the State of Massachusetts Department of Environmental Quality Engineering in Worcester. He has his MS from WPI.

Jacob Arends is a sales representative for Dictograph Security Systems in Aruba, Netherlands Antilles.

Stephen Buckley is a project engineer for the Maryland Department of Transportation in Baltimore.

Michelle Bugbee works as chemical engineer at Monsanto Polymers & Plastics in Indian Orchard, MA.

Steve Burgarella works for General Scanning Inc., Watertown, MA.

Arthur Butler is a graduate student and research assistant in the department of electrical and computer engineering at Carnegie-Mellon University, Pittsburgh.

David Capotosto holds the post of process engineer at Shape Inc., Biddeford, ME.

William Carnes, who has his MS from WPI, works for Raytheon, Sudbury, MA.

Thomas Casale is a microwave design engineer for Varian Associates in Beverly, MA.

Louis Castriotta is currently an industrial engineer-in-training at Miniature Precision Bearings, Keene, NH. He is a local Junior Midget Pop Warner football coach.

Jacqueline Courtney currently works as an industrial engineer at Pitney Bowes in Stamford, CT.

J. Steven Curran works as a service engineer for Combustion Engineering, Windsor, CT.

Greg Danti holds the post of design engineer at Harris Graphics, Dover, NH.

Sheldon Dean is a grad student in the department of chemical engineering at WPI.

Edward DeMattia is now a research engineer in gallium arsenide semiconductor development for Raytheon Company in Northboro, MA.

George Duane works for Grumman Aerospace in Bethpage, NY.

Marilyn Duncan, who has received her PhD in endocrinology from WPI, is now a research fellow studying biological rhythms at Massachusetts General Hospital, Boston. She attended the University of Delaware and received an MS from UConn.

Monica Ferullo holds the post of quality engineer at Northern Telecom in Concord, NH.

Katrina Fontes is a programmer for IBM in Endicott, NY.

John Franzini continues with the Naval Underwater Systems Center, New London, CT. He and his wife, Kate, reside in Norwich, CT.

Jon Freeman serves as a senior hardware engineer at Prime Computer, Framingham, MA. He has an MS from WPI.

Paul Goodrich is a test engineer with Teledyne Philbrick, Dedham, MA.

Dave Grace works as an R&D engineer at Varian's Extrion Division in Gloucester, MA.

Ira Gregerman holds the post of productivity management officer at State Street Bank & Trust, Boston.

Zahi Haddad, who has an MSEE from WPI, is an assistant professor at Springfield (MA) Technical Community College.

Charles Hickey serves as a process engineer for GE in Cleveland, OH.

Michael Hobson has been commissioned a second lieutenant in the U.S. Air Force following graduation from OTS Lackland AFB, TX. He is assigned to Edwards AFB, CA.

Amine Khechfe is now a graduate student in mechanical engineering in the energy division at the University of Wisconsin, Madison. Previously, he was with the Trane Co., La Crosse, WI.

Margaret Raymond, who holds an MBA from WPI, is employed as a marketing specialist at Data General, Westboro, MA. Her husband, **Richard Raymond,** also has an MBA and serves as a senior consultant at DEC in Boylston, MA.

Josh Reed has accepted the post of associate physicist with the Johns Hopkins University Applied Physics Laboratory, Laurel, MD.

Frank Reeves has been employed by Con Diesel Mobile Equipment Co.

Judith Rezendes is a reliability engineer at Polaroid Corporation, Cambridge, MA.

Douglas Rich holds the post of plant engineer at Axton Cross Industrial Chemicals, Holliston, MA.

John Riley works in technical field sales for Fluid Conditioning Equipment Inc., East Aurora, NY. He is located in Clifton Park, NY.

Marie Ellen Ristuccia works as a staff engineer for Hewlett-Packard in Andover, MA.

Elizabeth Roughan has joined Unitrode Corporation, Watertown, MA, where she serves as a process development engineer.

John Ruggles is a research assistant and graduate student at Clarkson University, Potsdam, NY.

Gregory Ryan has joined GTE Sylvania Products, Westboro, MA.

Jean Salek is employed as a process engineer by Chevron Research Co., Richmond, CA.

Ronald Salig, who has an MS in fire protection engineering from WPI, holds the post of vice president of engineering at MBS Fire Technology Inc., Grafton, MA.

Frank Sansevero works for Hamilton Standard, Windsor Locks, CT, as a mechanical design engineer.

Kevin Santry serves as a software engineer for Atex Inc., Bedford, MA.

Joseph Scafidi works for New England Wheels, Waltham, MA.

Leonard Schiavone is on the staff at Mitre Corporation, Bedford, MA.

Bill Simmons holds the post of associate engineer at General Dynamics-Electric Boat, Groton, CT.

Williams Simpson is with General Dynamics Electric Boat Division.

Andrew Smith works as a design engineer at DEC in Tewskbury, MA.

Gail Smith has joined Hamilton Standard, Windsor Locks, CT. She is an associate engineer.

Nancy Smith has accepted the position of design engineer at Harris Graphics Corporation, Dover, NH.

LCDR **Thomas Smith,** USN, who has an MSME from WPI, is currently at the Naval Submarine School in Groton, CT.

Sanggono Soebroto has been named a field engineer at Schlumberger Well Services in Indonesia.

Dean Sorensen has joined Eastern Utilities Associates.

Paul Sorrento is working for Raytheon Company.

Dan Soulia is now a design engineer with Harris Graphics in Dover, NH.

Mark Souter has joined the Air Force.

Gregg Speer is a technical associate at Emhart Corporation, Beverly, MA.

Richard Walker has been employed by Fafnir Bearing Division of Textron Inc.

Mary Ann Wall, who has her MS in computer science from WPI, holds the post of chief, systems and programs, U.S. Army Natick (MA) R&D Center.

Steven Wallet is a design engineer with Torrington Co. in Connecticut.

Mark Walz holds the post of project manager/engineer at Nuclear Metals Inc., Concord, MA.

Daniel Ward works for Eastman Kodak, Rochester, NY.

Mark Warren is employed at Raytheon, Sudbury, MA.

Brian Wasko has joined Merrill Lynch International Bank. He has an MS in chemical engineering from WPI.

Lester Waters is a software engineer working in computer development for DEC (Rainbow Group) in Littleton, MA.

Timothy Watkins is at Lehigh University.

Brian Wetzel has joined Barnhart, Johnson, Francis & Wild Co. Inc.

Chiara Whalen works for Newport News Shipbuilding.

Bryan White has been employed by Hughes Aircraft Co.

Barry Whitehouse, who has a master's degree in mathematics from WPI, has joined Pratt & Whitney.

John Whittaker serves as a test engineer at LTX Corp., Westwood, MA.

Oren Wiesler is a computer design engineer for DEC in Littleton, MA.

Paul Williams has joined Harris R. F. Communications in Rochester, NY.

Tom Wilsack is employed at Polaroid, Waltham, MA, as a process engineer.

Angela Winter is currenty employed by Hewlett-Packard, Andover, MA, as an applications engineer.

Lt. **Brian Witkowski** recently completed Officer Training School in Engineering at Fort Belvoir, VA, and is currently an executive officer with the U.S. Army at Ft. Leonard Wood, MO.

James Witt is a systems engineer at Intellution Inc., Westwood, MA.

Carlos Zuccolillo is a technical advisor for La Perseverancia S.A. in Asuncion, Paraguay.

School of Industrial Management

Joseph Federici '72 has been elected to the 1985 DPMA Executive Council. He serves as vice president of Region 14 for the Data Processing Management Association (DPMA). The customer service manager at Bay State Abrasives Division of Dresser Industries in Westboro, MA, Federici also holds the posts of data processing manager, telecommunications manager and security officer. He has been with the firm for 30 years. He was a charter member of the Worcester chapter of DPMA and was president for two terms. A member of the Westboro (MA) Chamber of Commerce and treasurer for the Westboro Athletic Boosters Association, he was selected the 1983 "Booster of the Year."

Roy Moffa '77 has been named director of program management, a new post at Apollo Computer Inc., Chelmsford, MA. Previously, he was chief executive officer of Pixel Computer in Wilmington. From 1969 to 1983 he worked in engineering and marketing for DEC. He has a BSEE from Spring Garden College in Philadelphia.

COMPLETED CAREERS

Arthur B. Bronwell, WPI's ninth president, died May 10, 1985, in Willimantic, CT, at the age of 75. He had served at WPI from 1955 to 1962.

During his tenure as president at WPI, enrollment grew from about 800 to well over 1,200 students and the graduate and evening program expanded substantially. Also, a development program was instituted in which $5 million was raised in a five-year period.

When he resigned in 1962, the Alumni Gymnasium addition was in progress. Completed projects included Morgan Hall, Olin Hall, graduate study program, Atwater Kent Laboratories renovation, Salisbury Laboratories renovation and increased endowment. One of the first training nuclear reactors ever placed on a college campus was installed at WPI in 1959.

Don Berth '57, vice president of university relations at WPI, recalls that Bronwell had a zest for new ideas. "He brought some much needed non-New England perspectives to WPI, and a number of faculty from other major colleges and universities. His forte was engineering education and he had wide recognition on the national scene when he arrived at WPI." Berth continues, "His wife, Virginia, was an especially great asset to Art and to WPI. She was a gracious lady, and I can recall being entertained with my fellow classmates at the President's home. Her enthusiasm was contagious. A visit to the Bronwell home was especially memorable for a then young college student such as I was in 1956 and 1957."

Prof. Donald Zwiep, head of the department of mechanical engineering at WPI says of Bronwell, "He was very interested in expanding the recognition of WPI beyond the immediate area. He also helped young faculty progress with various incentives, including tuition assistance for their children, and the establishment of the former Young Faculty Organization."

"Art Bronwell brought to the campus an extremely broad background and interest in engineering education," says Prof. Wil

Kranich, who has just retired as dean of graduate studies at WPI. "Through his familiarity with the interactions and processes of academia, he was able to accomplish smoothly many of the changes which had brought opposition in the previous administration."

Prof. Emeritus Elliott Buell, a longtime personal friend of Arthur Bronwell, remembers him when he was at Northwestern during World War II. "Arthur was then professor of electrical engineering and I was an instructor in the math department. As a Signal Corps training-program administrator, Arthur engaged me to teach a refresher course in math to military students—four hours a day, Monday through Friday, for ten weeks at a time. Quite an assignment!"

Following Mr. Bronwell's move to WPI, he invited Prof. Buell to join the math department: "A decision I never regretted. Under Arthur's direction, one of my initial duties at WPI was to promote the use of digital computers, then newly emerging on the national scene as an important tool in science and engineering."

After leaving WPI, President Bronwell was named dean of engineering at the University of Connecticut, Storrs, retiring as dean emeritus in 1977. At UConn he introduced graduate programs in aerospace and in biological and environmental engineering and initiated plans for a new electrical engineering building and computer center.

President Bronwell, a native of Chicago, graduated from Illinois Institute of Technology in 1933 and took his master's degree there in 1936. (The Institute awarded him its Distinguished Alumni Citation.) He joined Northwestern's faculty the next year and became professor of electrical engineering in 1947. The following year he received his MBA from Northwestern. He held honorary doctorates from Northeastern University and Wayne State University.

During World War II, while at Northwestern, he was executive director of the American Society for Engineering Education and managed a program for the Army Signal Corps which trained 300 officers. After the war, he served on a joint Army and State Department mission to Japan on technological recovery at the request of the occupation government under Gen. Douglas MacArthur.

As a consultant, he assisted Motorola Co. in designing the radar system for the B-29 bomber and helped design telephone equipment for Bell Telephone Laboratories.

While in Worcester, Mr. Bronwell was a director of Jamesbury Corporation and the Worcester Five Cents Savings Bank. He was vice president of the advisory panel on engineering science to the National Science Foundation. Also, he was a trustee of Worcester Academy, a vice president of the Chamber of Commerce, a corporation member of the Worcester Boys Club, a trustee of Bancroft School and president of the Worcester Economic Club. He was a director for the Salem Square Development Board, Worcester Free Public Library, the Worcester Council of Churches and the Worcester Orchestral Society.

Mr. Bronwell, who was listed in *Who's Who in the World* and *Who's Who in America*, served on a state citizen's committee which tried to bring a federal space-flight laboratory to Massachusetts in 1961. He was listed in *Men of Achievement*, *Men of Distinction*, and *Engineers of Distinction*. He was a member of the Council on Foreign Relations in New York City and a fellow of the IEEE. Other organizations included IRE, ASME, American Economic Society, Newcomen Society, Sigma Xi, Tau Beta Pi and Eta Kappa Nu.

For eight years he edited the *Journal of Engineering Education* and he wrote for popular magazines and technical journals, including the *Saturday Review*. He was the author of a book, *Advanced Mathematics in Physics and Engineering*, and co-authored *Theory and Application of Microwaves*. His *Science and Technology in the World of the Future* was rated one of the 100 best books of 1970 by the *Library Journal*.

Arthur E. Gorman '17 of Ormond Beach, FL, a former chief sanitary engineer for the U.S. Atomic Energy Commission, died February 12, 1985. He was born on Dec. 18, 1892, in Haverhill, MA, and later received his BSCE from WPI.

Mr. Gorman had been associated with the City of Worcester, the U.S. Public Health Service, the Chicago Department of Health and Sanitary District, Wallace & Tiernam Inc. and Pardee Engineering. He had served as engineer of water purification for the City of Chicago, as well as assistant city engineer. During World War II, he served on the U.S. War Production Board. He was a consultant to the U.S. Public Health Service and a director of the land and public services branch of the U.S. National Housing Agency.

For ten years, he was chief sanitary engineer for the U.S. Atomic Energy Commission. From 1957 to 1969, when he retired, he was a consultant to the reactor development division of the Commission.

His memberships included the ASCE, Theta Chi, Skull, the American Water Works Association, the American Public Health Association, the Illinois and Washington, DC, Societies of Engineers and the American Academy of Environmental Engineering.

Nelson P. Ingalls '17 of Hancock, NH, passed away on October 6, 1984. He was born June 24, 1895, in Newburyport, MA, and later studied electrical engineering at WPI.

During his career, he was with Heald Machine, A & P Tea Co., and Norton Co., Worcester, from which he retired in 1960 following 23 years of service. While with Norton, he served as assistant foreman, assistant superintendent and safety engineer.

Mr. Ingalls had been vice president of the Worcester County Safety Council and belonged to the National Safety Council, the American Society of Safety Engineers, the Worcester Economic Club and the Masons. He was chairman of the town finance committee in Sterling, MA.

Charles L. Waddell '18 died July 16, 1984, in Margate, FL. A native of Buffalo, NY, he was born on July 1, 1896.

After receiving his BSEE, he was employed by Worthington Corporation until 1959. Among his positions were draftsman, assistant chief engineer of the condenser and heater division, production manager and manager of the contract engineering division. After retiring from Worthington, he joined Lawrence J. Schilling as a real estate salesman.

Mr. Waddell was a professional engineer, the former vice president of the local board of education and a Mason. He belonged to Phi Gamma Delta.

Carl F. Meyer '22, a WPI professor emeritus, died February 27, 1985, in Winter Park, FL, at the age of 84. He was born in Lawrence, MA.

After receiving his BSCE, Prof. Meyer was awarded his professional CE degree from WPI in 1929. In 1938, he obtained his MSCE from Cornell. For two years before joining the WPI faculty in 1924, he was with the U.S. Coast and Geodetic Survey. He was an exchange professor at the University of Hawaii in 1936–37.

In World War II, Prof. Meyer was a civilian sanitary engineer with the Navy in Norfolk, VA, and also set up war-training courses at the University of Redlands in California.

During his 41 years in the civil engineering department at WPI, Prof. Meyer served as a consultant on numerous civil engineering and public works projects. His textbook, *Route Surveying*, a widely used text in civil engineering, went through three editions.

Always a favorite with students, he was tapped by them for Skull. The faculty selected him to receive the Trustees' Award for Distinguished Teaching in 1964. In 1965, he was awarded an honorary doctorate in engineering by WPI. He belonged to Tau Beta Pi, Sigma Xi, Chi Epsilon and Theta Chi.

Prof. Meyer was a past president of the Worcester Engineering Society, the Worcester section of the ASCE (life member) and the WPI chapter of Sigma Xi. A registered, professional engineer, he was active with the American Society for Engineering Education and the American Congress of Surveying and Mapping.

In retirement, Prof. Meyer wrote *The Fiddle Maker*, about his father, whose handmade violins were compared in quality to those of Stradivari. He played the cello in the Florida Symphony Orchestra. Earlier, while in Worcester, he played first cello for the Little Symphony Orchestra and became a life member of Local 143, American Federation of Musicians.

Lincoln A. Cundall '23, of Rochester, NY, a former member of the President's Advisory Council at WPI, died suddenly on February 23, 1985. A Worcester native, he was born on June 13, 1899.

He received two degrees from WPI, his BSEE in 1923 and his professional EE in 1932. Over the years he was associated with Bethlehem Steel Co., Harding Engineering Co., Consolidated Packaging Co. (designer of automatic packaging machinery) and Eastman Kodak (supervisor of automatic machinery design). He was a professional engineer in New York State.

For 32 years he was a volunteer manager of radio communications in times of disaster with the Red Cross. Since his retirement in 1965, he had done volunteer work with the Rochester Science Museum.

A founder and officer of the Antique Wireless Association, an organization dedicated to the preservation and documentation of radio from its infancy, he compiled a slide show documentary on Marconi, a copy of which is in the Science Museum in London. The Antique Wireless Museum in East Bloomfield, NY, has hundreds of artifacts which he personally restored.

Mr. Cundall, a Mason, was the son of R. N. Cundall '97. He was a former vice president of the Rochester chapter of the Alumni Association, as well as a council representative. In 1973–74, he served on the President's Advisory Council.

Paul H. Norgren '27, a research associate at Columbia University and former assistant professor of economics at WPI, died February 16, 1985, in Stamford, CT. A native of Worcester, he was 81.

Following graduation as an electrical engineer, Dr. Norgren received his master's (1937) and PhD degrees (1940) in economics from Harvard. He had been a research associate at Columbia since 1963, working on problems of scientific and engineering manpower.

During his career, he was a professor of economics and a research associate in industrial relations at Stanford University and Brooklyn College, as well as a professor of management at Rutgers. He had been a research associate at Princeton and a senior staff associate for Industrial Relations Counselors Inc., of New York. In 1929 he started work as a design and standards engineer for Sylvania Electric Products.

In 1939–40, Dr. Norgren worked with social scientist Dr. Gunnar Myrdal of the University of Stockholm, Sweden, in a study of racial problems in America for the Carnegie Corp. in New York. From 1941 to 1947, he was a labor attaché at the American Embassy in Ottawa, Canada.

Dr. Norgren served with the labor division of the Office of Production Management in Washington, DC, in World War II. He was also vice chairman of the National War Labor Board.

The co-author of ten books, Dr. Norgren belonged to numerous research and professional societies, including the American Economic Association, the Industrial Relations Research Association, Sigma Xi and Tau Beta Pi.

Daniel F. O'Grady '30, class president and a WPI trustees emeritus, died May 18, 1985, in Falmouth, MA, following a long illness. A graduate civil engineer, he was born in Clinton, MA, on July 5, 1908.

Retiring WPI president Edmund T. Cranch remembers Dan O'Grady as a warm, loyal friend and advisor. Stephen Hebert '66, director of development and alumni relations, said of him, "Dan served WPI with a style, finesse and flair that was very special and very successful. We are indeed fortunate that he was a member of the WPI family and that he chose to be so deeply involved with his alma mater."

Following graduation, Mr. O'Grady began his 43-year career with New England Telephone Co., starting in the sales department in Burlington, VT. Later he was general commercial manager of the utility's Bay State operations, Boston, and general services manager statewide. In 1970 he was named executive assistant to the president. He retired in 1973.

During World War II he was a captain in the U.S. Army in Europe and saw service in the occupation government of Bremen, West Germany.

He was past president of the WPI Alumni Association (1960–1962), and of the Big Brother Association of Boston, the Massachusetts Tuberculosis League and the Catholic Alumni Sodality of Boston. Also, he was a former chairman of the Massachusetts Chapter of the National Multiple Sclerosis Society, as well as a former member of the board of directors of the American Lung Association. He was a past president of the Woods Hole Golf Club and belonged to St. Joseph's Church in Woods Hole, MA, and to the Cape Cod Curling Club in Falmouth.

Mr. O'Grady was a member of ATO, Tau Beta Pi, Skull, the Tech Old-Timers and the Poly Club. For many years he was an active member of the executive committee of the Alumni Association. He served on the WPI Board of Trustees between 1965 and 1975. In 1969 he received the Herbert F. Taylor Award from the Alumni Association for distinguished service to his alma mater.

Dr. **Philip M. Seal '30** died at his home in Prospect Harbor, ME, on December 9, 1984, following a long illness. He was born in Springfield, MA, on Sept. 3, 1907, and received his BSEE and MSEE from WPI and his doctorate from Purdue University.

He was with Westinghouse for several years, then taught at the University of Maine and Purdue. From 1956 until his retirement in 1973, he was a professor of electrical engineering at Norwich University, Northfield, VT. He was also chairman of the department of electrical engineering at Norwich.

Dr. Seal was a member of Tau Beta Pi, Sigma Xi, IEEE, ASEE and the Memorial Society of Maine, and he was an active member of the Unitarian Universalist Church. He served three years as tax assessor in Gouldsboro, ME.

Harry G. Merrill '32 of West Boylston, MA, passed away on September 23, 1984. He was born in West Boylston on August 18, 1910, and later received his BSEE from WPI.

He was with Norton Co., Worcester, for 25 years, serving as an inspector and control engineer. A former town auditor in West Boylston, he was also a member of the local Congregational Church and the Tech Old-Timers.

William H. Clancey, Jr., '33, of Paxton, MA, passed away on July 4, 1984. A mechanical engineer, he was born in Worcester on May 2, 1911.

For many years prior to his retirement, he was with American Steel & Wire division of U.S. Steel in Worcester, where he served as division superintendent of the steel works. Starting with the firm in 1937, he had been a tester, division fuel engineer, foreman in the bloom and billet mill, and general foreman of rod mills, as well as assistant division superintendent of steel works. He belonged to the Tech Old-Timers.

James V. Rowley '34 passed away on January 18, 1985, in Portland, ME. He was born in Springfield, MA, on Sept. 18, 1911, and graduated as a civil engineer.

For a number of years he was employed by the federal government as chief of quality assurance in the Springfield (MA) Armory. He retired in 1965. He belonged to Theta Chi Fraternity.

Kenneth A. Linell '35 died January 22, 1985, at his home in Hanover, NH. He was 71 and a Worcester native. A civil engineer, he did graduate work at MIT and Harvard.

For many years he was with the Army Corps of Engineers in Boston and Waltham, MA, Providence, RI, and Hanover, NH. He retired in 1974. Following his retirement, he was an engineering consultant on major projects worldwide, including the Alaska pipeline.

Mr. Linell was co-author of a graduate-level college textbook, *Soil and Permafrost Surveys in the Arctic*, plus papers and articles in the field of soil mechanics, especially the effects on major construction in cold climates. In 1974, he was awarded a Meritorious Civilian Service Medal from the Army Corps of Engineers.

A life member of the ASCE and the Appalachian Mountain Club, he also belonged to several engineering societies. He was the father of **Kenneth E. Linell '66**.

Thomas S. Wingardner '40 died November 4, 1984, at his home in West Yarmouth, MA. He was born July 16, 1918, in New York City, and later studied at WPI. He graduated with a BS from Newark College of Engineering in New Jersey.

For more than 30 years, he was a radio navigation systems program manager for International Telephone and Telegraph Corp., Clifton, NJ. He retired nine years ago. He belonged to the Poly Club, Phi Sigma Kappa and Tau Beta Pi.

Arakel M. Shooshan '44, a project engineer for Badger America, Cambridge, MA, passed away recently. A native of Worcester, he was born on April 13, 1921.

After graduating with his BSME, he was with ESSO Standard Oil Co. in Everett, MA, until 1962, when he joined the Badger Co. (senior piping engineer). A professional engineer in Massachusetts, he was a Navy veteran of World War II, and was commissioned an engineering officer following a course in marine engineering at Annapolis. He was active with church work, Junior Achievement and the Masons.

Peter J. Vozzola '46 of Windsor Locks, CT, died of a heart attack on December 4, 1984. He was born in Hartford, CT, on May 2, 1921, and graduated as a mechanical engineer. He had an MBA from Western New England College.

For three years he was assistant plant engineer for Hartford Rayon Corp. In 1949, he joined Hamilton Standard, Windsor Locks, CT, where he served as a test and development engineer. He was a veteran of the U.S. Navy. The father of **Robert Vozzola '80,** he belonged to Skull and Phi Gamma Delta.

Caleb H. Thomas, Jr., '71 died unexpectedly of a heart attack in Merchantville, NJ, on December 12, 1984. A native of Middleboro, MA, he was born on Oct. 13, 1944. He was a graduate electrical engineer.

During his career, he was with Mohawk Data Sciences, East Herkimer, NY, and Formation Inc., in Cherry Hill, NJ. At the time of his death, he was a unit manager of Recording Systems for RCA in Camden, NJ. He belonged to Sigma Xi and Eta Kappa Nu, and the IEEE.

Lt. **Kenneth J. Kubilins '83,** a class agent, was killed in a training accident at Vance Air Force Base, OK, on October 7, 1984. He was born on January 5, 1961, in Muskegon, MI.

He received his BSME and then went into undergraduate pilot training with the USAF. A member of PTS, he also belonged to Tau Beta Pi.

HOMECOMING
1985

September 27–29

Departmental Continental Breakfasts
- Mechanical Engineering
- Electrical Engineering
- Chemical Engineering
- Civil Engineering

Alumni Crew Race
Eighth Annual Frank Sanella Memorial Road Race
Campus Tours
Tailgating on the Quad
Parade of Floats
- "WPI Traditions"

Soccer—WPI vs Trinity
Football—WPI vs Tufts
Class Barbecues
Alumni Brunch—London Exchange Program
Annual Rope Pull
Fraternity Receptions, Dinners, Parties
Resident Advisor/Student Hall Director Reunion
Nightclub
Coffeehouse

PLUS . . . The Third Annual Athletic Hall of Fame Dinner and Induction Ceremony
This year we honor the six newest members of the Hall:

Elmer Scott '41	Fred DiPippo '60
Charles Schmitt '45	John Korzick '68
Richard Ferrari '51	Percy Carpenter, WPI's first athletic director

And MORE!
But . . . no Paddle Rush.

WPI Journal

WORCESTER POLYTECHNIC INSTITUTE

NOVEMBER 1985

INSIDE:

Science and Technology Meet Society

Archives: Opening up the Past

The Entrepreneurial Spirit at the Sidewalk Cafe

A Message from Paul W. Bayliss '60 President, WPI Alumni Association

Smooth transition of leadership can be difficult, but it is vital to the continuing success of every organization. I am honored to succeed Harry Tenny '56 as Association president at a time when alumni participation in every facet of WPI affairs is riding the crest. Yet my post pales next to the importance of Dr. Jon C. Strauss' role as president of WPI in the pivotal decade for all of higher education.

If you are at all familiar with happenings on The Hill, you know that there is much to demand the astute attention of not only the president, but also of the entire WPI community. For one thing, student life at WPI is today a little different than when most of us were on campus. Fraternities continue to play a major role in residential and social life. But today the social scene is shifting back to campus activities and programs, and with completion of Founders Hall, a 225-bed residence complex, the college is offering students broader choice in their selection of living arrangements. Moreover, there is concern over the conduct of a number of fraternities. One house—Sigma Phi Epsilon (mine, in fact)—has been shut down.

In the past ten years, the Institute has made a special effort to bring more women into the undergraduate program. Today, women account for about 20 percent of the enrollment of 2,600 students. Women's varsity and club sports now number almost 20. This highly successful program, coupled with an equally prosperous men's athletics program *and* wider interest in intramurals and recreation of all kinds, have prompted a need for greater use of our land-locked athletic fields.

In response, WPI has undertaken a complete renovation of its outdoor athletic facilities, including installation of all-weather track and field surfaces on Alumni Field and reseeding of the Class of '93 Field. Ray Forkey '40 is leading this effort on behalf of the college.

The WPI Plan will soon be 20 years old. Yet for all its prophetic success in keeping WPI at the cutting edge of higher education, this bold experiment continues to undergo careful scrutiny on and off campus. Last spring, for example, the faculty voted for a more traditional grading system and somewhat altered the mix of engineering degree requirements, the latter in response to a national accreditation board review.

All this comes at a time when college-age populations are declining across the nation—and especially in the Northeast—and changing enrollment mixes in favor of electrical engineering and computer science are straining nearly all colleges' physical facilities and faculty needs.

As alumni, how can we help? First we can keep informed. If you are not aware of some of the developments I've described—and there are many more—you might want to subscribe to *Newspeak* (the successor to *Tech News*). You can do so by writing to the editorial office at the college.

On a more personal level, there are many opportunities for your involvement both within and outside the activities of the Alumni Association. Many fraternities have alumni advisory boards, and these groups have recently established the Alumni Interfraternity Council to provide greater graduate involvement in Greek activities. Simply contact the president of your fraternity to learn more about this program.

The President's Advisory Council (comprising individuals contributing over $1,500 annually to the Alumni Fund) serves as a valuable resource to the president of WPI on policy and other matters. And the heads of various academic departments are establishing alumni advisory committees to help set the course of the college for the years ahead.

The Alumni Admissions program has been busy reorienting its activities this fall to better focus on the admissions needs of the "Tute." Activities of our regional alumni clubs and the Corporate Contacts Program are well underway for the year, bringing together graduates from across the country to kindle friendships and to hear from college VIPs on the news from The Hill. Watch for these events and do attend them.

Finally, support your alma mater, not only with your financial contributions but in your demeanor as well. Most of us are proud of WPI—and with good reason. Pass it on. Acknowledge your affiliation, seek out other alumni, develop networks with them through both Alumni Association activities and your business relationships. And why not pass on this and every issue of the award-winning *WPI Journal* to friends and colleagues alike? You'll benefit—and so will WPI!

Finally, we welcome Jon and Jean Strauss to the WPI community. And we hope they will feel confident in calling upon alumni in the years ahead to foster and support the mission of WPI in the same untiring manner that has come to be the mark of WPI graduates everywhere.

Paul W. Bayliss

Paul W. Bayliss '60

WPI Journal
WORCESTER POLYTECHNIC INSTITUTE

VOLUME 89, NUMBER 2 NOVEMBER 1985

Staff of *The WPI JOURNAL*
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Alumni Information Editor, Ruth S. Trask
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Alumni Publications Committee: William J. Firla, Jr. '60, chairman; Judith Nitsch, '75, vice chairman; Paul J. Cleary '71; Carl A. Keyser '39; Robert C Labonté '54; Samuel Mencow '37; Maureen Sexton '83.

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, Hartwick College, Johns Hopkins University, Rensselaer Polytechnic Institute, Villanova University, Western Maryland College, Worcester Polytechnic Institute) and appear in the respective alumni magazines of those institutions. Second class postage paid at Worcester, MA, and additional mailing offices.

Staff of the Alumni Magazine Consortium: Editor, Mary Ruth Yoe; Design and Production Coordinator, Amy Doudiken; Assistant Editor, Leslie Brunetta; Designer, Allen Carroll.

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

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Cover: Dr. and Mrs. Jon C. Strauss in the presidential residence at One Drury Lane. Photo by Robert S. Arnold.

WPI's new Director of Alumni Programs, Robert G. Dietrich

Kudos for Another Million-Dollar Fund Year

For the second consecutive year, the Alumni Fund topped the $1 million mark. More than 5,900 donors, or 40 percent of the alumni body, contributed a total of $1,063,017, a 5 percent increase over last year's record amount. The average gift was $181.

Including corporate matching gifts, the Alumni Fund generated $1.4 million during the 1984–85 fiscal year. Matching gifts increased more than 37 percent, from over $258,000 to nearly $354,000.

"WPI alumni continue to give far above the national average," according to Alumni Fund Board Chairman Allen H. Levesque '59 of Chelmsford, MA, "and that generosity has been reflected in the quality of the college's physical plant and academic programs."

For the tenth consecutive year, a new record was reached. For the sixth time in seven years, WPI won a prestigious CASE (Council for Advancement and Support of Education) Award for sustained excellence in alumni giving. Just one college in the nation holds a better record.

"As always, this year's accomplishment was a team effort. Credit must go to the nearly 1,500 alumni and student volunteers who helped with solicitations, phonathons and other programs," Levesque notes.

Adds WPI president Dr. Jon C. Strauss, "It's a pleasure to begin my tenure as WPI's thirteenth president just as the 1984–85 Alumni Fund closes its books on its most successful year ever. My decision to come to WPI was influenced by the presence of a talented faculty and an outstanding student body, and I'm happy to include supportive alumni as another indication of WPI's excellence."

Peter Cronin

Fund director Craig Esposito (left) and Fund Board chairman Allen H. Levesque '59 with CASE awards.

Welcome, Alumni Director Bob Dietrich

Effective September 4, 1985, Robert G. Dietrich joined WPI as Director of Alumni Programs. He succeeds Anne Marie Angelico, who had served in the position since August 1984.

Dietrich is a 1980 graduate of West Virginia Wesleyan College, Buckhannon, WV. He comes to WPI from Stewart Howe Alumni Service of New England, Cambridge, MA, where he served as director. The firm develops alumni relations and annual giving programs for more than 35 college and university alumni organizations.

Commenting on the appointment, Stephen J. Hebert '66, Director of Development/Alumni Relations, said, "We're thrilled that Bob has joined WPI, for several other prestigious institutions were very much interested in attracting him to their campuses. I'm sure he'll bring a dynamic approach to our alumni programs and will help further the traditions so well known of our alumni body."

Freshmen Stats Continue Strong

Anyone involved in making projections of any type can appreciate the difficulty of hitting a numerical goal right on the head. But if figures assembled at press time hold up, that's just what the Admissions Office has done.

Given a targeted number of 656 new freshmen and transfers for fall 1985 entry, current figures indicate that 611 freshmen and 45 transfers have registered, for a total of exactly 656. "Still," says Director of Admissions Robert G. Voss, "I've never seen a goal hit exactly in 15 years in admissions work, and I probably won't for another 15 years."

Reaching the targeted goal, says Voss, was made easier by an application pool that was not only 10 percent larger than last year's, but was slightly stronger academically as well. "Because of their strength," he adds, "we knew we'd be competing even more than usual for accepted students. We adjusted for that by admitting a few more applicants this year." Overall, WPI admitted approximately 60 percent of its applicants.

The make-up and quality of the Class of 1989 is not substantially different from that of the past five freshmen classes. Sixty percent of entering freshmen were ranked in the top 10 percent and 85 percent ranked in the top 20 percent of their high school classes. Scholastic Aptitude Test Scores averaged 540 (up from 530) on the verbal section (the 81st percentile nationally) and 650 (identical to last year) on the mathematics section (the 91st percentile nationally).

Electrical engineering was again the most popular choice of major, with 25 percent choosing that major. Twelve percent each chose mechanical engineering or computer science or entered as undecided engineers. Overall, 81 percent choose one of WPI's engineering areas as a major.

Since the number of Massachusetts high school graduates declined by 3 percent from 1984 to 1985, Voss notes, and 55 percent of WPI's freshmen hail from Massachusetts, the increase in applications and quality of the entering class is particularly heartening.

Still, he cautions that the continuing decline in high school graduates (projected to be 34 percent in Massachusetts between 1984 and 1994) will have to affect WPI in time. "We are going to have to strengthen our reputation both regionally and nationally to overcome declining high school enrollments. Our alumni will play an important role in that effort. This past year was successful, but we've got to work hard to maintain that success."

If history is any guide, WPI will be up to the task.

Men's Chorus Among Nation's Top Singers

The American Choral Directors Association, Eastern Division, recently ranked WPI's Men's Chorus second in a field of 120 professional, semi-professional, community, college and conservatory choruses. As a result, the WPI singers will perform at the Association's 1986 convention in Boston.

In making its choice, the selection committee listened to 54 tapes of semifinalist groups in a blind judging process. Twenty-seven tapes came from Massachusetts-based groups alone.

According to Professor of Music Louis Curran, Director of the WPI Men's Chorus, the tape submitted by the group contained several compositions performed during WPI's March 1985 tour of Great Britain.

That tour, which allowed both the Chorus and the Brass Choir to perform and travel in England, included performances in Pusey House Chapel before His Grace, the Bishop of Leicester, and at Westminster Abbey, Canterbury Cathedral and St. Edmundsbury Cathedral. In addition, tours of, for example, Cambridge, Windsor Castle, Center Court at Wimbledon, Piccadilly Circus and Oxford Street, and, of course, Worcester, complemented the groups' exhausting but exhilarating visit.

"It was with mixed emotions," recalls Curran, "and with new suits, sweaters, coats, china, rugs and other loot, that we returned to the States—wealthier in many ways than when we had left."

Fields Taking Shape as Fall Arrives

Besides completion of WPI's sixth residence complex, Founders Hall, much of the summer's activity on campus focused on the yet to be finished renovation of Alumni Field and the baseball and soccer fields.

At press time, installation of the Omni-

Some 225 upperclass students are the first to live in spanking-new Founders Hall, at the corner of Institute Road and Boynton Street. The complex, based on the classic architecture of WPI's first residence hall, Sanford Riley, built in 1926, features residence suites of two to three rooms; a dining room with cathedral ceiling and kitchen facilities; meeting, study and common rooms; and even a weight room in the basement. Dedication of Founders Hall was planned for Parents' Day, November 2.

Down goes the sand—on Alumni Field, as installation of Omniturf nears completion. Unlike any other synthetic surface, Omniturf incorporates a three-quarter-inch layer of sand spread among the millions of one-inch tufts of polypropylene "grass," producing a more natural look and feel to the multipurpose facility.

turf surface on Alumni Field had been completed, and the soccer, field hockey and football teams had played their opening games on the new artificial turf.

In addition, an all-weather surface for the running track had been prepared. And although the rains of early September slowed progress on the reseeding of the baseball fields, workers were doing what they could to prepare the surface for use next spring.

Raymond J. Forkey '40 is chairman of the committee charged with raising the nearly $2 million needed for the project. According to Forkey, the facilities that are being refurbished in the 3R project (for Recreational Resources Renovations) will meet a need which has existed on campus for many years. When completed, the fields will provide first-rate recreational and athletic space consistent with the indoor facilities of Harrington Auditorium.

"The synthetic surface we're installing—Omniturf—is ideal for the landlocked situation facing WPI. We are projecting an increase of more than 80 percent in field availability for everything from varsity sports, to intramural team use, to general recreational use."

Working on the 3R project with Forkey are George T. Abdow '53, Donald F. Berth '57, Gerald Finkle '57, Patricia Graham Flaherty '75, August C. Kellermann '46, Paul J. Kerrigan '57, John H. McCabe '68, Robert C. Stempel '55, and Thomas Sullivan. The committee is working primarily with alumni, as well as trustees and parents, to generate the funds necessary for the project. According to the committee's most recent report, excellent progress toward that goal is being made.

Since the 3R project will not be completed until spring of 1986, dedication of the new fields is planned for Reunion Weekend, June 7.

"I am fully optimistic that we will be able to generate the funds needed," adds Forkey. "When the fields were built in 1915, dedicated alumni provided all the necessary funds. I am certain that very soon we will be able to report to our alumni, friends and students that once again the WPI community has backed another major effort to improve the quality of life for generations of students to come."

Sound synthesis: Megan Woolhouse (left), Lisa Conboy and Maryann Donahue look on as WPI professor Peter R. Christopher demonstrates equipment that synthesizes sound and generates visible sound waves on the oscilloscope.

To the Frontiers of Science

For the past three summers, more than 50 high school students have come to WPI for two weeks to explore current unsolved problems in chemistry, physics, biology and mathematics. For most of them, Frontiers in Science is a far cry from their normally academics-free summer hiatus.

"We want the Frontiers program to be different," says Mathematical Sciences Prof. Peter R. Christopher, who heads the event, "and we believe it is. The approach is project-oriented, and the emphasis is on material not usually offered to high school students." The goal, says Christopher, is to promote an interest in science and mathematics by providing students an intellectually stimulating learning and research experience.

Besides lectures, work sessions, labs and group projects, the program features guest speakers, field trips and athletics. Each participant also has access to WPI's computer facilities.

Students in the physics section, for example, had the opportunity for hands-on use of lasers and computers, as well as instruction in cryogenics and electronics. The mathematics section examined a wide range of topics including logic, statistics, algebraic systems, combinatorics and graph history. Chemistry topics included the synthesis, characterization and spectroscopy of interesting compounds.

Among this year's extra-curricular activities were trips to the Worcester Science Center, Worcester Foundation for Experimental Biology, Higgins Armory Museum, Digital Equipment Corporation and Worcester Art Museum.

Frontiers is funded in part through corporate sponsorship, normally by firms located near the hometowns of students selected for the program. In the past, students from Connecticut, Massachusetts, New Hampshire, New York and Rhode Island have participated.

In the Heat of Henley

Great expectations can lead to great disappointments, but in the case of the WPI men's crew team's trip to England last summer, a lack of competitive success did not spoil the team's three-week adventure. In fact, it just added fuel to the team's desire to return soon to give a stronger showing of its abilities.

WPI competed in three regattas while in England, beginning with the Marlow Regatta on June 22, the Reading Regatta on June 29, and ending with the prestigious Henley Royal Regatta, July 4–7.

"Our eight-man boat finished second in both the Marlow and Reading Regattas," says coach Dave Ploss. "And our four-man finished third in the Marlow and fourth in the Reading Regatta. At Henley, the fours boat drew a British light-weight team in the first round—a team that eventually made the semifinals. In the eights, we drew the Palm Beach Rowing Association entry and had a good shot at beating them, but we didn't come through in that race when we should have and lost by a length."

WPI made it to the semifinals in the elite-four race but was beaten by three lengths by the boat that eventually won the Regatta and ended up on the British National Team. "Competing at Henley is second only to the Olympics," adds Ploss.

The WPI crew was composed mostly of sophomores and seniors with one freshman in the group. Team captain Joe Fern '87, of East Greenwich, RI, says, "Our racing experience helped us develop composure and poise for our head-to-head races this fall. We didn't really have much time for anything else but rowing while we were there, though we did take a couple days to do some sight-seeing."

The trip was the third for a WPI crew team, but the first in three years. Accompanying the team to London were families of some team members as well as Donald Berth '57, vice president for University Relations, and Mrs. Miriam Rutman, wife of the late Walter Rutman '30. In addition, Jay Feenan '82 managed to time a London business trip to coincide with his alma mater's Henley competition.

Roger Crimmins
Sports Information Director

Donald Berth '57

WPI's four-man boat in the heat of Henley competition.

SECOND IN A SERIES

THE ENTREPRENEURIAL SPIRIT

Greetings from the Sidewalk Cafe

By Michael Shanley

There's an unmistakable aura of wildness in the air in Venice, California, but then Bob Goodfader '60 EE wouldn't have it any other way.

"There's a pigeon in the ladies room!" comes the scream from upstairs.

Bob Goodfader laughs. He loves it.

The pigeon isn't the first problem of the morning. Nor will it be the last in this remarkable Venice, CA, spot called the Sidewalk Cafe.

Bob, who owns the Cafe, is lounging behind a desk in his pleasantly ramshackle, windowless office beneath the restaurant. At 46, he's a lean, bearded man with curly hair and a prominent twinkle in his eye.

Just a few minutes earlier, he had had to deal with Saul, who manages Bob's vending lots, located next to the Cafe. Here on Ocean Front Walk, vending lots (nothing more than a slab of pavement) are big bucks. Space is rented out to people who hawk everything from hot dogs and candy to sneakers and watches.

Saul, a tall black man, is dressed to kill in a dark-blue suit and hat, electric pea green sweater, white shirt and tie. A Hollywood film company, he explains, was supposed to be using one of the lots to shoot location footage today, but they're nowhere to be seen. Saul is upset; if they don't show up, he doesn't get his cut of the action.

Sucking on a cigarette, he waves a piece of paper. Bob glances at the paper and shrugs. "Who knows?" says Bob, handing it back. "I've never heard of this outfit. If they show up, they'll pay."

Saul is not happy, but he wanders off in a cloud of smoke.

Before Saul, it had been one of the carpenters renovating part of the building.

"I'm putting a big dumpster outside the back door," the

Michael Shunley

carpenter stops in to say. "Do we need a permit or anything?"

Bob thinks for a moment, "I think I've got a permit somewhere," he says. Then a pause. "But it's probably expired."

"Will they hassle us?" asks the carpenter.

"Probably," says Bob. "They love to hassle us."

"I know a couple of cops," offers the carpenter.

"You know cops? Oh, good. Then we're all set."

The carpenters are redoing the part of Bob's building that once held a clothing store. The clothing store was flooded, you see, after rain poured through a gaping hole in the roof. All the stock was destroyed. The roof was being torn apart to satisfy the local authorities, who demanded that Bob comply with the earthquake ordinance.

After a while, here at the Sidewalk Cafe, you stop asking questions.

Shortly after the carpenter leaves, in wander two men in painter's bibs and caps.

"I need two hundred," says one to Bob. "I'm going to Vegas."

Bob gives him the two hundred out of his pocket and yells over to his aide, who sits, seemingly oblivious, at a desk beyond a partition. The aide is evidently keeping a running tab on the painters' draws. The painter is also interested in making golfing arrangements.

Just what is it they're painting, Bob is asked after they leave. He looks puzzled. "Painting? No, they're not painters."

Somewhere amidst all this, after Saul and the pigeon, but before the non-painters, Bob's wife, Mary, enters. She has come to express her displeasure with the broken awning in front of her bookstore, which adjoins the Cafe. It's also possible that she was the faceless voice who found the pigeon, but that seems so long ago now that everybody's forgotten about it.

Welcome to the Sidewalk Cafe, where a real-life situation comedy is forever unfolding on the shores of the Pacific Ocean, just down from Muscle Beach, not far from the Gaslight Cafe, where Allen Ginsberg and the early Beats once hung out.

It's here that roller skates and headsets were made famous, where weirdness is a way of life.

Meet Bob Goodfader, former professional gambler, onetime atomic bombsite radiation tester, former cable TV pioneer, near-scratch golfer, health food caterer, restaurant owner.

"This is fun. Are you having fun?" Bob asks a visitor. For him, it's just another day. Everything is amusing, and no problem is worth getting upset about.

"I'm a street person," says Bob, a native of Winthrop, MA. "Always have been. That's why I like it here."

This street person, however, is also a crafty, albeit offbeat, entrepreneur who has run some 42 businesses over the years. "Some do well," he shrugs, "some go bust."

It's in the same offhand manner that he describes his 1960-62 Army stint, which included time at the Dugway, UT, Proving Grounds, where chemical and bacterial warfare tests were conducted. He was also part of the nuclear-disaster team for the Christmas Island bomb tests, 1,000 miles south of Hawaii.

"We did 26 nuclear bombs," says Bob. "I was in charge of the instruments that measured radiation, like the badges people wore."

He also trained those who watched the tests, including then

Secretary of State Robert S. McNamara.

Throughout much of his Army career, Bob had been a gambler, a poker player, often sneaking off to Nevada for a long weekend of gambling. So after his discharge, Bob and a pal set out for the high-stakes poker tables of Nevada, Utah and Texas, where you could make $25,000 or more a night. That is, if you have what it takes. You don't last long in that rarified atmosphere, where thousands of dollars hinge on the flip of a card, without nerves of steel and a healthy disregard for the value of a buck. But a pro can pull in a yearly six-figure income. Easy.

Bob had been a gambler, a poker player, often sneaking off to Nevada for a long weekend of gambling: "We were kids they'd fill the game up with, because they knew we didn't cheat."

"We played with some famous people," says Bob. Among them was Dean Martin, whom Bob calls a "great gambler."

"Basically, we were kids they'd fill the game up with because they knew we didn't cheat. Whenever a house in Nevada needed an extra person or two to fill a game, they'd call us.

"We'd gamble pretty much non-stop from Friday to Monday, staying up 36 or 48 hours at a time. We almost won a casino one night."

All the tables weren't of the glitzy movie star variety, however. Some were in one-horse towns, where local sheriffs and mobsters called the shots. Bob's partner got his arms broken a couple of times—for the crime of winning.

"You don't know who you're playing with. Sometimes after you got through with a game, you ran—and you left your money. Sometimes you got run out of town—stuff right out of *Easy Rider*."

All in all, says Bob, it's not as glamorous as it seems. "It's not a real good life. It's hard work. It's relentless. And you can get killed at it. So I banked enough money to quit, and I quit."

After those wild years, Bob longed for something a little more mainstream, so he went home to Massachusetts to work as a sales engineer for Sylvania Electric. "I was ready for a rest. Something where you went home every night and slept in a good bed and got up in the morning and met normal women instead of hookers."

After a couple of years, he was sent out to Los Angeles as West Coast sales manager.

Bob would stay with Sylvania until 1970, but that was only a part of what he had going. Throughout the Sixties and Seventies, he started, bought or saved a number of small businesses: an offset printing business, a ski and dive store, an accounting firm, a bookstore, a metals fabrication plant, the first Los Angeles business to make psychedelic lights, a stationery store, and a cable television company, to name a few.

"I formed an outfit called the Good Management Corporation. People came to me when they were in trouble, and I raised money, or helped them reorganize, or whatever was necessary. It was very lucrative."

When Good Management and cable TV got too big, Bob left Sylvania. Unfortunately, he had to drop the cable TV business before too long. "You need huge sums of money to really get cable going," he says. "But when I wanted to expand, which you have to do in that business, Bank of America told me cable was just a passing fad, that it wouldn't last ten years. They wouldn't lend me as much as I needed. So when King Broadcasting hit southern California, I sold them my system."

Not long afterward, of course, cable TV exploded, and Los Angeles franchises such as Bob had were worth millions. Not one to play "what might have been," this merely amuses Bob.

Throughout it all, he gambled for extra money. (It's legal in many Los Angeles communities.) But the California games, which Bob calls "the toughest in the world," are a different kind of gambling.

"That's a grind-out kind of thing. The stakes weren't as high. You were just a little better than everyone else and you made that much more. I used to figure it out by the hour. I'd make about 25 or 30 dollars an hour, and that was about the best I could ever do. It's like making a living, it's not really even gambling—unless some big fish came into the game, and then you could catch three or four hundred quick. I'd work during the day and then play all night."

In 1976, Bob bought an old abandoned building in what was then more or less an old abandoned town, and built the Sidewalk Cafe. In doing so, he would become partly responsible for changing the face of Venice.

"When I started, it was a drug area," says Bob, "minorities and drugs. Middle-class whites never came here, especially at night. Even now, people sweat it some at night, but it's nothing like it used to be."

Venice has always been a bit odd, ever since Abbott Kinney, a manufacturer from the Midwest, decided to recreate Venice, Italy, on the coast of California. In the early 1900s, he built miles of canals, stocked them with gondolas and even built a few houses.

The dream soured almost immediately when no one else seemed to share his fascination with the project. The Depression didn't help things any, and the discovery of oil pretty much finished the place off.

"After they put in the oil wells," says Bob, "the place stunk so badly that nobody wanted to live there. It went into total disrepair.

"But Santa Monica, which is the next town over, has always been nice. And once they started building the marina [Marina del Rey, perhaps the largest in the world] on the other side, the property values went up, and many of the bad areas were squeezed out.

"Venice has always had a reputation for being a free area, a place you could do anything. In the Fifties Allen Ginsberg and the Beatniks started here, and the place was hipsville, with coffeehouses and whatnot. Then in the Sixties the hippies were here before they moved to San Francisco. When they left, the area went down again, until the marina picked up in the Seventies."

This is not to suggest, however, that Venice has lost any of its, shall we say, special flavor. As Bob puts it, "Everyone comes here from wherever they live, doing whatever it is they do that's a little strange. Then all the tourists come to watch the show."

The strip where the Sidewalk Cafe stands is nothing special, yet: "This is where L.A. comes to the beach. This is California, surfing, muscle beach. Anything goes—fire-eaters, escape artists—you name it."

We're up on the roof now, up on top of the Sidewalk Cafe. From here you get a panoramic view of the shoreline leading up to Santa Monica. The beach is nothing special, really, with its drab concession stands and oil drills. Neither is the strip, where the Sidewalk Cafe stands alongside dozens of well-worn retail shops. Yet this real estate is the equivalent of a mini Las Vegas— pure gold.

"This is where L.A. comes to the beach," says Bob, amazed that he must keep explaining something so obvious. "L.A. is right next door, and it's landlocked—they've got nowhere else to go.

"On a hot day, there's a million people from here to Santa Monica," he says, pointing up the coast. "You can't walk."

"Besides," he expounds, "this is California, this is surfing, this is muscle beach. We've got fire-eaters, escape artists, you name it. Anything goes."

Down at the other end of Ocean Front Walk is the original Muscle Beach, with its outdoor weightlifting equipment. Made famous in the beach party movies of the 1960s, Muscle Beach was once home base for body-builder Arnold Schwartzenegger.

Next to Muscle Beach are the asphalt basketball courts that attract L.A's best young hoop players.

Bob is pointing in the other direction now, in back of the Cafe. "That's the artists' section. In the summer the limos line up to drop off the stars. What's that little actor's name? Not Dustin Hoffman, but . . . yeah, Dudley Moore. He owns a place over there. Plays the piano once in a while."

Back down at ground level, on the vending lots next to the Cafe, Bob is pointing down at an 8×10-foot slab of dirty, sticky pavement, one of many laid out parking-space style.

"How much do you think I rent this out for?" He's laughing now because he knows this is going to be funny. "Six hundred bucks a month in the winter, a grand in the summer."

Sometimes the lots are taken up by film crews. "They come here to film all kinds of movies and TV series," says Bob. "And they usually come to the Cafe because they need lots of room for their trucks and equipment, and I've got it."

TV series like *The Rockford Files*, *Starsky and Hutch*, *Knight Rider*, and even *My Mother, the Car* have all filmed segments at the Cafe. As have a number of movies. The film *Breathless*, starring Richard Gere, contains the immortal line "Meet me at the Sidewalk Cafe."

"I charge them $8,000 a day to film in the restaurant," says Bob. "Because, mostly, they cause problems."

Even without the film companies, though, business is great. In the summer, crowds are lined up across the street waiting to get into the Cafe. Seating is European style—there are no reservations, and you may have to share your table with strangers.

Bob's other current businesses include Bite of Health, a wholesale health-food catering service, and Green Bean, a natural-style restaurant, both located in West Los Angeles; Piazza, which buys and leases land, including the vending lots next to the Cafe; Ocean Walk Properties, a limited partnership that also buys properties, and Small World Books, which owns and runs the bookstore.

Enough to keep a fella busy, though Bob doesn't appear harried and finds time to keep his mid-70s golf game sharp.

He's already plotting his next move, which is west from California. "I have some land in Hawaii, and I want to build a little restaurant. Just a little one, one for me. I'm going to live there three months a year, here in Venice three months a year, New York three months a year and Paris three months a year."

Not a bad plan.

Michael Shanley, former director of the WPI News Bureau, is director of Public Relations at Fitchburg (MA) State College.

The saga of a group of social scientists awash in a sea of engineers and scientists—and how they have stayed afloat—to say the least!

The Society-Technology Question: New Directions at WPI

by John M. Wilkes
Associate Professor of Social Science and Policy Studies

Oh, I didn't know they did that sort of thing at WPI."

This is the kind of response I'm used to getting from off-campus people I speak to about the social sciences at WPI. It's amusing to hear. But it's frustrating, too.

On such occasions it's hard to resist the temptation to add an additional shock, telling my listeners that WPI offers a major in the study of society-technology (ST)* and is deeply immersed in Interactive Qualifying Project (IQP) work.

Even today, looking back, I guess I underestimated the number of high-caliber students willing to enter into the thicket with me. By "thicket," I mean the social research I was pursuing when I joined the WPI faculty in 1976—the social psychology of science.

Now, however, I find myself nearly *over*stimulated by at least 10 different student project groups who have helped me expand my research on cognitive styles into issues such as right brain-left brain distinctions, the experiences of women in the sciences, the Hacker debate in computer science, and the process by which people clue each other about their cognitive orientations.

It's gotten to the point where many of these students have met the challenge of serious social research so well that they've accompanied me to professional meetings and conferences to discuss their work with respected scholars in the field.

Meanwhile, students have dragged me into some thorny thickets of their own, particularly the nuclear power debate, the role of computers in the space program, studies of what might be called the technological mentality, and an examination of how people become effective computer scientists.

The Department of Social Science and Policy Studies (SSPS) is a product of the WPI Plan. It was established about 10 years ago to nurture that sector of the IQP that would consist of classic studies of society and technology or science.

It was tacitly understood that in practice many IQP projects would have fairly modest goals or limited scope and that many projects would essentially be community service efforts or lean rather heavily toward the technical side. The idea was to give strong support to projects that would truly require a serious understanding of the society side of the equation and, therefore, that should be grounded in the social sciences. We've also tried to serve as a technical resource for those engineering and science faculty members doing ST studies.

Certainly, however, our small group of social scientists—four economists, a social psychologist, a political scientist and myself, the sociologist—have run into roadblocks at WPI. Few science and engineering faculty members, for example, knew early on how to tap the resources of SSPS. Too often, we feel, we got called in on projects too little or too late.

There was a sense that we represented a small beachhead in a rather large system and that perhaps we should take a lesson from the Marines, who are said not to be concerned very much about numbers but rather attempt to recruit just a few good men and women. Over the ensuing decade, this has proved to be good advice.

It was our ability to integrate a few really good student projects with our own research, and thereby help demonstrate the enormous potential in the IQP, that has made the difference for SSPS. We are now, in many cases, the envy of our social science colleagues elsewhere, particularly those who are interested in ST studies but are not based in centers devoted to such activities.

Still, a question plaguing most of us is how to get students who will become engineers or scientists to take the time to revise and enrich for publication project reports which would be a contribution to the social science literature. When the work is indeed publishable and is not really the work of the advisor, who should be responsible for making sure it reaches its audience?

For example, currently I have an embarrassment of riches—unpublished work best viewed as collaborations between myself and dozens of students. I certainly don't want to publish this work under my own name. Besides, I have plenty of my own research awaiting my attention.

On the other hand, when I present a paper that includes six or eight unpublished project reports in the bibliography, a colleague can fairly ask why this crucial material was not made accessible to the field in some form. The question is: what

**The society-technology major has two tracks—one emphasizing policy analysis and the other emphasizing social impact analysis and technology assessment.*

form is appropriate? For in truth, few project reports are ready for publication as they stand. Typically, however, they do include a few choice nuggets worth preserving. Over time a series of such projects can reveal an interesting pattern of results to someone who is scanning the whole. I'll illustrate.

As I've already mentioned, I've always been interested in the social psychology of science. My dissertation was based on a comparative study of 275 academic physicists, chemists, economists and sociologists. I demonstrated how the most successful body of researchers in each area differed from the elite in other fields along the lines of cognitive style.

But I really had little hope of pursuing this research area at WPI with engineering students. It involves delving rather deeply into the debate about creativity and the nature of science itself. I did, however, devise two undergraduate courses that drew on this background.

Largely because of student initiative sparked by these presentations, the projects I've advised at WPI have included a dozen topics building on my background in cognitive styles and the creativity debate. While some students have taken these ideas and run with them, others have involved me in studies growing out of their own interests. These range from examination of public interest in astrology, laetril and antivivisectionism, to analyzing the problems of the elderly and the commercial failure of the video phone, which was produced by Bell Labs in the 1970s.

Over time the line between my research and student projects has become rather blurred. For example, at least five project teams have worked on topics derived from a National Science Foundation study I conducted on women in science. This work involved 1,200 students at major universities. Here at WPI, three project groups teamed up to revise and reissue the questionnaire to 120 WPI students. Two more project groups joined in to do parallel analyses of the original project on the women's issues once the data were gathered and organized. The research of these last two teams has proven to be so fruitful that it will probably be the basis for a new proposal to extend the original NSF study into a sample of women's, liberal arts and engineering colleges.

The stimuli for projects don't always come from faculty, however. Sometimes, for instance, I find myself drawn into research activities that come directly out of student research. Two good examples of this are my research on the nuclear power debate and my growing interest in the social implications of fire protection engineering.

To illustrate using the nuclear power example—it all started so modestly. Four able students needed an advisor on a project involving sea-bed disposal of nuclear waste and came to me. I had no research interest in this particular topic, but recognizing in the nuclear debate a rich society/technology issue, I agreed to discuss the possibilities.

As we sat around the office, the discussion rapidly turned to speculation about what leads people to be anti-nuclear. The students had no trouble spinning off diverse theories that they had heard circulating on campus. Before long I became intrigued and started taking notes. I had soon re-fashioned these general ideas into four researchable hypotheses focusing on knowledge, anti-technological attitudes, personal optimism or pessimism, and confidence in institutions.

On hearing that, at least in principle, these theories represented empirical issues that could be tested (i.e., were not simply matters of opinion), the students got excited and soon found themselves critiquing the 1975–76 national Harris Poll on nuclear power as a springboard toward devising their own survey instrument.

But that's not all they did. They began reading about the society/technology debate in general so that they could fairly represent pessimistic or anti-technological positions in the survey. They also reviewed several existing measures of institutional confidence and devised, almost from scratch, a nuclear knowledge scale. What's more, the nuclear knowledge issue led to our attending an evening course at Clark University together.


Michael Carroll

Prof. John M. Wilkes

"Some students have dragged me into some thorny thickets of their own—social research in areas like technological mentality, the nuclear power debate, and how people become effective computer scientists."

All in all, the project became a major undertaking and served as the capstone of a significant intellectual experience for the students' careers at WPI.

The result of the initial effort was a modest study of 100 WPI and Clark students. No one was more surprised than I to see what a devastating effect this carefully constructed study had on the conventional wisdom in nuclear circles about the nature and sources of nuclear opposition. None of the explanations that we began with was adequate. Yet the students' work proved to be quite a contribution to the debate at the time. To give you some idea of the wider impact of the study, it was ultimately reported at the meetings of both the American Nuclear Society and the Society for the Social Study of Science (4S) in 1978. An abstract of the 4S presentation came to the attention of the head lobbyist of the American Nuclear Society in Washington, who later visited me at WPI.

But, oddly enough, the most important audience turned out to be right next door. The Public Affairs Research Center at Clark University invited me to devise part of their statewide survey of 1,000 Massachusetts residents on the subjects of public confidence and nuclear opinion. Then, the utilities covering the state and the Edison Electric Institute combined to provide the small amount of funding necessary to include a revised knowledge scale in the study.

As the scope of the project increased, I

"No one was more surprised than I to see the devastating effect this student project had on the conventional wisdom about the nature of opposition to nuclear energy."

Able-bodied adults stay on welfare not out of choice but out of necessity: they can't find jobs, according to Prof. Leonard Goodwin (above), in his 1983 book, Causes and Cures of Welfare. *Based on considerable research on the welfare "dilemma" in the U.S., the landmark volume concludes that the current welfare system is "bankrupt" and in need of drastic overhaul. "There is virtually no evidence," Goodwin adds, "that welfare dependency is caused by preference for welfare."*

called on a colleague at Bates College for support and assistance, and he took time to administer a student survey on the Bates campus, thereby increasing our comparative body of information substantially.

Then, in March 1979, we discovered that our Massachusetts state study was the last good body of evidence on public opinion and technical optimism prior to the Three Mile Island (TMI) incident, which followed data collection by three weeks. A followup was done one year later, and we were therefore in a position to do a classic social-impact analysis focusing on the events of TMI.

These data spawned several new student projects and became a strand in my own continuing research. They also found their way into my course introducing social concepts. Hence, many WPI students have had the opportunity to theorize about the likely impact of TMI on these variables of knowledge and opinion and to test themselves against often counter-intuitive outcomes.

The ingenuity of the student spin-off projects in the nuclear series still brings a smile to my face. In addition to the original study examining the climates of opinion on the different college campuses, we've had groups look into the structure of the Clamshell Alliance, re-analyze existing national survey data in search of trends more apparent in light of later developments, and study the relationship between public opinion and media coverage by news region in both Massachusetts and Connecticut.

We've also re-examined media coverage at the time of the national surveys that figured in other projects. Clark and WPI were re-studied after TMI to assess the effect on those different climates of opinion. And another study was mounted at WPI and Mt. Holyoke College to examine sex difference in nuclear attitudes.

In addition, studies have been mounted in which the key decision makers (now retired) at Yankee Atomic and Northeast Utilities—the companies that brought nuclear energy to New England—were interviewed at length about the decision process that convinced them that nuclear power would be the wave of the future. All this activity is in addition to the studies of pro- and anti-nuclear logic, and a retrospective look at the impact of the nuclear power plant in Plymouth, MA.

Currently a group of students is going into the field with follow-up studies of all four colleges in the original data archives—Bates, Clark, Mt. Holyoke and WPI. Coming as it does five years after TMI and during a period of lower interest in the subject as well as a more negative climate of opinion at the national level, this study promises to round out our knowledge of the process whereby technologies become defined as social problems and redefined as non-issues.

In short, you might correctly conclude that this series of projects seems to have a life of its own. Personally I find that I can't get away from the subject despite my heavy involvement in other things. I recently met a sociologist at a professional meeting who plans to write a book on this subject and makes no bones about the fact that he will be building on our work and wants a full record of everything we've written.

There seems no end to the off-campus connections emerging from these projects.

The temptation to continue the nuclear projects series now that there are 11 existing student campus surveys may simply be too great to resist. After all, some 40 students in 15 project groups have already had a great deal of fun with this subject, and there doesn't seem to be any compelling reason to stop now.

Of course, every run has its price, and if we keep going like this, someday I may have to stop and write a book just to tell what has happened in this one sub-area of cumulative WPI project activity on the nuclear issue. I am currently toying with the idea of trying to recruit a student group that would do no new studies but would simply review all the work done by the prior groups and bring it out in some coherent and integrated form.

I hope that this brief and personal review will give you some idea about what we're trying to do in the social sciences at WPI. Our dreams for the future are fairly simple to state, although they will certainly be harder to achieve.

We are pleased that virtually every WPI student now takes social science courses before undertaking the IQP. At the very least we want them to know what types of data and facilities are readily available, just for the asking, and what kinds of projects will require them to go out and break new ground. We want to encourage initiatives by prepared students with a clear sense of purpose—not simply let people stumble into a morass out of ignorance about what has gone before.

As faculty, we foresee the Department of SSPS spawning a research center in due course, one that fosters professional research that grows out of, and feeds back into, project work. Current candidates for department-wide research topics—which would encourage interdisciplinary cooperation across the campus—include science education, the social impact of computers, and the social implications of fire protection engineering (FPE).

Besides these, the specializations of my colleagues Douglas Woods and John O'Connor in the areas of economics involving energy, resources and health care, as well as Leonard Goodwin's expertise in the area of welfare policy, will undoubtedly continue to be among the major streams of research activity shaping SSPS at WPI.

The trend will probably be toward a department that specializes increasingly in science/technology/society projects with certain common foci particularly evident among those of us who are not economists. For example, Len Goodwin, Kenneth Ruscio—our newly recruited political scientist—and I have overlapping interests in education, learning styles and education policy regarding computers and the teaching of computer science.

SSPS department head Dr. Douglas W. Woods

> "There was a sense that social science represented a small beachhead in a large system—that we should, like the Marines, recruit just a few good men and women."

Further, we envision a core group of some 10 percent of the student body who really get serious about this side of their studies and go well beyond the minimum of doing an IQP. This is the rationale for proposing what we call the dual major—a social science *and* engineering degree, in which the IQP is waived in favor of a second MQP with society-technology issues as its focus.

This second MQP would involve the same resources, background course work and professional attention devoted to the technical MQPs at WPI. The result of this type of academic program would be a special degree—one which we suspect will be highly prized by both the recipients and their potential employers. It will be especially prized by graduate programs focusing on technologically based policy areas. Their view of the ideal candidate would be an engineer who had done some serious study in the social sciences.

We suspect you'll be hearing more about those subjects based on work under way at WPI. But for the present, you now have some idea that, yes indeed, we *do* do that sort of thing at WPI.

THOMAS J. FORD '68 M.S.:

Science in the Mountains

By David Brooks

Traveling northward in New Hampshire, you can lose all sense of civilization as you approach Franconia Notch with the White Mountains towering above on all sides. Still further north lies Canada, and it's barren country you'll find from Franconia to the border.

But the road out of the wild mountains of Franconia Notch yields unexpected surprises. Quiet towns with pleasant homes are scattered about, and as the highway swings through a thick forest, a large sign by a lonely side road announces: "White Mountains Regional High School."

This full-fledged yet completely isolated school of 500 students offers all the benefits of a large urban high school. And on the staff is Tom Ford, who earned an M.S. in General Science from WPI in 1968.

Ford is known around town as "The Brain." It's a distinction earned through a career spanning 22 years as a physics teacher and chairman of the science department. For the traveler recently overwhelmed by a passage through the White Mountains, the discovery of Tom Ford's physics lab 45 minutes to the north of Franconia Notch is a revelation.

There Ford has labored to clarify the subject of physics and other sciences to his students, who are about evenly divided between the college prep and vocational curricula. They have all benefitted from his help. To advanced students he gives the full impact of his knowledge. "We believe that our students are as well trained here as they would be if they attended the most sophisticated urban high school," says Ford.

Similarly, vocational students studying agricultural and industrial arts benefit from a science education attuned to their interests and abilities. Tom Ford adjusts his teaching methods to his audience in order to fulfill what he describes as his life's ambition, to impart what he knows of science and of life. "Communicating is his big thing," says one senior.

Tom Ford has lived most of his years deep in New England, although he could have chosen the faster pace of an urban environment. But his choice has been motivated simply by his preference to make his home in the mountains.

In the early 1960s when White Mountains Regional High School was first being planned, Ford was teaching physics in Lancaster (NH) High School. Lancaster is one of the five towns that banded together to form a regional high school in the township of Whitefield. He was given the opportunity to plan his own teaching and laboratory space, and he worked closely with the architects from start to finish of the construction.

It was his participation in the formation of the new high school that initially persuaded Ford to remain in his home land. The school opened its doors in 1967, and since then Tom has been commuting 22 miles from the town of Franconia, where he and his wife, Wendy, have been raising Mark, 17; Megan, 16; and Amy, 13. Wendy teaches kindergarten in Groveton, a commute twice as great as Tom endures every day.

At the age of ten Ford arrived in Franconia with his family from St. Paul, Minnesota. His father started Franconia Hardware, at first in the family home. Everyone pitched in to help. "I can still remember my dad's admonition that helping with the business put food on the table," Tom says today.

Later, as the hardware business prospered, Tom enrolled in the Venard School in Clark's Summit, PA, where he received a prep school degree in 1953. He also took the equivalency test that earned him the secondary degree of the Catholic University of America.

Making quite a singular choice for college, he traveled to Canada, where he acquired in 1957 a B.S. in Science at St. Dunstan's University on Prince Edward Island. Then, three years in the Navy earned him a commission as a Lieutenant J.G.1.

WPI came later, while he was teaching. Speaking of a long commute, in order to attend WPI, Ford drove the 400-mile round trip from Franconia to Worcester for two long years to spend one day a week on campus. In addition, he spent two summers living in Worcester and attending WPI full time.

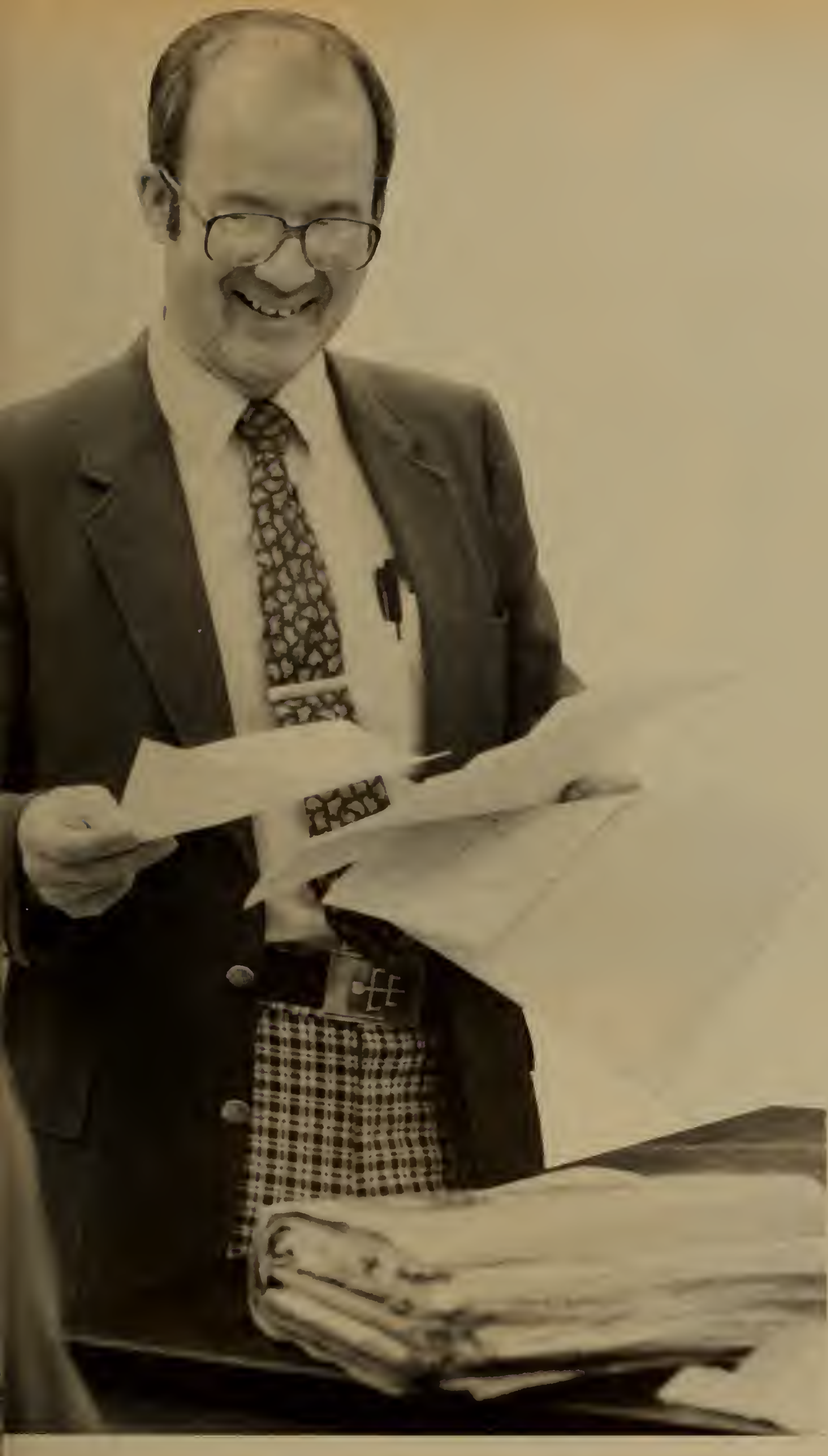
For some, technology can be so completely absorbing that it squeezes out interests in the humanities. Tom has avoided this pitfall. He earned an undergraduate Literary Letter and participated as an actor and stagehand in school and college dramatics. Today he enjoys listening to his classical music discs and has a preference for Gregorian music.

Other interests earned him a pilot's license and a master electrician's license. For a while he even managed the family hardware business in Franconia.

It was his early experience in his father's hardware store, says Ford, that charted the course of his life. "Getting to know all the tools and supplies and their functions awakened me to the world of science," he says. It's this outlook that has fueled his commitment to using straightforward teaching methods and apparatus—in combination with microcomputers—to simplify the learning of complex ideas.

One of Tom Ford's top priorities has been staying at the forefront of the computer movement, seeing that White Mountains High is supplied with effective computer equipment, and developing courses. *Reader's Digest* picked him out of the New Hampshire wilderness and featured him in an article when computers were becoming important in the schools. Ford has had more than 14 computer programs accepted for publication by the Digital Equipment Corporation Users' Society. In addition, he was a Bell System Representative for Aids-to-High School Science at state meetings and has made an address at Olivetti's Tarrytown, N.Y., Educational Center.

Ford's fondness for science and education culminated with his 1971 selection as New Hampshire Teacher of the Year. Yet



he's not locked himself in his lab for all these years. His résumé lists 68 achievements that indicate prolific activity both in educational *and* community affairs.

Early last summer Ford was chosen to go west to Flagstaff, AZ, for a two-week seminar for specially selected high school physics teachers. Later in the summer he was one of 40 physics teachers selected nationally for a two-week physics honors workshop on the campus of Virginia Military Institute.

Etched vividly in Ford's mind is one non-occupational accomplishment: After 20 years of cigarette smoking, he quit several years ago and hasn't touched tobacco since. His profession, he says, clarified the physiological dangers of using tobacco. Today, he has scored a special sort of triumph over what he believes was an addiction.

Ford and his family conduct charitable programs for disadvantaged children. Their efforts have resulted in community-wide participation in the non-profit Copper Cannon Corporation. The Ford family also belongs to St. Catherine's Parish, of which Tom has served as president.

This fall Tom Ford and his family are breaking with tradition. Although happy where he is now, he has accepted an opportunity in Bethel, ME, 60 miles to the east, to teach physics at Gould Academy, a prep school.

"I'm enjoying this new educational challenge," he reports. So is the entire family. His three children will be able to attend the academy tuition free, and Wendy Ford has been enthusiastically hired by the Bethel school system, eliminating at last her long commute.

The family tradition of being up on the top of the White Mountains, however, has not changed. Bethel is a quiet little town in the north country, not unlike the pristine surroundings Tom Ford has enjoyed all his life. "I suppose my pursuit of science in such a place is rare among scientists, who, I understand, usually find their most lucrative opportunities in more urban, industrial areas."

So be it. Tom Ford has been strapping on his cross-country skis right outside his back door since he was a boy in Minnesota and New Hampshire. Today he is going through changes, for sure, but he's still managing to keep his beloved physics lab deep in the heart of New England.

David Brooks is a freelance writer living in Mt. Carmel, CT. His son, Roland, earned his B.S. (1979) and M.S. (1984) degrees at WPI in mechanical engineering.


Michael Carroll

No Soul of Faint Heart

Dr. James S. Demetry's ten years in administration are history now. But his was a decade of growth for one of WPI's most innovative programs— the Interactive Qualifying Project.

By Kenneth McDonnell

Jim Demetry returned to WPI on that tragic day in May 1970 when five students died in a hail of bullets on the campus of Ohio's Kent State University.

Demetry '58 EE, '60 MSEE was back just for a visit, at the urging of William R. Grogan '46 EE, '49 MSEE, Dean of Undergraduate Studies.

"Bill called me in Monterey [CA], where I'd been teaching at the Naval Postgraduate School," Demetry recalled recently. "A lot was changing at WPI, Bill was saying then. I was a little skeptical, in light of what I was hearing about the changes sweeping much of higher education. So I came back to see for myself what was happening here. Something about the WPI Plan and those times told me that WPI would be an exciting place to be."

It's now a year later—1971—and Jim Demetry has returned to his alma mater for more than just another visit. Pulling up roots he and his wife, Sally, had put down in Monterey, where Jim had earned his Ph.D., and gathering up daughters Sara, Chrysanthe (currently a sophomore ME student at WPI) and Athena, the Demetrys settled back East in nearby Holden, Jim to join the Electrical Engineering Department, he and Sally to raise the girls, and she later to teach pre-school children at the Congregational Church nursery school in Holden.

Meanwhile, the WPI Plan is being implemented and many of the "bugs" worked out. As it gains momentum in the early 1970s, the Plan wins the respect of educators for its philosophy, focus and quality in an era of kneejerk responses to changing attitudes in higher education.

Demetry has become an influential voice on campus, a strong advocate of the Plan, a personality with clear leadership qualities.

In 1975, he would be appointed chairman of the Division of Interdisciplinary Affairs (DIA), there to ride herd over the enormously demanding Interactive Qualifying Project (IQP) program, a degree requirement that calls upon students to examine in depth a specific relationship between science or technology and societal and human needs.

Today, nearly ten years later, Jim Demetry is hanging up his administrator's hat to return to full-time teaching and research. In one sense, his move is a return to the nest. In another, with his establishment of a solid foundation for the IQP, his shift is an opportunity to infuse the DIA and the IQP with new blood, a development he says is natural for such a dynamic program. Prof. Lance Schachterle (HU) has taken over for Demetry on an interim basis, while a nationwide search for a permanent DIA chairman takes place.

Jim Demetry's involvement has made him the person most familiar with the IQP, perhaps the most innovative and distinctive element of the WPI Plan. And it's not likely that we've seen or heard the last of Jim Demetry.

In these ten years, Jim Demetry has seen and heard it all about the IQP: the praise of students, parents and the media for the actions of the Plan's founding fathers; the comments of countless faculty about the superior work done by many students; the dedication of a core of deeply involved professors; the avoidance of IQP advising by some faculty as a means of easing their workloads; the thanks of project sponsors who over the years have benefitted from the interaction they experience through the IQP with both WPI students and faculty.

"The IQP," he says, "remains the one part of the Plan that sets WPI apart from our peers. No other college I know of has an IQP-type activity as one of its degree requirements."

Often, says Demetry, the IQP requires preparation study in the social sciences to help make students more aware of general social problems; better able to question, criticize or reinforce prevailing ethics and values; and capable of making better judgments and policy recommendations on issues that affect society.

As might be imagined, the range of IQP topics is broad. Each year, some 200 projects are completed, involving teams of one to four students. And each year, the cream of the crop are recognized through the President's IQP Competition.

In 1984-85, for example, three senior IQP teams were singled out for superior conception, performance and presentation of their IQPs: Kurt Bahnsen (EE), Kenneth Chenis (EE) and Virginia Noddin (CE) for their analysis of priority issues in the National Society of Professional Engineers Constituency Survey; Stephanie Ford (ME), Patricia McSherry (MGE) and Michael O'Donoghue (MGE) for their assessment of improvements in the housekeeping department of San Francisco General Hospital; and JoAnne Shatkin (BB) for her study of the quality of bottled water in Worcester.

Final reports of IQP teams often run beyond a hundred pages, accumulating to fill shelf after shelf in Gordon Library. One student, Gary Shephard ('86 CE), has been studying the evolution of the Plan itself, in part to assess how growth at WPI since the Plan's inception in the early 1970s has influenced the need for change in the program in order to maintain control of what is an essentially experimental system. His findings should make good food for students and faculty thought, at the very least.

For all its attributes, says Demetry, the IQP remains something of an orphan. "It exists on the volunteerism of the faculty, and it has no 'home' academic department or discipline to help secure its focus. When professors start feeling the crunch of their teaching and research schedules," he says, "some may have a tendency to voice concern over the IQP simply as a relief valve."

Demetry concedes that, for a fair number of faculty members, IQP advising is difficult to execute well, but not just because of their workloads.

"Some faculty members," he contends, "are hung up on the notion that if they are to advise IQPs, it should be done in the more traditional manner of the expert dispensing wisdom and knowledge to eager young minds, as is often the case with the MQP [Major Qualifying Project]." If WPI stuck to this tradition, he acknowledges, the college would have precious few engineering and science faculty members advising IQPs, simply because their expertise tends to be mono-disciplinary.

"We're doing our best to educate for breadth, awareness and involvement, and we need faculty role models to accomplish this. It's not something for which we can rely solely on the social sciences and humanities facilities. To do so would be hypocritical, in my judgment."

Roger N. Perry '45

This student's IQP involved design and construction of a remote-controlled sailboat exhibit that visitors to the Peabody Museum in Salem, MA, can "sail."

Marvin Richmond

Using knowledge of computer engineering gained in his course work, a student instructs toddlers in the use of a computer terminal which he modified to accommodate their motor skills while introducing them to the computer age.

What is needed, he believes, is an institutional viewpoint that says, within a faculty-student IQP advising relationship, that the professor need not be embarrassed by the fact that he or she may not know everything there is to know about a complex aspect of some sociotechnical problem. "The really important thing is that our faculty have and convey genuine concern about the problem, that they be willing to be co-learners with the students, and that they be adept at sharing their well-developed skills of research and inquiry with students less experienced in these important processes."

To encourage this attitude, Demetry has tried to foster among faculty what he likes to call a "perimeter searching." "We must continue to build in our faculty the desire to nibble at the intersections of their knowledge and the realm of social concern—to try to interest, say, chemical engineers to investigate environmental toxicity as it relates to their primary expertise."

IQP advising, he says, is an ideal vehicle for enabling this kind of educational outreaching—for both the advisor *and* the student. "It can lead to a sharing of new knowledge between the student and yourself that *should* be the essence of education—at any age.

"The basis for continued excellence in the IQP is well established and widely accepted," says Demetry. "But we've got to build further on that base. The right signals to our faculty will enhance the quality of the program, enabling both faculty and students to benefit even more than they already have."

From time to time, he says, the IQP has been a sacrificial lamb on campus. "Projects require a great deal of faculty involvement to help plan, monitor and evaluate students' efforts. So, when push comes to shove, some faculty may raise questions over the role of the IQP in an already strenuous academic program, and its necessity in the training of scientists, engineers and managers. These days, nothing could be more vital to educating tomorrow's leaders."

There's nothing unusual or unhealthy about honest debate in higher education, Demetry acknowledges. "It's part of academic tradition." But, he adds: "tunnel vision never made a leader of any organization."

"It's a miracle, this IQP," says Frank Lutz, Associate Dean for Projects. Traditionally, he says, engineering schools are not known for their liberal perspectives on preparation for a profession and for life. "At one time, WPI was this way. But in large part the IQP has changed that here. Where else can students spend a good part of a year working with organizations across the state and the nation—sometimes even working in Washington, DC—working on real problems that daily affect people everywhere?"

It's probably safe to say that to most undergraduates—and Plan graduates, too—the IQP is as vital an element of their college experience as any other part of their education: "It's no less valuable than coursework, the MQP, Humanities Sufficiency or Competency Exam," according to Prof. John van Alstyne, Dean of Academic Advising.

Most incoming freshmen, too, as well as their parents, look at the IQP experience as one of the key factors that stirred their interest in WPI in the first place. Says Admissions Director Robert Voss, "The IQP is the one aspect of the Plan that students and parents believe is special. I know it's faculty intensive, but from an admissions point of view, it's more than worth the time."

Each year, about 30 percent of all IQPs address problems facing off-campus organizations. Because of their origin and focus, these projects are often the most interesting and challenging for students. It's been Demetry's job, in part, to gather and coordinate project ideas from both off-campus sponsors and the faculty.

In Holden, for example, Demetry and others, such as former town manager William Kennedy, who is also an adjunct faculty member at WPI, advise IQPs that deal with such issues as hazardous waste, traffic control and the effects of Massachusetts' controversial Proposition 2½ on the financial viability of the town. Other Worcester area communities also serve as active project sites.

Demetry is coordinator of an IQP division focusing on energy, resources and the environment. This is one of six divisions ranging from issues in economics and social development, to planning in urban and rural environments. His background in systems engineering serves well his interests in the environment. In fact, his nine years on the Holden Planning Board included the posts of chairman and vice chairman. Since 1981 he has served on the Board of Selectmen and as its chairman for a year.

Yet the IQP was by no means Demetry's only responsibility as chairman of the Division of Interdisciplinary Affairs. Each year, he says, about a half dozen students come to DIA for guidance on constructing major fields of study that fall into no particular academic department. Jody Bobbitt, for example, a senior from Lincoln, MA, and formerly an electrical engineering major, is now studying technical writing as an interdisciplinary major. WPI's membership in the Worcester Consortium for Higher Education enables her and other DIA students to take courses not offered by WPI at colleges such as Clark University and Holy Cross.

A popular area of study for DIA students, Demetry adds, is biochemistry, a major for which there is no established department at WPI. "The holistic approaches to education built into the Plan and the Consortium enable less conventional study where the college has not assembled the critical mass necessary to support a major in these fields."

Another of the DIA's responsibilities involves counseling students to overcome decision blocks that may seem to limit their academic and project opportunities. This activity keeps not only Demetry, but also DIA teaching assistants Jerry Kulhowvick and Michael O'Donoghue busy much of the year. And once each term, the DIA sponsors the Technology and Society Conference (TSC), giving IQP teams the opportunity to present progress reports on their projects to their peers.

"Many projects are on-going from year to year," says Kulhowvick, "like the NASA-MITRE-WPI Space Shuttle experiment program, and students yet to begin their IQPs often learn about project openings through TSC sessions and other formal and word-of-mouth channels."

> "The IQP sets WPI apart from its peers. No other college I know of has an IQP-type activity as a degree requirement. Yet it's an orphan of sorts, with no academic discipline to call home."

Demetry has been deeply involved in the Washington, DC, Project Center since its inception in 1974. Together with Frank Lutz, the Center's director, Demetry has played a major role in shaping and guiding this, one of WPI's most prestigious programs.

Each fall, 36 students, chosen by a competitive selection process, live in Washington and work on their IQPs at agencies such as the National Academy of Science, National Association of Manufacturers, Patent and Trademark Office, and in the offices of Congressional representatives.

"The Washington Center is one of WPI's showcase programs," Demetry says, "but more important, it gives some of our finest students first-hand opportunities in the pressure-cooker atmosphere of the nation's capital." (See "Mr. Boynton Goes to Washington," forthcoming in the February 1986 WPI *Journal*.)

Since taking over as DIA chief in 1975, Demetry has managed to spend one-fourth of his time teaching in electrical engineering. And while the action for him may have centered more on the side of his DIA activities, he has always felt a strong identity with his EE colleagues.

"It's been a great ten years at DIA, but in truth I'll be happy to return to full-time teaching and research."

Still, a decade in academic management may have left more of a mark on him than he realizes. "Much of my research will focus on investigating the capabilities of WPI's network of AT&T personal computers and helping students get the most out of the system."

He says he'll also continue consulting as an expert witness in litigation involving electrical systems and devices and working as an advocate in environmental and community issues, an interest he fostered while a member of the Sierra Club in California.

But the odds are that Jim Demetry will remain one of the best friends of the IQP, that wandering prodigy of the WPI Plan, that precocious offspring that needs constant guidance, encouragement and perhaps even TLC.

"WPI has made a commitment to the IQP. We ought to continue to demand of our faculty high quality in their project activities. But without the appropriate rewards system, this goal may never become completely realized."

He adds: "By its very nature the IQP will continue to be WPI's most challenging *and* most rewarding educational experience. But because it is so unusual, it may also continue in a state of unstable equilibrium, ready to tumble if the system that established it isn't in proper balance."

The Times They Were A-Changin'

Berkeley in the 1960s, through the eyes of Dr. Alan Foss '52 CHE

By Michael Shanley

Campus unrest at the University of California at Berkeley may have ended with the Vietnam War, but the effects of the turmoil, like battle wounds themselves, lingered for years.

"It hurt us," says Alan Foss '52, Professor of Chemical Engineering at Berkeley. "The legislature and the people of California lost confidence in the university. Our budgets were cut way back. Research was interrupted and the campus itself didn't get the attention it needed. We're just now starting to see the upswing."

The social and anti-war protests of the Sixties and early Seventies had their seeds in Berkeley's legendary Free Speech movement, led by Mario Savio.

"The movement was used by some as an excuse to destroy property and stage confrontations," says Foss, a thoughtful, soft-spoken man with longish silver hair and sideburns. He arrived in Berkeley in 1961, just before the turmoil began. "It was very upsetting. It made my stomach churn."

Academically, too, there were some problems. "Some of the faculty members who sympathized with the students bent the rules," says Foss. "The social sciences and the humanities were in worse shape than the physical sciences, but, in general, there was a widespread sense of chaos. Students looked at all of us as part of a monolithic ogre. They treated everyone on the same basis."

While a stroll across the Berkeley campus today shows the 30,000-student university to be anything but staid—Sproul Plaza, for instance, is still home to mimes, protesters, musicians and an assortment of street people—Foss sees a marked change in attitude.

"Students are more conservative now," he says, "more focused. They want to establish themselves in a profession. In many ways, they've rejected the ideals of the earlier students."

As for the faculty, Foss says, "We may not move as quickly as we once did, but we look at issues more carefully now. We think things out."

A Connecticut native, Foss came to WPI from Mt. Herman prep school near Northfield, MA. Looking back at his college days, it's a handful of chemical engineering professors that he remembers.

"[Recently retired Dean of Graduate Studies and Professor Wilmer L.] Kranich, [retired Professor John M.] Petrie and [Professor Robert E.] Wagner—they were really dedicated teachers, full of energy and enthusiasm. They did yeoman's service."

Foss first visited Berkeley in the Fifties, while vacationing in the California mountains. "I was working as a research engineer for Du Pont in Delaware. I always had a teaching career in the back of my mind, and when the time came to finally decide, I had some contacts at Berkeley."

The early Sixties, Foss says, were a good time to be a teacher, especially at Berkeley.

"It was a great growth period," he recalls. "The chemical engineering department was half the size it is now and just beginning to take off. The National Science Foundation was bursting with money. The intellectual climate out here was tremendous. It's a hell of a lot harder to get started in teaching now."

A specialist in process control who teaches on both the graduate and undergraduate levels, Foss has seen a good deal of fluctuation in the appeal of chemical engineering over the years.

"Ten years ago, we were graduating only 40 or so students a year. Then in the late Seventies, things picked up as the energy crisis developed. By 1980, our students were getting three or four job offers each. When the bottom fell out of the synthetic fuel products market in 1981 and 1982, the job offers dropped. By 1983, only 20 percent of our students had jobs when they graduated.

"Things picked up again last year, when about half of our graduates had jobs, many in the semiconductor industry. Employers found that chemical engineers can do a lot for them."

As Foss looks back on the turmoil that disrupted the halcyon days of the early Sixties, it is the time frame he finds most surprising.

"I didn't expect it would last nearly that long," he says of the unrest. "I also didn't expect the financial effects to be so severe—our budgets were affected for almost 20 years.

"We came through it fairly well, though. Except for some lost opportunities, I think we're stronger for it."

Three of Foss's four children attend Berkeley—a son in chemical engineering and two daughters in architecture. (A third daughter is at San Jose State.) Unfortunately, in California there is no tuition remission for children of faculty members.

"It's seen as being non-egalitarian," sighs Foss.

Mike Ciesielski

Opening up the past

Shedding their dusty, Old Curiosity Shop images, college archives are coping with an information explosion, the computer revolution—and the legacy of Watergate. Behind the new archives is a new breed of archivists, ordering the past and looking to the future.

"Twenty years ago, the rule was that things were just put in boxes and stuffed in closets," says Shelley Wallace, archivist of Hartwick College. Indeed, in the late 1960s, when David McCullough, author of *The Great Bridge*, went to Rensselaer Polytechnic Institute to research the history of the Brooklyn Bridge, he was led to a large, locked storage closet. Inside that closet were the papers of John and Washington Roebling, chief engineers of the bridge. McCullough was amazed: "There were boxes of papers that probably hadn't been opened since the family had given them. In many cases the papers were tied up with the original shoelaces and strings."

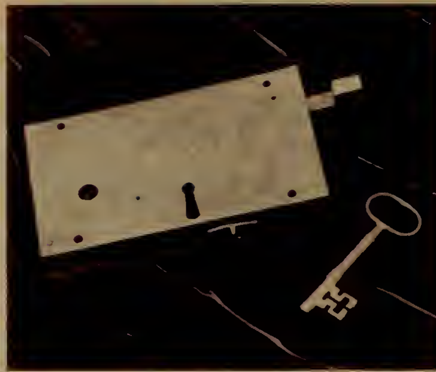
Such stories are legion among college archivists and archives users, and they are not surprising. College archives were often placed in the care of already overworked librarians who did not have the time either to fully explore the holdings or to deal with the special problems of cataloging and preserving them.

That situation began to change during the 1970s. In the 40 years since the founding of the U.S. National Archives in 1934, standards of appraisal, preservation and cataloging of archival materials had been established and new generations of archivists had been trained. More money had become available. Books such as *Roots* interested people in social history and genealogy. Academic historians began to explore the well-organized major archives—and missed that organization at colleges.

Other, more subtle, forces were at work. "Major anniversaries usually trigger a lot of interest in what's in the archives," says Charlotte Brown, who became the archivist of Franklin & Marshall when the college created the position in anticipation of its 1987 bicentennial. And the scrutiny placed on written documents and tapes during the Watergate trials made heads of corporations and academic institutions alike aware of the importance of maintaining complete records.

"I don't think the original idea was to house dance programs from military balls and ground-breaking shovels," says Winifred Spencer Dulany, archivist of Western Maryland College, "but I get my fair share of both." Nevertheless, college archives hold more than cherished memorabilia. Properly speaking, they are made up of any papers or artifacts pertinent to the ongoing history of an institution: Board meeting minutes, presidents' papers, commission reports and grade

By Leslie Brunetta



Stephen Mullen (both)

Boxes such as the one labeled "F&M, Old Papers," previous page, may hold gold or straw. The lock and key (left) of Rudolph House, where Villanova's first students and teachers lived and studied. Villanova's "other" Liberty Bell (right) was to replace the cracked Liberty Bell but instead rang with it on July 4, 1776. RPI has the telegram (below) telling Washington Roebling that the first cable had connected his Brooklyn Bridge towers.

records. Student publications, sports programs, scrapbooks and photographs. As a collection, they are meant to compose a portrait of an institution's past. And when used wisely, they can help to determine the institution's future.

The primary purpose of college archives is to support legal and other decision making, says archivist Helen Samuels of MIT, whose archives are frequently cited as among the best in the nation. But archives also serve as a body of information made available to researchers. "The second is only possible if you're doing the first right," Samuels says. "At first, I think a lot of administrators thought we were establishing the archives for 'the greater glory of MIT.'" But, in fact, administrators have found day-to-day uses for the archives as a resource for committees on topics from reaccreditation to curriculum.

Legally, the archives can be one of a college's best forms of defense. If, for example, a college is sued for discriminating against women in the hiring of faculty, the archives might yield records showing the sex ratio of the position applicant pool, staff evaluations giving fair reasons for not hiring particular applicants, and records showing the hiring of women in the past. If a memo has been written by a past president asking that ways be found to increase the number of female applicants for posts, it would be in the archives, ready to be introduced as evidence.

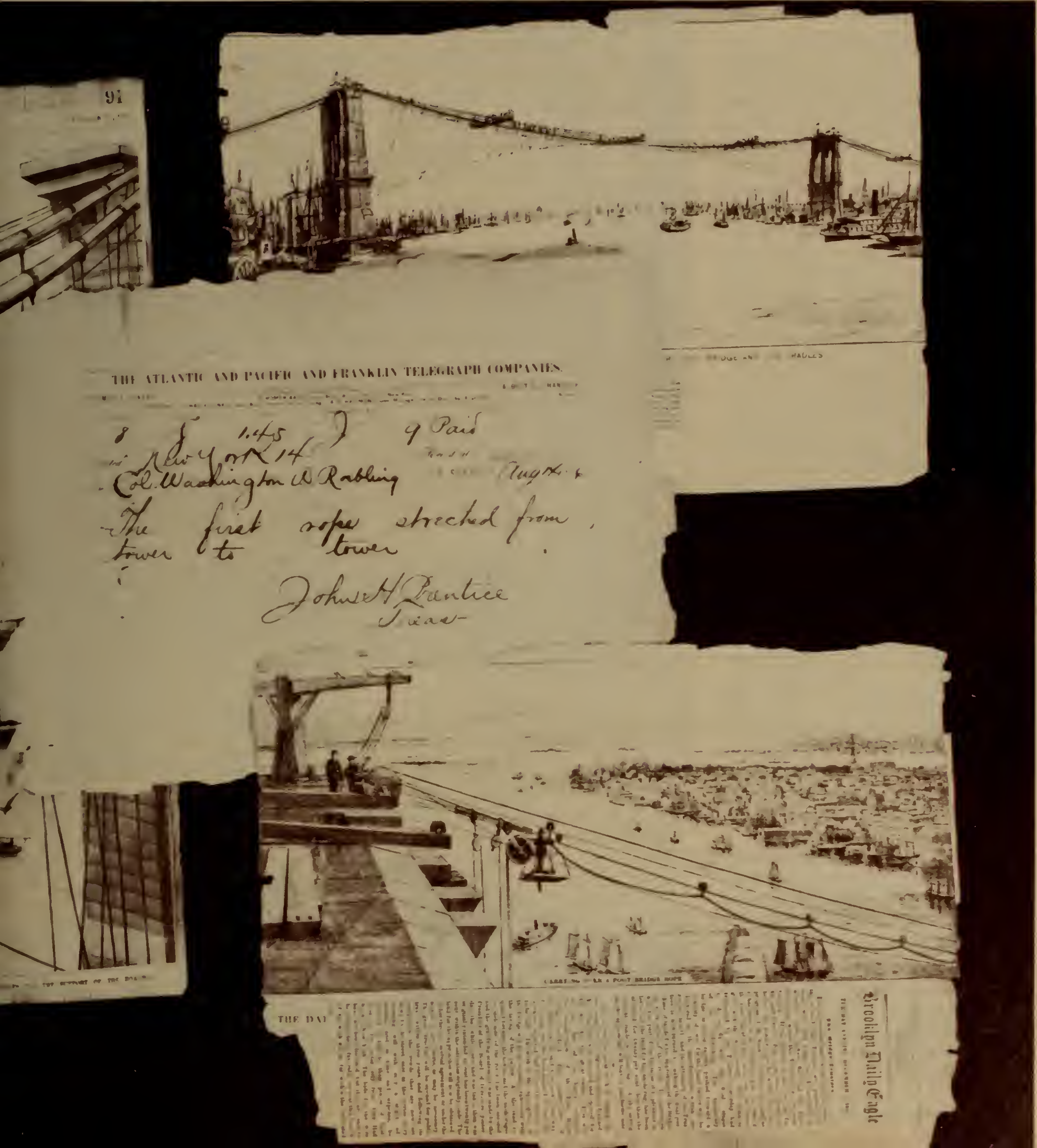
On the other hand, if the college has indeed discriminated against women, archival records might also be used against the college on trial. Thus, the idea of leaving a paper-trail may go a long way toward promoting increased corporate responsibility.

Having good archives can also be cost effective, says Elizabeth (Cam) Stewart, archivist at RPI: "Unless an administrator has been at an institution for more than 10 years, he or she may not know that a committee was convened in the past to deal with exactly the same topic arising now. I wish we had a record of time and money saved by not having to repeat committees over and over again, thanks to having records of previous committees close to hand."

When archives are kept with the goal of maintaining complete information rather than of glory-mongering, it benefits the researcher as well. John Thelin, director of the Higher Education Doctoral Program at the College of William and Mary, researches the history of the American university and the changing experience of getting a college education: "The archives are the institutional memory. The codicil to that is that a person's memory may have amnesia or total recall, be ordered or bogged down in trivia. You really want to get away from these horrible house histories that just glorify the past. The secret is to be more universal."

Universality can seem a pretty tall order. Every day, campus word processors spew out both papers and diskettes. Copying machines duplicate the most insignificant memos. Students and administrators fill out form after form on rooming and dining preferences, insurance coverage, taxable income, academic interests and performances, ethnic and religious affiliations. "One of the most important qualities an archivist can have," observes Winifred Dulany, "is to be a good weeder." Lora Brueck, archivist at Worcester Polytechnic Institute, agrees: "I don't think anyone else at the school has the knowledge, time or space to decide what to keep or not to keep."

Most archivists come into the profession with a degree in either history or library science, and often with one of each. A background in history helps to predict what might be useful to future researchers, while library science teaches methods of classification. But for this training to be truly effective, there must also be that essential element of obsession lurking near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Robert S. Arnold

the surface of the archivist's personality —the desire to organize. "You need to have a desire for order," explains Jane desGrange, Hartwick's museum director, who oversees the archives. "I don't know how to train it unless you have a mother who makes you put all your socks in one drawer."

Through the years, materials have made their way into the archives "over the transom and under the door," says Jane desGrange. If anything, the flood hasn't yet reached its crest. Besides obtaining documents and artifacts through donations and purchases, archivists now find themselves seeking out, and combing through, the inactive files of campus offices.

Surprisingly, a pivotal figure in this shift in archival policy has been Richard Nixon. In September 1974, after resigning from the presidency, Nixon made an agreement with General Services Administrator Arthur F. Sampson: 42 million pages of documents and 880 tapes—the very coals burning at the center of the Watergate inferno—would be moved from Washington to California and stored near San Clemente at government expense. No one could have access to them without Nixon's permission. He could hold the tapes and papers until September 1, 1979, when they would be donated to the United States—with the provision that Nixon could order any of the tapes destroyed. The agreement also stated that all the tapes would "be destroyed at the time of his death, or on September 1, 1984, whichever event shall first occur." The full truth about the Watergate affair would never be known.

The assumption made was that the documents were Nixon's personal property, even though they had been made at taxpayers' expense. Outraged, Senators Sam Ervin, Gaylord Nelson and Jacob Javits introduced a bill which passed by a vote of 56 to 7 to become the Presidential Recordings and Materials Preservation Act. It directed that the papers generated in Nixon's presidential office belonged not to

Getting the goat at WPI meant capturing this statue (left) from another class. The small Chinese masks (right) and bronze seated Isis with suckling Horus (below right) are in the Western Maryland archives. A 1761 letter patent (below left) allowed John Hartwick to settle on land bought from the Mohawks. With it are a deed for Hartwick Seminary's land and a deerhide trunk brought there in 1830.

Mike Cieselski

Mike Cieselski

him, but to the nation. In 1978, the Presidential Records Act applied the principle to all presidents, effective from January 1981.

Parallel policies have been put into practice on campuses and in corporations across the country. If the records of a university president, say, are perceived as university rather than personal property, they are not so likely to be lost when the president changes jobs or cleans out his files. "It was a major step when the board of trustees in May of '82 set the policy that documents were the property of RPI and not of employees," says Cam Stewart. "This gave us the right to collect and preserve them. It really helps our chances of getting them."

Not that college employees are as possessive of their documents as Nixon was. But having worked with issues on a daily basis, they may underestimate records' value to some future historian. And before they understand why the records are kept and that any sensitive records can be classified, they may be suspicious: "Just as I get very possessive of the archives, people get possessive of their records," says Shelley Wallace. "I don't think people want someone coming in and telling them what to keep and what to throw away. You need to be tactful."

That's where a process known as records scheduling comes in. The archivist examines the types of records generated by an office and determines which should be automatically sent on to the archives and which can be thrown away once they become inactive: the progress of the records from creation to redemption or damnation is "scheduled." From then on it's up to the office staff. This separation of powers makes the appraisal system more efficient and can keep sensitive documents confidential. Not even the archivist needs to see them: the staff can be taught to organize and pack documents before sending them on. And there is an added benefit for administrators sensitive about confidentiality, Charlotte Brown says: "If you have good control over your records through the records management system, the chances of documents being leaked or misrepresented are minimal." The process is new at most universities, but the response has been overwhelmingly positive. The Rev. Dennis Gallagher, O.S.A., the new archivist at Villanova University, reports, "I've been very pleased with the enthusiasm of the people I've been approaching."

Knowing that a decision made today may either greatly help or hinder the work of the historian of tomorrow can make appraisal a nerve-jangling experience. Helen Samuels notes that it's really a matter of risk assessment: when the federal government is saving only about one or two percent of its documents and college archives an average of 5 to 10 percent, it's not surprising that archivists worry about missing something. "I know what historians' current needs are, but what about their future needs?" Charlotte Brown asks. "You know you're going to make mistakes."

"If we keep the number of records that we are producing now, research becomes impossible," observes Shelley Wallace. "There's a trade-off—the more records are kept, the less significant each of them becomes." David McCullough's research has confirmed this view: "To me the irony is that we not only have more documents than ever, but we also have fewer documents of any value. No one writes letters anymore. We're going to have official memoranda documenting our age—people in the future will think we spoke in memorandese."

Having selected the documents worthy of storage, the archivist has to use a method of storage worthy of the documents. Temperature and humidity have to be controlled. Staples and paper-clips, which can rust, have to be removed before paper-based records can be stored in acid-free containers. This is essential: the acid in the wood pulp base of most paper produced after the 1880s causes relatively rapid deterioration. By separating this paper from the air, which also contains acid, deterioration can be slowed.

But contemporary documents are not just made of paper. The words and images of the 20th century are also carried on film, photographic prints, video tape, audio tape, phonographic disks, computer disks both hard and soft, computer tape,

Mike Ciesielski

Two masks (left) for Franklin J. Schaffner '42's movie, "Planet of the Apes," are in F&M's collection. In 1824, the Rensselaer School was founded and the first book of RPI Board of Trustees minutes (right) begun. The diary of WPI graduate and John Deere designer Theo Brown (below) documents world events, family outings, and his more than 160 agricultural patents in 66 volumes of words, watercolors and photographs.

Tom Griffin, RPI

computer cards and paper tape. Each presents its own problems.

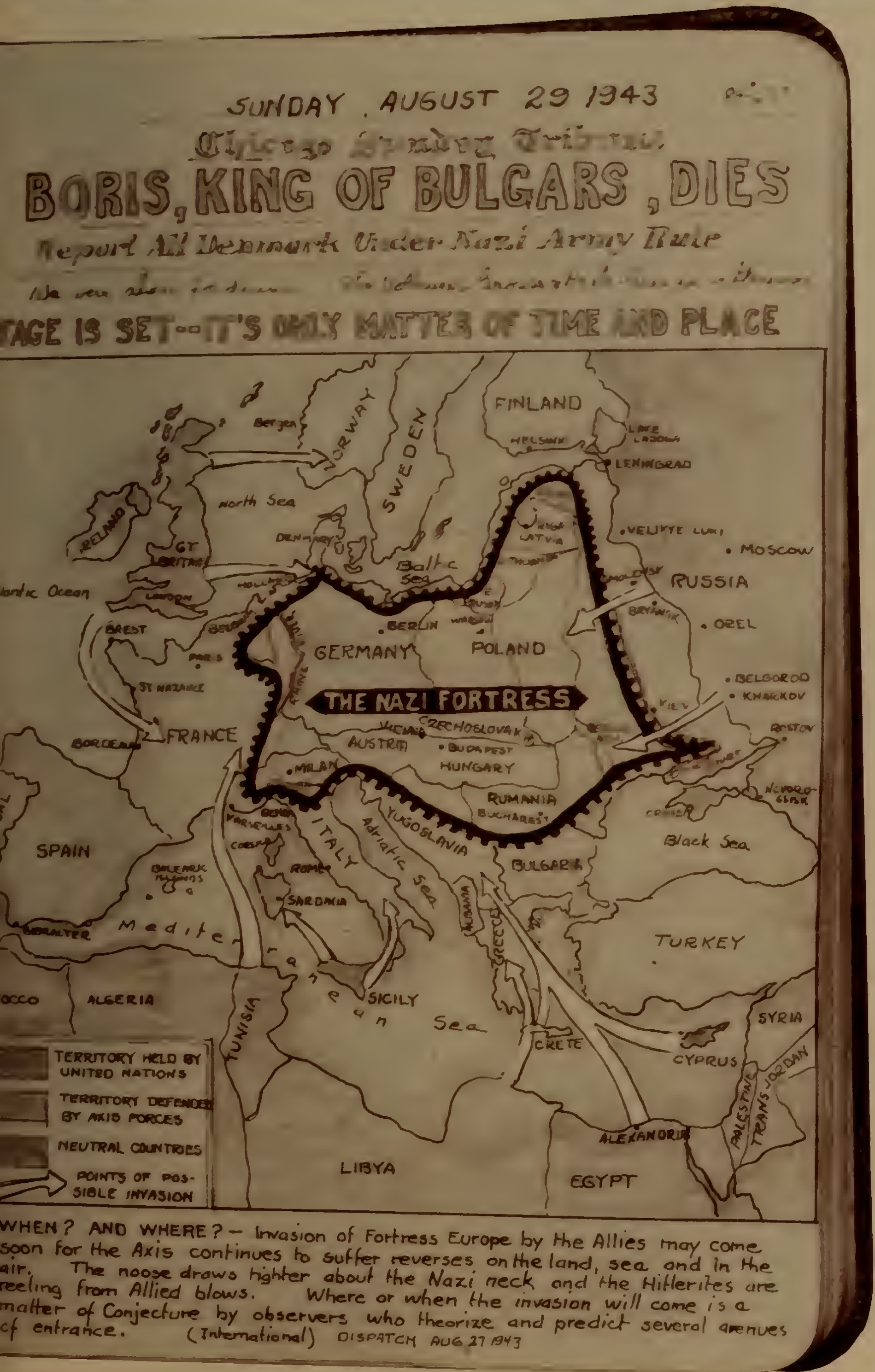
Movie film, especially that in color, begins to decompose after about 20 years, and rehabilitating it is a complicated and expensive process. (John Thelin has known films to explode when first exposed to the air after many years.) Photographic negatives, plates and color prints are prone to chemical processes that cause fading and discoloration. Video and audio tapes need to be "exercised" annually by rewinding. Phonographic disks warp and can be scratched, and may in any case become nothing more than substandard Frisbees when record players give way to the compact disk revolution.

Imagine the problem that storing all these materials—all of which will be imperative for an understanding of our time—poses for the archives. Even if it has the wherewithal for the staff and the materials needed to preserve them, it would also have to physically segregate them by their temperature and humidity requirements.

And then there's the computer. Computers may make life easier for the office worker and the researcher, but they conjure up nightmares for the archivist. Technology constantly advances. The Committee on the Records of Government (created by a consortium of organizations to advise federal, state and local governments on the challenges of record keeping) cites a dramatic example of the havoc such advances can cause. In the mid-1970s, archivists discovered that, less than 15 years after the results of the 1960 census had been stored on computer tapes, only two machines capable of reading the tapes still existed—one was in Japan and the other had already become a museum piece in the Smithsonian.

Even if computer technology were to stop developing (a highly unlikely if), the variety of computers causes immense retrieval problems for the holder of today's documents. Anybody who has tried to read

Robert S. Arnold



a DECmate II disk on an IBM PC will quickly realize the problem—to read all the disks they have, archives would need to keep a representative from each compatible group of machines. "It seems as though with every advance you make with computers," comments Villanova's Father Gallagher, "you have to worry about how to retrieve material."

It was once thought that computers' ability to store hundreds of pages of information on something as small as a 5 1/4" square diskette would be a boon to archives. Written documents whose actual physical existence was of no intrinsic worth would be transcribed onto diskettes. Archivists could imagine scaling down their storage measurements from cubic yards to cubic feet. But aside from the incompatibility problem, "storing on computers is still controversial," according to Shelley Wallace. "How long will floppy disks last? When you're talking about archival material you're talking about things that should last for a thousand years."

Floppy disks don't last a thousand years. In fact, some archivists believe that even under optimal conditions, floppy disks begin to lose data after five years. Magnetic tapes last about 20 years and the specifications for their ideal storage fill six pages in a National Bureau of Standards handbook. The irony is that in many cases, rather than having tapes and disks take the place of paper in the archives, archives are having to make space for both—a hard copy of the material stored on the tape often seems the best insurance that it will not be lost. An added safety measure is to keep a hard-copy log of the program governing the tape's storage system.

Computers can also eliminate large amounts of documentation. "I'm concerned about electronic mail networks," explains Helen Samuels. "When they were first designed, they acted as a substitute for the telephone. But now they're being used as a substitute for letters and documents. A lot of communication and decision making is going unrecorded."

The Committee on the Records of Government points out that the kinds of records that have traditionally formed the bulk of archives holdings—memoranda, letters and minutes that show how decisions are made and that are used in litigation to determine accountability—are the same records made most vulnerable by the advent of administrative computers. Memoranda and letters are replaced by electronic mail. Drafts of reports, which often reflect changes of ideas, are eliminated when one draft is recorded over another on disk.

Archives users interested in literature should also sit up and take note of this phenomenon. As contemporary writers stop processing their words with No. 2 pencils and switch to 128K personal computers, the study of changes made in the course of composition may become a thing of the past. Manuscripts will be replaced by print-outs: the struggles of deciphering a scrawl cramped by the rush of inspiration will be gone, but so will the satisfaction. To get an idea of the impact of this change on the study of literature, ask any T.S. Eliot scholar what would have been lost if Ezra Pound's emendations to "The Wasteland" had been made not in pencil on Eliot's manuscript but right on the computer keyboard.

Another computer-caused problem exists. The same mechanism that makes filing documents easier for a secretary can make retrieving those documents that remain almost impossible for the archivist—files often have whimsical names that are meaningless to the uninitiated. On top of that, they are listed chronologically or alphanumerically rather than by subject. Trying to reassemble the paper-trail of a decision is like being unable to see the forest for the trees—and not even getting the satisfaction of knowing the difference between a sycamore and an elm.

The only way out of this mess, believes Helen Samuels, is for software writers to begin to understand the implications of their programs, and to rewrite them so that, for instance, drafts with changes other than spelling corrections are saved. Software writers have done a fantastic job for the primary users of computers, Samuels says, but have unwittingly given the cold shoulder to future users: "We've got to raise the consciousnesses of those who are designing the systems, make them think about the future uses and reuses of information. The guys designing are too current minded."

The computer is not completely vicious, however. It can also be the saviour of the archives. With the vast bulk of materials being produced, an easy and efficient way to catalog and retrieve them is essential. And that's where the computer's ability to store huge amounts of information and to quickly match up bits over here with bits over there comes in. Many college libraries' catalogs are, or will soon be, stored on a computer. The natural next step is to include the archives' collections. And while this makes the job of both archivist and researcher easier, the real advantage will be to expand the horizons of both by linking up the catalogs of many archives.

On a single campus, this might mean erasing artificial barriers, as Lora Brueck intends to do: "I'm hoping to index the archives photo collection with the Institute computer to try to tie up the different photo collections around campus." On a national—or even, eventually, international—scale, such link-ups will mean that a researcher working in one archives will be able to find out what's in another without having to travel there. It may even be possible that something like the interlibrary loan system will be feasible with facsimiles of documents that are not too fragile to be photocopied being sent from archives to archives.

Computer links are already in place in some of the archives connected to major, well-endowed libraries. The libraries belonging to the Research Libraries Group (RLG)—Johns Hopkins, many of the Ivy League schools, and large public universities such as the University of Iowa—share an on-line data base that effectively makes a user of one library a user of all. A system called the Online Computer Library Center has a similar service for smaller libraries that can't afford the RLG service.

With this kind of program, use of archives could increase dramatically. Remember, archives materials don't circulate as library books do. "A great problem is that you have to be at the archives to do research," John Thelin says. "So you need some kind of a grant and time off to be there. It often means that you're limited by time as to what you can do. And what's available to you through institutional peculiarities tends to drive what's written. You can become landlocked." Link-ups could greatly ease such problems.

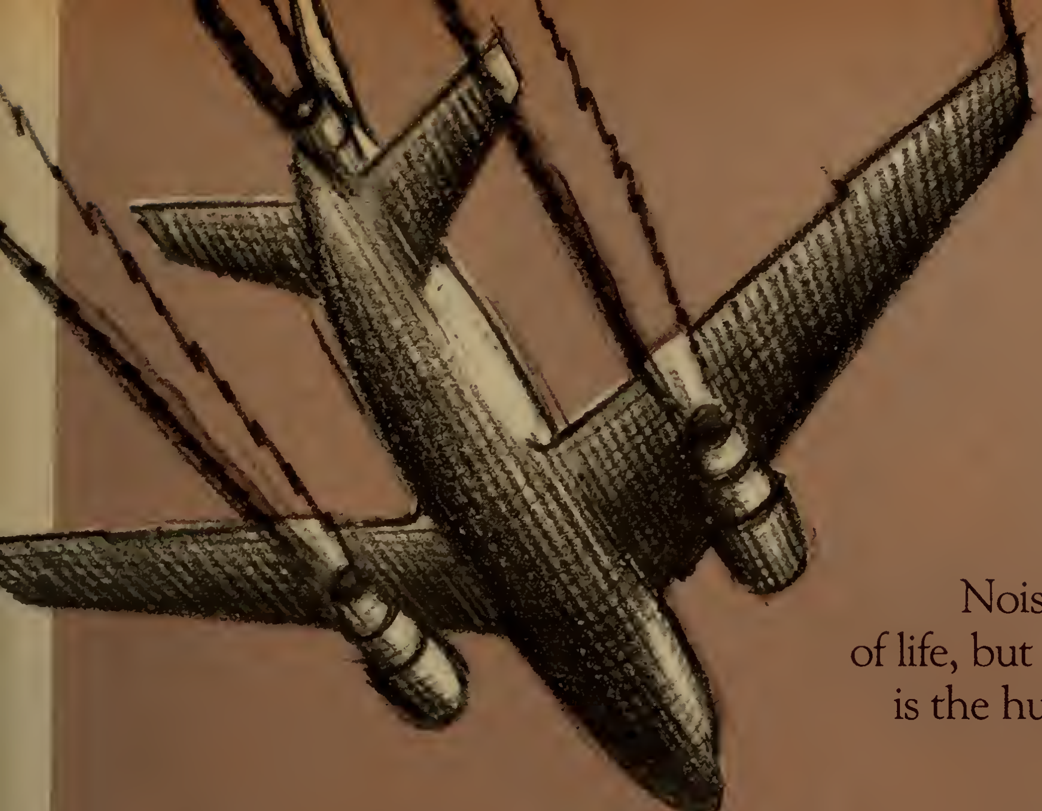
If you don't know where you've been," says Jane desGrange, "you don't know where you're going." More and more people are subscribing to that philosophy. "I think it's probably just the process of a society maturing," David McCullough says. "We are such a throw-away society, but we know that there are things that we absolutely must not throw away. We are thankful for past generations for saving things."

As more people recognize the value of history, history is forced to recognize the lives of more people. "In the past, archives have [illegible]nly documented the male elite, but they are really beginning to document the average person now," says Charlotte Brown. "I think the whole aura of the archives will change. We all have the right to know that our history is being kept, and to know that we can get to it."

Increased use of the archives will inevitably cause a shift away from the casual practices of the past. "There's nothing like finding the trunk in the attic," says McCullough, "but it's been getting less and less like that. And rightly so." The ambivalence evident in McCullough's statement is shared by many, including the archivists, as the archives are more professionally managed. For the archives to be put to the best use, systematic cataloging of materials is essential. And, if the preservation of many documents is to be assured, more care must be taken of their handling. But will it become too orderly, too tame?

"Archives need to give people who visit them some time and space to roam," says John Thelin. "We need that element of discovery rather than just finding what's ordered." McCullough agrees: "Something really does happen when you're working with original documents—a reaching of the past that comes about only in this way. Research has to be an adventure. You get your energy from that."

McCullough has noticed that access to certain materials—old newspapers, for instance—isn't as broad as it used to be. He says that archivists are continually forced to flip a coin whose tail is preservation of materials and whose head is service to the researcher. More often than not, they still manage to toss heads. "I have no feeling that the archivists' proprietary feelings interfere with me," he notes. "The most important ingredient in the archives is the human element—people who not only know the archives but are stimulated by them, whose satisfaction from their work comes from sharing their knowledge and enthusiasms. Archivists have been the unsung heroes for too long."



Noise is a physical fact of life, but when the receiver is the human ear, it's hard to be objective.

By Mary Ruth Yoe

Illustrations by Allen Carroll

UNWANTED SOUND

About three million dollars' worth of epoxy is being slathered over the road surface of the Brooklyn Bridge in hopes of eliminating its constant, humming whine. Some people like the whine. They find it part of the bridge's history. An artist even included the hum in a multimedia work honoring the span. But for the most part, the people who like the whine aren't the people living closest to it. Residents of those neighborhoods along the riverbank see the epoxy as a victory.

The story illustrates a central truth about the nature of noise. Noise, like beauty, is in the eye—or more precisely, the ear—of the beholder. Even the classic definition of the phenomenon departs from real objectivity: Noise is "unwanted sound."

That element of subjectivity has its roots in the basic diagram of acoustics, a series of three boxes linked by sharply pointing arrows:

$$\boxed{\text{SOURCE}} \rightarrow \boxed{\text{PATH}} \rightarrow \boxed{\text{RECEIVER}}$$

In fact, it would appear that the philosopher's conundrum of a tree falling in the forest has a foregone conclusion. If the tree falls, *something* is there to sense it. Thus, a sound's receiver might be a robot in an automated factory. Or it might be a brick wall shuddering under the rumbling vibrations from a stamping machine badly in need of some form of isolation. Subjectivity enters the picture when the receiver is a person. At that point, sound—like noise—must be talked about not only in physical terms such as mechanical intensity, but also in terms of human perception of loudness.

Although noise is most often thought of in terms of loudness—words like *screech, shriek, bang, crash, bam, bark, blast, rumble* and *roar* rush by in a wave of onomatopoeia, assaulting the ears—the soft creak of a floorboard can be noisy enough to rouse a light sleeper. To someone rushing to finish a monthly report, the sound of normal conversation floating in from the hallway is enough to prompt a significant banging-shut of the office door—the bang probably louder than the conversation. There are even people who do *not* automatically shudder at the sound of chalk scraping across a blackboard.

Because human perceptions are highly individual, the subjective nature of noise—sound received but unwanted by someone for some reason—cannot be ignored. But first, some objective descriptions of the physical phenomenon of sound, as received by the human ear, are in order.

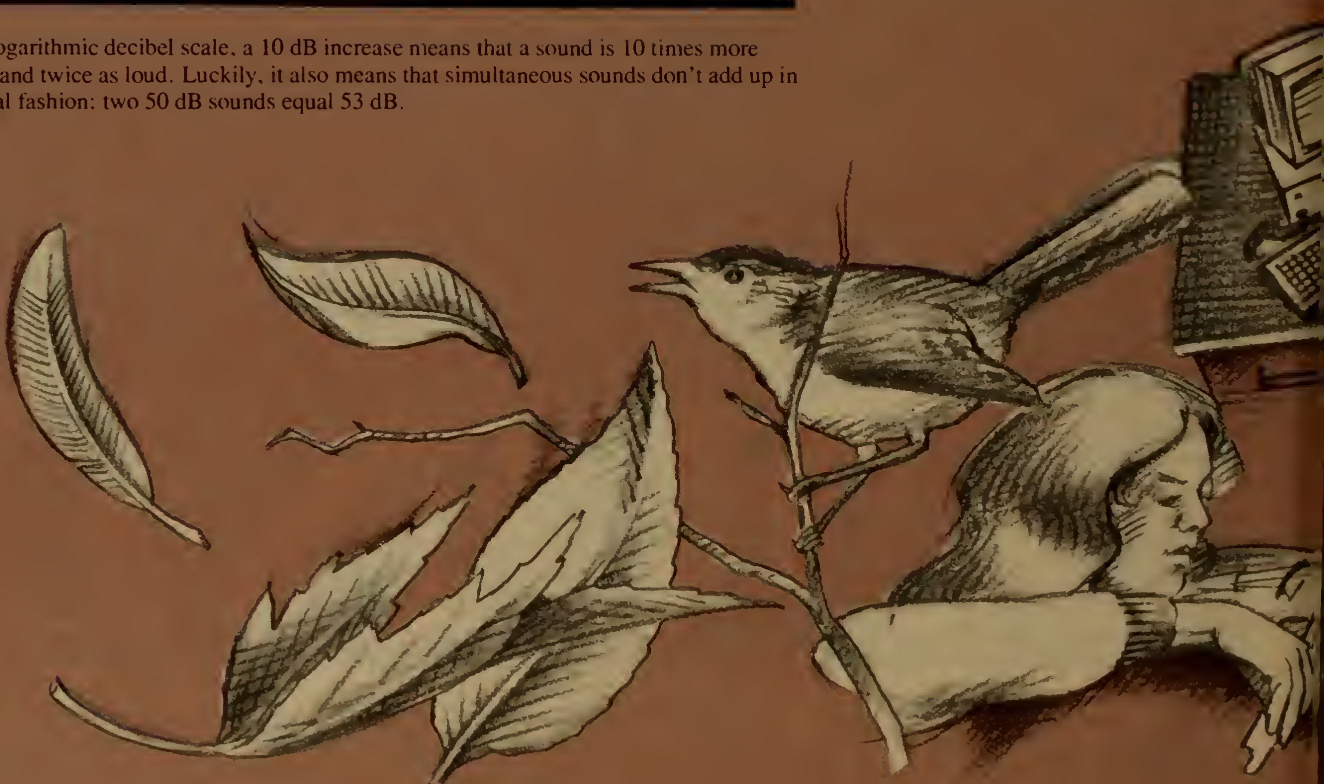
Decibels (dB), named for Alexander Graham Bell, are used in describing both the mechanical intensity of sound and its perceived loudness. The scale is logarithmic because of the wide range of energies and pressures involved. A 10-dB increase represents a ten-fold increase in noise intensity and is perceived as roughly a doubling of loudness. A quick example: 30 dB is 10 times more intense than 20 dB and sounds twice as loud, while 80 dB is 1,000,000 times more intense than 20 dB and sounds 64 times as loud.

The human ear evolved in a world where the average sound level pressure seldom surpassed 70 decibels. That's the sound of an average radio, or an automobile from 50 feet. In the midst of urban rush-hour traffic, you're exposed to about 85 decibels. A jackhammer averages 100 decibels. A jet engine at take-off, from 100 meters, about 120. Thus, while the 20th century cannot be said to hold the patent on loud sounds and conflicting sounds, both are more prevalent today, especially in urban areas.

The ear is attuned to a certain set of signals created by sound waves whose frequencies range from 20 to 20,000 Hz (Hertz, or cycles per second). Hearing is most acute in the range of 1,000 to 4,000 Hz. Into that range fall the majority of sounds that make up human speech, including, at about 3,000 Hz, the sibilant consonants—s, sh, f, and th—that are so important for conversational cues and that,

Background Noise

In the logarithmic decibel scale, a 10 dB increase means that a sound is 10 times more intense and twice as loud. Luckily, it also means that simultaneous sounds don't add up in the usual fashion: two 50 dB sounds equal 53 dB.

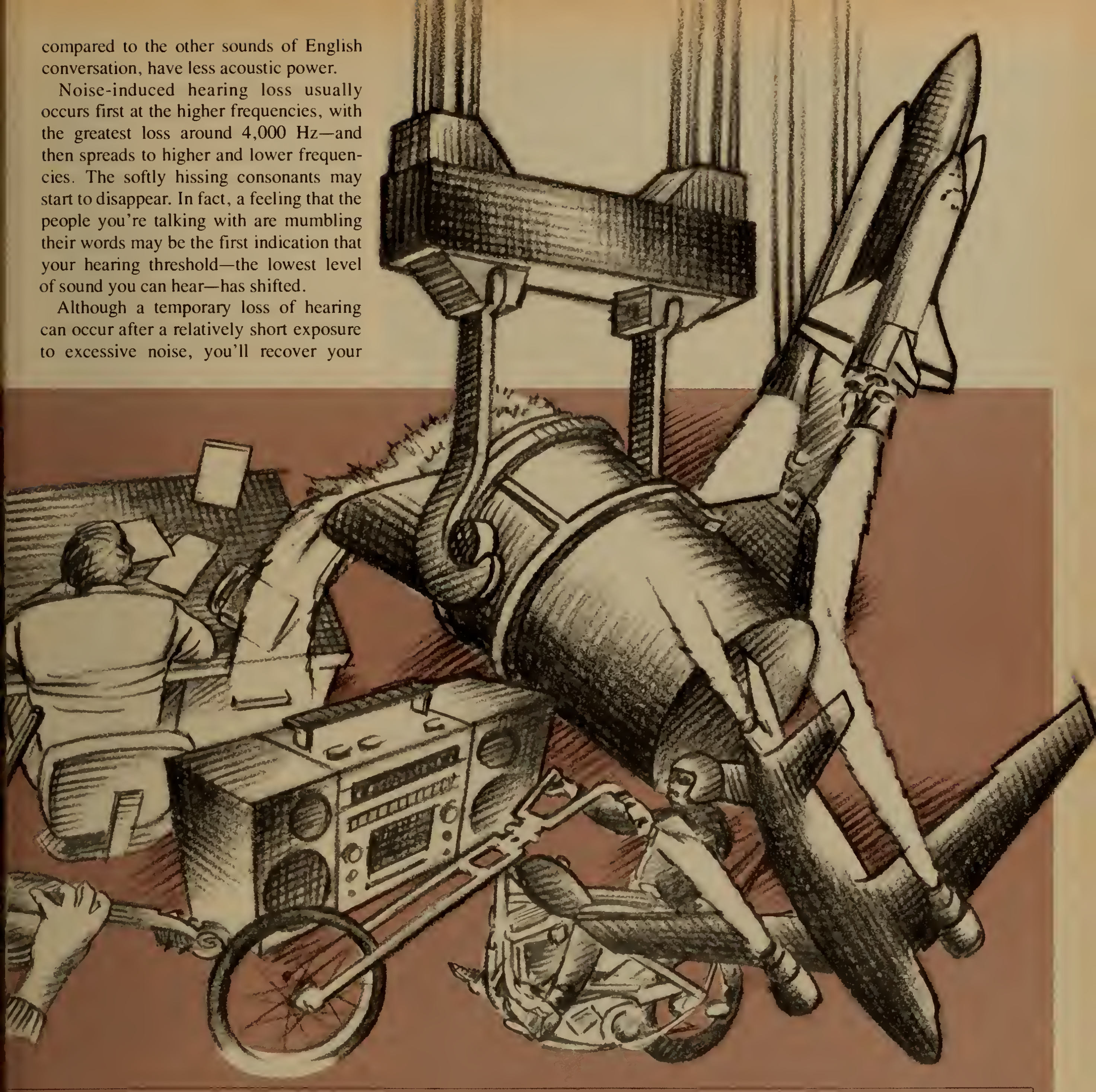


0	10	20	30	40	50
Threshold of hearing	**Rustle of leaf**	**Desert**	**Quiet whisper**	**Soft music from a radio**	**Quiet office**
			When background noise dips below this level, some people may have difficulty getting used to the extreme quiet.	Quiet living space. Only a few people will have trouble sleeping.	Normal conversation possible at distances up to eight feet.

compared to the other sounds of English conversation, have less acoustic power.

Noise-induced hearing loss usually occurs first at the higher frequencies, with the greatest loss around 4,000 Hz—and then spreads to higher and lower frequencies. The softly hissing consonants may start to disappear. In fact, a feeling that the people you're talking with are mumbling their words may be the first indication that your hearing threshold—the lowest level of sound you can hear—has shifted.

Although a temporary loss of hearing can occur after a relatively short exposure to excessive noise, you'll recover your



pre-noise hearing fairly soon after the ruckus has stopped. Prolonged noise exposure—the 40 years of eight-hour days that make noise an occupational hazard for more than half of the country's 13 million production workers—can, however, result in a hearing loss that is irreversible, permanent.

While there's some debate on the level that chronic noise must reach before it literally hurts the ears, the Environmental Protection Agency has designated 75 dB as the sound intensity level at which exposure, over the course of a working life, causes risk of permanent damage to hearing. For those who work in areas with noise levels over 85 dB, hearing conservation programs are mandatory, as are protective devices for workers where the eight-hour, time-weighted exposure exceeds 90 dB (see box, page XVI).

"Hearing loss due to noise is an insidious thing," says Paul Michael of Pennsylvania State University's Environmental Acoustics Laboratory. "You really don't sense your lack of hearing. Sound doesn't appear less loud. You don't bleed or show that you're being damaged." Also, a certain amount of hearing loss, usually in the upper frequencies where noise-induced shifts also occur, is almost expected as the result of normal aging (in the United States one-fourth of the population over age 65 is affected).

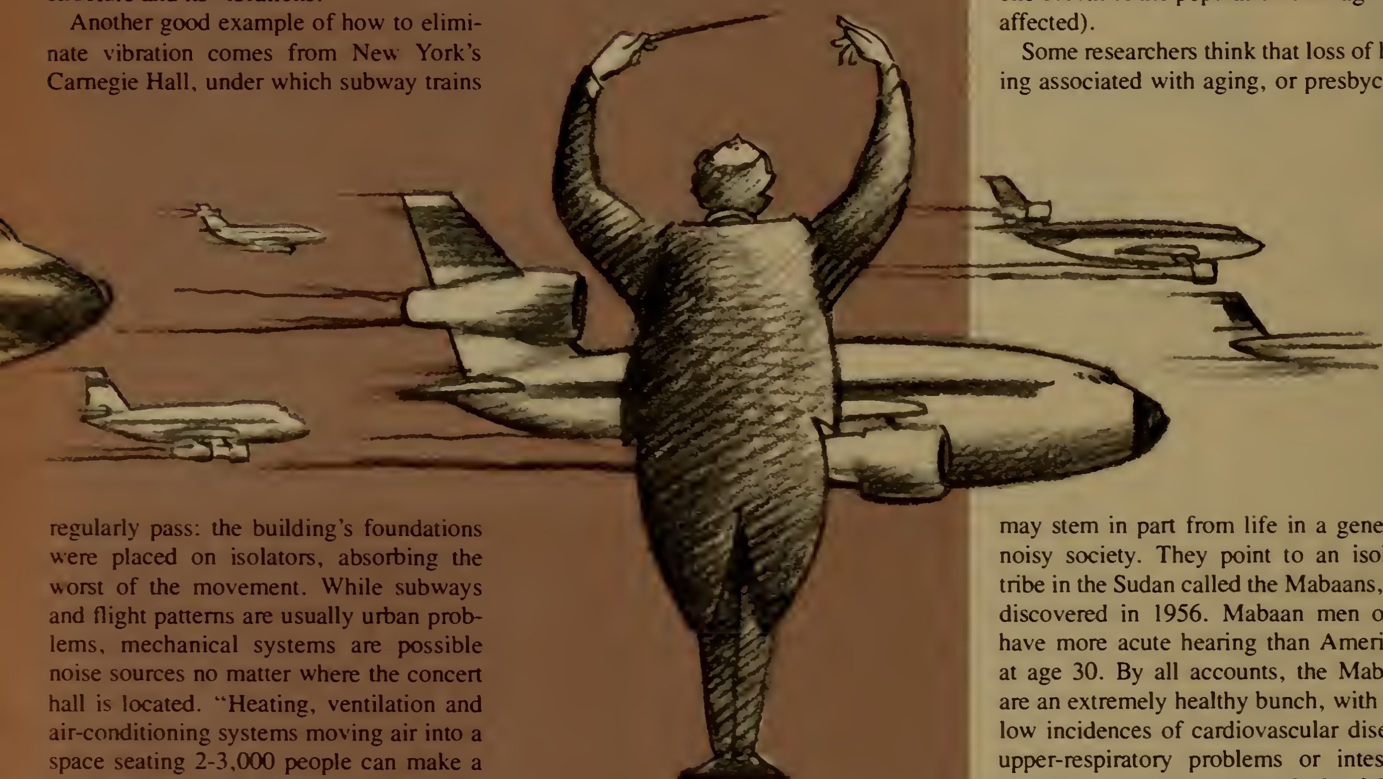
Some researchers think that loss of hearing associated with aging, or presbycusis, may stem in part from life in a generally noisy society. They point to an isolated tribe in the Sudan called the Mabaans, first discovered in 1956. Mabaan men of 80 have more acute hearing than Americans at age 30. By all accounts, the Mabaans are an extremely healthy bunch, with very low incidences of cardiovascular disease, upper-respiratory problems or intestinal disorders. It may be that a lack of 20th-century stress—not just a lack of noise—is responsible for the Mabaans' slower rate of aging in general.

Making Room for the Sound of Music

As a concert hall acoustician—from his Connecticut base, he's worked on more than 70 major concert halls and theaters nationwide—Christopher Jaffe, of Jaffe Acoustics Inc., sets the acoustic criteria for a hall's architects. He's concerned with balancing the musical sounds, creating the right reflecting patterns to showcase the score. He's also concerned with keeping out unwanted sound.

Such noise usually enters the building in one of three ways: as extraneous, airborne noise; as structure-borne noise—vibrations moving the building's surfaces; and through the building's mechanical systems. "Perhaps the best-known example of extraneous noise," says the RPI graduate, "is the Kennedy Center, which was built right by the National Airport landing approach. The solution was essentially to have a building within a building—floating the entire concert hall" within an outer structure. The large air space created between the two separate structures attenuated the airport noise and "also physically isolated the concert hall from the outer structure and its vibrations."

Another good example of how to eliminate vibration comes from New York's Carnegie Hall, under which subway trains



regularly pass: the building's foundations were placed on isolators, absorbing the worst of the movement. While subways and flight patterns are usually urban problems, mechanical systems are possible noise sources no matter where the concert hall is located. "Heating, ventilation and air-conditioning systems moving air into a space seating 2-3,000 people can make a lot of noise," Jaffe points out. Improvements in duct design—making ducts larger, lining them, putting in silencers—lessen system noise. "Isolating the mechanical-systems room—floating it—is often less expensive than floating the concert hall," Jaffe says. Also, having separate systems for the stage and rehearsal areas eliminates the possibility of sound leakage.

Yet the acoustician's carefully thought-out designs and techniques are, Jaffe admits, "somewhat at the mercy of the workmen on the job." Workmen, for example, may drop junk between the building's layers, using up the air space intended for isolation. "Or we'll design a beautiful isolating wall, the workers will put a hole in it for a duct, and then won't caulk around it." The solution: "We try to check on the work in progress as many times as the client will allow."

Is eliminating the noise the less glamorous part of his job? "It's certainly not less important. We can give you a great, qualitative concert hall—but if the air conditioning comes on, and you can't hear the music comfortably—"

The physical damage done to the ear by prolonged exposure to noise is hidden deep in the snail-like curves of the cochlea and its organ of Corti (see box, page XIV). Similarly, the medical consequences of noise exposure are considerably less straightforward than the SOURCE—PATH—RECEIVER diagram appears on the printed page.

If, as you begin to read this paragraph—BANG!—a cap pistol explodes behind you, you'll startle. Your heart leaps up, along with your adrenalin. Your muscles tense. You may begin to sweat. Your body prepares for fight or flight. Then you realize that the alarm was only a cap pistol. Sheepishly, you settle back to your reading, and your body returns, somewhat more slowly, to its normal mode of operation.

"It's one thing for the body to go into overdrive occasionally," says Frank Rosenthal, an environmental health scientist at the University of Massachussetts Medical Center, "and another for it to stay there. Loud noises have always signalled danger, and the body reacts." The most-often cited reactions to noise are known as non-specific responses, and they are associated with stress. For example:

- A Dutch study found that in the six years following the opening of a new runway at Amsterdam's Schiphol Airport, sales of anti-hypertensive drugs increased 100 percent among nearby residents.
- A Polish study compared the medical records of workers exposed to noise levels of 85-115 dB with the records of workers in areas where levels were 70 dB or less. The "noisy" workers had (along with higher incidences of threshold shifts in hearing) a higher incidence of peptic ulcers and hypertension.
- In California, children living and attending elementary school under the air corridors of Los Angeles International Airport were matched with a control group from quieter neighborhoods. The air-corridor children had higher systolic and diastolic blood pressures.

The studies, including laboratory and animal experiments, are numerous. They link noise with elevated blood pressure, gastrointestinal disorders, increased irritability, headaches, fatigue, allergic reactions, vasoconstriction of peripheral blood vessels, increases in catecholamine secretions, sleeping disorders, damage to the brain stem, sore throats, and more.

But the research is often more suggestive than conclusive.

"Most studies are correlational,"

Vibration: It's Not Noise, But

"Where noise was 75 years ago," says Wright State University researcher Donald E. Wasserman, "vibration is today—at least in the U.S." Wasserman is talking about occupational vibration—the mechanical shaking to which 8 million U.S. workers are exposed, from truck drivers to stonecutters.

To engineers, noise and vibration differ mainly in the media—air vs. structures—through which they travel. But, says Wasserman, who once headed the National Institute for Occupational Safety and Health (NIOSH) program on vibration, "when it comes to the body, the two are separate entities."

Occupational vibration itself divides into two entities: whole-body and hand-arm. About 7 million U.S. workers—truck and bus drivers, operators of heavy equipment and farming machinery, some miners—are exposed to whole-body vibration. About 1 million—operators of gasoline-powered chain saws, pneumatic tools, and some electrical tools—are exposed to hand-arm vibration. While whole-body vibration, a general stressor, has not been directly linked to specific health problems, it affects safety: battered by the vibrations from their vehicles, drivers get tired, losing control over the machines.

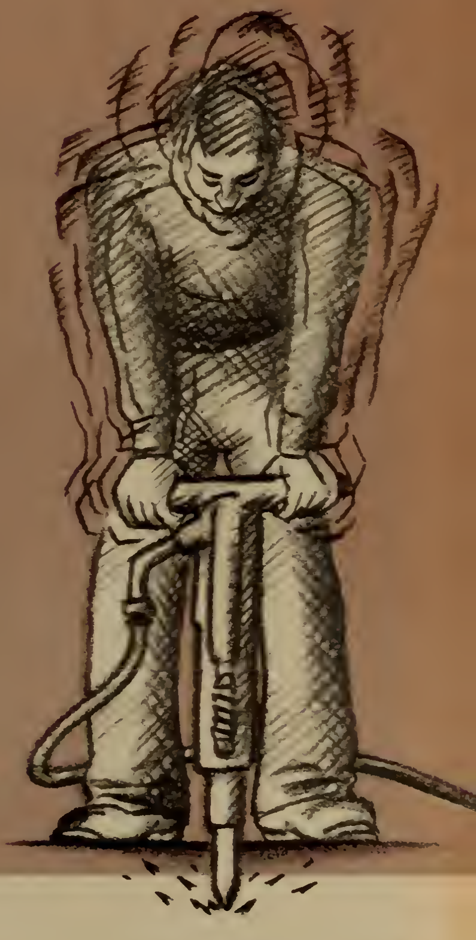
"Hand-arm vibration," says Wasserman, "is a completely different story." The physical symptoms have a name: Raynaud's phenomenon of occupational origin. In 1862 the French physician Maurice Raynaud reported several female patients with a blanching and numbing of the fingers that eventually led to gangrene. With the advent of vibrating tools in the early 1900s, operators began to display similar symptoms of insufficient circulation.

While Raynaud's disease occurs in about 5 to 8 percent of the general population (often women), one of two workers using vibrating tools begin to display Raynaud-like symptoms within two years on the job.

"There are no good treatments," says Wasserman, "and the disease is uncurable." Attacking the problem at its primary source—the machinery—can be hard. Pneumatic tools like jackhammers "depend upon vibration for their working principles. The ability to pull out that vibration is very limited."

So prevention must focus on personal protection—such as avoiding work habits that themselves reduce circulation. Wearing gloves can muffle the vibrating force and—just as importantly—keep hands warm. Cold causes circulation to slow; thus the whole body, especially the hands, must be kept warm. Workers can deflect some of the vibration by holding the tool less tightly: "You don't hold on with a death grip." And they should avoid smoking, especially on the job: "Nicotine is a vasoconstrictor." They should take work breaks (perhaps 10 minutes for each continuous hour of operation).

These are not official regulations. The U.S. has no standards limiting vibration levels, no mandatory worker protection programs à la noise. "Vibration is just starting to come out of the woodwork," says Wasserman, "to be recognized as a real problem."



explains Mark Wagner, who teaches environmental psychology at Franklin and Marshall. "You can't go out and expose people to noise, day after day, to see what will happen." Still, the suggestion is plain: noise is a stressor, and, says Wagner, "Just as lack of sanitation was a major public health problem of the early 20th century, stress-related illnesses are a major health problem today."

Among the many scientific yardsticks used in talking about noise are units known as *noys*. Contours of perceived noisiness, they are used to determine—what else?—annoyance. When an irate citizen phones the local police station to complain of muffler-less hot-rodders, of overamplified outpourings of rock music, of the mournful howling of a neighborhood dog, that citizen is seldom prompted by concern over possible damage being inflicted on the inner ear. More often, the complainant's motivation is annoyance.

In general, high-frequency noise is more irritating than low-frequency noise; high-intensity noise more so than low. Lots of short noises are more upsetting than a steady, continuous source. Complex noise—conflicting layers of sound that the brain automatically tries to sort out—is usually more annoying than noise from a simple source.

The less predictable the noise, the more annoying it usually is, which seems to have a corollary: when a person feels she has control over a noise, she is apt to find it less annoying. Ends are seen to justify means: because an ambulance screaming by is usually considered noise in a good cause, its siren is not so annoying. If a noise is perceived as threatening, it's rated more annoying. People afraid of flying, for example, are more likely to be upset by aircraft noise. Although laboratory studies indicate that the initial exposure to noise is the most annoying, longtime residents of noisy neighborhoods often report at least as much annoyance, if not more, than do recent arrivals.

Annoyance often comes from the *meaning* of the noise. "To a person studying," says Paul Sheldon of Villanova University's psychology department, "the sound of a party in the next room may be more annoying than its actual sound level would seem to warrant. There might be an element of jealousy involved, or it might be that relatively low-level speech can be more annoying than continuous noise at a higher dB."

While some people find noise more annoying than others, it's hard to predict who those people will be. So far, demographic factors such as age, sex, income, education and occupational status don't seem to be involved. One study, however, may disquiet people who insist on absolute quiet: among college students, greater self-reported sensitivity to noise was associated with lower intellectual ability and less confidence in social relationships.

On the other hand, those college students might be able to trace their bad grades and lack of friends back to their sensitivity to noise and the effects noise can have both on task performance and social behavior. First, noise interferes with human communication: obviously, noise can make it harder to carry on conversations. The upper limit for normal conversation is thought to be background noise of 70 decibels, even when the speakers are close together. At six feet, they may be shouting.

Noise can make people more aggressive, more irritable, more violent—and less sensitive to other people, both during exposure and after the noise has stopped. In one study, researchers wanted to compare the effect of different noise levels on helping behavior. People exposed to 65-

Damage: The Inside Story

Within the tiny, snail-like coil of the cochlea lies the organ of Corti, where thousands of sensory hair cells stand, their filaments extending into the fluid of the cochlear duct. By the time it reaches this inner sanctum, sound has been tranformed into mechanical energy that makes the hair cells wave back and forth, triggering neural impulses. Transmitted to the brain, those impulses are interpreted: sounds.

Very loud sounds—explosions or gunfire, for example—can produce vibrations severe enough to tear the organ of Corti or cause structural damage leading to a rather rapid breakdown of normal hearing processes. Over-exposure to noise of lower levels for long periods of time also results in degeneration. The damage is cumulative: first come blister-like outcroppings along the hair cells' filaments, or stereocilia. If exposure continues, those blisters rupture: the tissue supporting the filaments may soften; then the hair cells themselves may swell and finally erode. One explanatory theory is that constant exposure to noise makes the cells work at high metabolic rates, rates which eventually lead to exhaustion and death.

In humans, the organ of Corti is 34 millimeters long, with three rows of outer and one row of inner hair cells running along its length—thousands of cells in all. The amount of injury to the ear (and the corresponding hearing loss) seems to depend on where the damage occurs. Loss of sensory cells in the upper part of the cochlea (where hair cells sensitive to low-frequency sounds are) can be quite extensive—up to 20 percent—with no change in hearing. The same amount of damage at the base of the cochlea, in the area sensitive to high frequencies, means a hearing threshold shift of roughly 40 dB. (The first sound you'll hear at a particular frequency

Damage is hidden deep within the ear: the organ of Corti (right), rests within the center of the cochlear duct (above). The duct is in turn part of the cochlea, the snail-like coil that makes up the auditory portion of the ear's bony labyrinth (top).

dB noise levels were much more likely to help someone pick up dropped papers and books than were people exposed to noise levels of 85 dB. Taking the experiment from the lab to the quad, the researchers found that 80 percent of passers-by stopped to help someone pick up dropped and scattered belongings when the outdoor setting was quiet. But when a loud lawnmower was stationed near the victim—who was wearing an arm cast to make the Help signal even more pronounced—only 15 percent of the passers-by stopped to help.

Is it that noise puts you in a bad, even selfish, mood? Or, as some researchers believe, does noise distract you, so that you miss certain cues or overlook relevant information—such as, in the case above, the victim's cast?

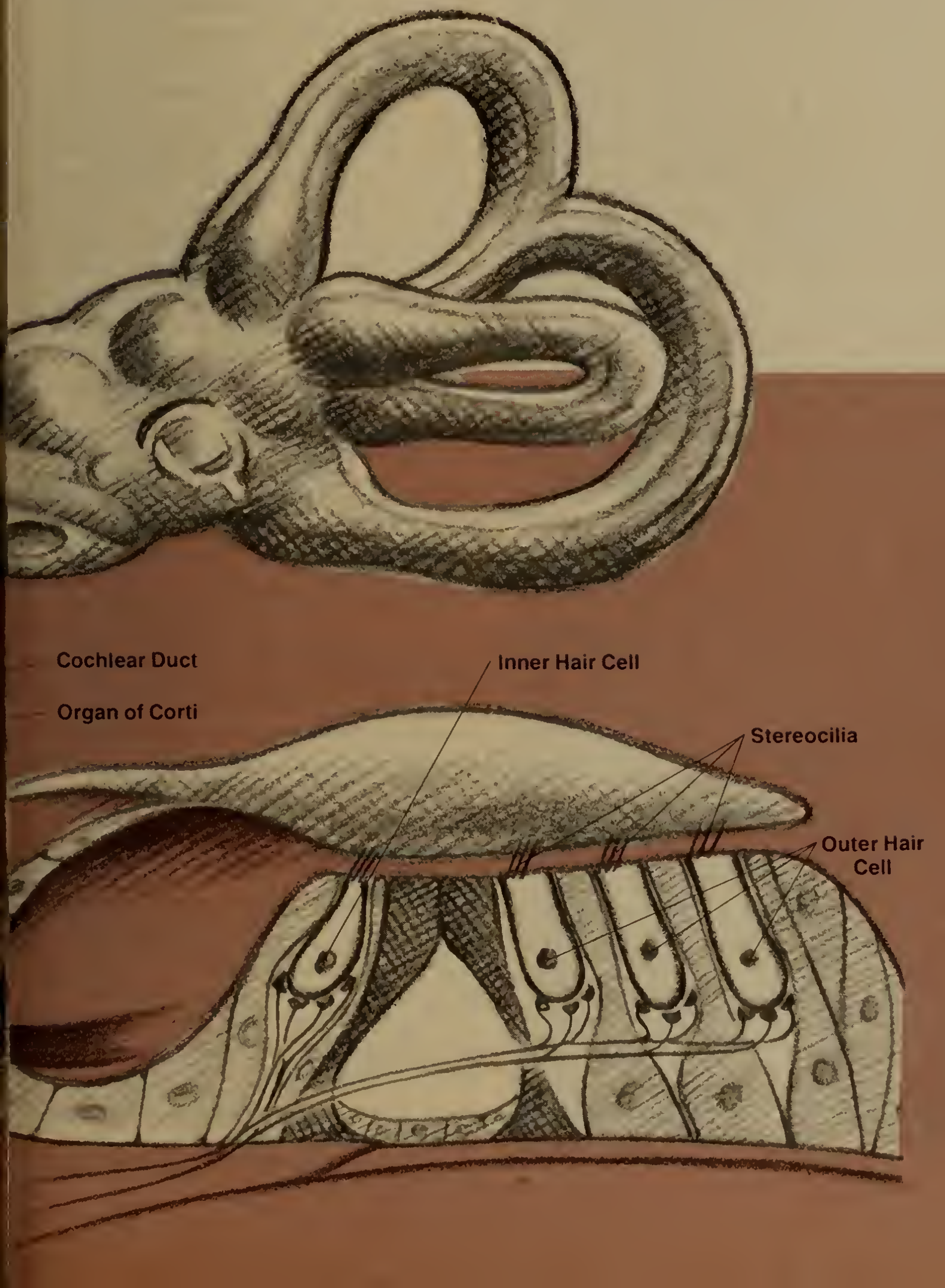
Missed cues and overlooked information can, of course, affect your performance at work. Although the effects of industrial noise are more often studied, noise—usually at lower levels—is also a factor in the white-collar workplace. In fact, says a 1985 poll, noise is the No. 1 factor affecting productivity in the office environment. Commissioned by a manufacturer of office systems (including soundproof dividers), the poll may have a built-in bias. Workers may not see noise as their major problem. When Philip Greiner of Villanova's School of Nursing studied a company's personnel, he found that "what caused stress for the employees was being caught between their boss and the person underneath them—not the noisy equipment."

Still, the office does seem to be getting noisier. Large, open-plan office designs, often housing banks of electronic computers and printers, do not provide workers with much acoustical privacy. The typical dot-matrix printer, sans soundproofing cover, runs at about 65 dB—meanwhile, the West German government has legislation in effect making 55 dB the upper limit for places where intellectual work is in progress.

How much does noise interfere with a worker's ability to get the job done? It seems to depend upon the task. If the job is relatively boring and repetitive, a certain amount of noise, even high-intensity noise, can actually improve performance—by arousing the worker, or by masking other, more distracting noises. Masking and arousal are principles behind the piped-in music that provides background noise in many offices.

But as the task increases in complexity, and the worker must pay attention to additional informational cues, noise can present a problem. Even then, noise doesn't seem to affect the *average* efficiency or rate of work. Rather, there are ups and downs in attention and productivity—quality, not quantity, suffers. On the assembly line, a lapse in attention can mean a shoddy product or an accident. In the office, it translates into other kinds of mistakes.

Interference with performance also depends upon the noise. Human speech—perhaps because of the information it contains—can be the most unwanted of sounds. "The original piped-in music, Muzak, sticks to instrumentals," points out Villanova's Sheldon. "It never has words. Nothing sudden, nothing jarring."



will have an intensity 40 dB greater than the first sound heard by someone with normal hearing.)

At first, damage is minimal. Once injured, however, the ear seems more prone to injury. "If the ear is injured," points out Mark Holmes, a mathematician at Rensselaer Polytechnic Institute, "and the system repairs itself, it is nevertheless *repaired*, a fact that may affect its future workings and therefore might explain the theory that noise injury seems to mean increased susceptibility to noise."

Holmes and an RPI colleague, Julian Cole, are at work on a mathematical model of the ear. "We're building a system based on what is known about the physical characteristics of the ear," says Holmes. Such computer models will have obvious advantages over animal and postmortem studies on which researchers have had to depend for their knowledge of the ear's inner workings. "Once the model is completed, we should be able to run computer tests to see how noise actually damages the system."

Noise Control: Whose Job is It Anyway?

Noise, said the Reagan administration in announcing budget cuts for the Environmental Protection Agency's noise-control programs in the early 1980s, is a local problem, for state and local authorities. Occupational noise remains a federal problem, regulated by the Occupational Safety and Health Administration (OSHA). Some observers, however, charge that OSHA has put noise on its back burner.

As proof, they cite the stepchild status of the Hearing Conservation Amendment, a much-debated measure that went into effect in 1982. Rather than lowering the permissible 8-hour, time-weighted noise exposure limit from 90 dBA (the A-weighted scale measures loudness in a way that mimics the properties of the human ear), OSHA instituted hearing conservation measures for employees exposed to noise at or above 85 dBA. Such employees must be made aware of the noise level at which they work, given annual audiometric tests to check their hearing losses, notified in writing of significant threshold shifts, provided hearing protectors if needed, and provided with noise education. (Selecting 85 dBA as the boundary was based on economic considerations; noise damage *can* occur at lower exposure levels over a worker's career.)

An estimated 5 1/2 million workers (out of 13 million in general industry) are included under the amendment; companies will spend some $250 million a year on the required programs. Nevertheless, Morgan Downey of the American Speech-Language-Hearing Association says, "There has not been wide-scale resistance to the Hearing Conservation Amendment—such changes are often easier than making engineering changes to get the noise down." To some degree, occupational noise control is always a balancing act between the needs of employers and employees. "Noise control has two goals to be observed simultaneously," points out Henry Scarton, a mechanical engineer who heads RPI's Noise and Vibration Control Research Laboratory. "You want to quiet down the net environment, yet not ruin the function of the tool."

Still, some industries did not take the Hearing Conservation Amendment lying down. The Forging Industry Association (forging is a notoriously noisy trade) took OSHA to court (the United States Court of Appeals for the Fourth Circuit, in Richmond), charging that the new regulation was unreasonable. And, in November 1984, a three-judge panel handed down its decision, against the amendment. "Airplanes, hunting rifles, loud music and a myriad of other sources," the court said in its 2-1 decision, "produce noise potentially as damaging as any at the workplace."

By extension, the ruling implied that unless a hazard is exclusive to the workplace, the government cannot impose safety standards. "You could apply that logic to standards on lead, benzene, asbestos, and even radon gas—all of which we are exposed to in our everyday lives," Jack Sheehan of the United Steelworkers of America told the *New York Times*. Still, OSHA—which has basically taken a pro-employer stance through the years of the Reagan administration—was initially unsure whether to appeal. Under pressure from labor unions, it eventually asked the full nine-member court to reconsider the decision; meanwhile, OSHA told its field offices to continue to enforce the amendment.

In late September, after almost nine months of deliberations, the Richmond court unanimously upheld the Hearing Conservation Amendment, finding "simply no merit" in the forging industry's argument. The decision wasn't front page news, but the amendment's supporters were elated, claiming the stage had been set for real progress.

Random, intermittent bursts often have the most effect on performance, in the same way that unpredictable stressors of any kind—whether an electric shock or your supervisor's sudden about-face of commands—can lead to an anxious sense of being out of control, a frustration which can linger on after the noise itself has ceased.

Noise is a fact of life on Earth. As Stephen Jasperson, physics department head at Worcester Polytechnic Institute, points out, "Most physicists don't study noise per se. We're all invariably involved in trying to beat noise, to make measurements in spite of noise, to extract very small signals in a noisy world." In a way, that's the same effort that humans are engaged in every day.

Is the everyday task of extracting wanted sound from background noise getting harder? "America probably has gotten noisier," admits Penn State's Paul Michael. "The number of people, the number of cars, the number of machines have all gone up, and so has the amount of noise. It's hard to tell what the rate of increase would have been without noise control programs."

As it is, one American in two faces daily noise that interferes with speech or sleep. Noise may be a price paid for other, more pleasant aspects of the Western standard of living, and people seem, at least on the surface, to adapt. Some adapt almost too well.

"In a social context, the world is getting noisier," says Frederick A. White, a professor emeritus at Rensselaer Polytechnic Institute and author of a standard text, *Our Acoustic Environment*. "A lot of noise is fashionable. There's no way to control it." White is talking about leisure noise—hunting, motorcycles, snowmobiles and, most of all, amplified rock music. "Many young people," he says, "are going to encounter permanent hearing loss." Studies in the U.S. and abroad seem to bear him out, although some, produced by anti-rock researchers, have been dismissed because musical prejudices colored the methodology.

But although amplified rock music (it commonly hits as high as 110 decibels) has been shown to affect hearing, vision and attention span, its devotees continue to listen, at concerts, at discos, through stereo headphones. They may pay for it a few years down the road, but for now they enjoy it, the way some people like the whine of the Brooklyn Bridge.

1914

Horace Cole writes, "The education and associations at WPI have served me well during 41 years with the Westinghouse Electric Corp. and 30 years of retirement."

1918

Walter Dennen, Sr., a World War I Navy veteran, said in a May profile in the (Worcester) *Sunday Telegram,* "We've suddenly got more patriotism than we've had for a long time. There's no country in the world that's as wonderful to live in as this one we have. We ought to respect and recognize it."

During the war, Mr. Dennen was an ensign and engineering officer aboard a naval cargo ship.

After the war, he returned to Worcester to work a couple of years at Norton. He then became a teacher at Worcester Boys Trade High School, and finally director of the school and administrator of the city's Vocational School Department. He helped form the 7th Division of the U.S. Naval Reserves based in Worcester, receiving a citation from the Secretary of the Navy for his work.

At the request of the Class of 1930 of Worcester Boys Trade School, Mayor Tinsley of Worcester declared June 14, 1985, as Walter B. Dennen Day. During ceremonies at the William Paul House in Holden, MA, he was presented with Mayor Tinsley's proclamation and a scroll signed by Governor Dukakis.

In 1969, Mr. Dennen received the Goddard Award from WPI. He is class president and the father of **Walter B. Dennen, Jr., '51.**

1920

Albert Woodward, who retired from General Motors in 1961, resides in Cranston, RI. His wife passed away last year.

1921

Dr. **John Williams** is a professor emeritus from the department of chemistry at the University of Wisconsin, Madison.

1926

Reunion **June 5–8, 1986**

1927

Charles Moore has swum 700 miles in Cleveland's Cudell Recreation Center pool since 1971.

1930

Russ Barnes and his wife, Jane, moved from Kingston, MA, to Plymouth, MA, in June.

After attending recent family graduations **Roscoe Bowers** and his wife traveled to California, where they visited friends and Ros. played golf at the Castlewood Club in Pleasanton. Other points of interest were San Francisco, the Napa Valley, Grants Pass, Eugene, OR, the Village of Mt. Shasta and again, San Francisco. Ros. writes, "Just before leaving, I beat my age once more with 36–40—76 at Jacaranda!"

Charlotte and **Charlie Cole** write they've had a good year. They recently went up the Mississippi on the *Mississippi Queen.* They also cruised the West Caribbean and areas near Mexico and Panama.

Stan Fillion's granddaughter, Marie, graduated from high school in Burlington, VT, May 31. She has won track and music awards as well as a National Science Award. For several years, she has served as official school pianist. She was named oboist with the All-New England Band.

Carm Greco is recovering from brain surgery.

Ed Greco, who is also ill and was unable to attend the 55th reunion, sent best wishes to his classmates.

Herbert Hillis worked in the area of civil aeronautics in Washington, DC, for 14 years before transferring to Army research and development in 1954. He retired from Natick (MA) Labs in July 1970.

Jim McLoughlin and his wife, Annette, "man the information booth one day a week at Fort Nathan Hale Restoration in New Haven, CT." Jim describes the fort's history to visitors.

Fred Peters and his wife, Kate, visited his daughter, a missionary sister, in Chile last February. His daughter "survived the March earthquake, but lots of folks didn't."

Last November, **Paul Reynolds,** a retired Lt. Colonel in the U.S. Army, and his wife, Bernice, attended a luncheon at Williams Air Force Base Officers' Club in Arizona, where they met with Brig. Gen. Charles Duke, an Apollo 16 astronaut.

Carl Backstrom, Class Secretary

1931

Reunion **June 5–8, 1986**

1932

George Barks is a realtor-associate with Century 21 in Carlsbad, CA.

1933

Alex Alves continues working for his own company, Engineered Sinterings, in Watertown, CT. His son is now president of the firm. Alex is proud of the fact that after 12 years of his personal involvement with the development of injection molding of metal powders, his company has just issued a catalog on the new process, and is working on orders for parts made by this advanced method.

Bill Anderson says that he and his wife, Ruby, are both well and enjoy visits with their children and five grandchildren. Their son is a high school teacher and coach and their daughter is a physical therapist.

Norm Clark and his wife, Gert, recently took a popular cruise to Alaska.

Ed Conway, one of the better golfers of our class, has had back problems which adversely affected his play. Now that he has recovered, he is playing closer to his former effectiveness. Ed enjoys woodworking, has a fully equipped shop in his basement, and recently completed a cherry highboy—no small accomplishment!

Rod Klebart is also continuing with his working career. He lives with his wife, Anna, in Webster, MA, where he's served as chairman of the town's engineering office Capital Outlays Committee for 20 years.

Both Isabel and **Fred Potter** were hospitalized during the past year ("the toughest period of our 52-year marriage!"), but are now well enough to ride their motorcycles. They sold their two sailboats and three of their five motorcycles, but still swim at least a half mile every day. They don't feel the need to go away for vacations because they reside in "a beautiful vacation spot: Little Silver, NJ."

William A. Slagle, Jr., has been re-elected president of the Royall House Association of Medford, MA. During his first year in office, the historic house was chosen after a nationwide survey to be featured on television. The house was also awarded grants for its 18th-century perfection of Georgian architecture and its role in the Revolutionary War. Among "first" exhibits were a showing of Royall House dolls and quilts and a display of 18th-century rare pieces of needlework and furniture during the Winchester Art Association show. In 1986 Royall House will be seen nationwide in the PBS film "Pride of Place," as well as in "The Whiskey Rebellion." Somehow, in spite of all this public relations activity, Bill still finds time to weed the Royall House herb garden!

Olga and **Al White** reside in New Jersey, the Garden State, and like the Potters, feel they don't need to travel extensively. Al was sorry to hear that Walter "Tut" Tuthill had died, and remembers him well as a partner in a joint project at WPI. He hopes to attend our 55th reunion, which, incidentally, is only 2½ years away!

We recently talked with **"Buck" Whittum,** who with his wife, Kay, lives in Eastham on Cape Cod and enjoys fishing, clamming, scalloping and oystering. Weather permitting, Buck often attends the Tech Old-Timers' meetings at WPI. He and Kay took a trip to Iceland, where they found the scenery, people, and history of the country fascinating.

The statistics on the geographic location of your classmates may be of interest. Of the 95 we can account for, 24, or about one quarter, live in Massachusetts. Connecticut and the retirement state of Florida are tied for second with 14 each. The other 43 are scattered among 20 states and two provinces of Canada. Quite a few report that Florida is their winter home.

Al Brownlee, Class Secretary

1934

Charles Bissell, who retired in 1978, has recovered from his 1984 coronary by-pass operation and is spending the summer gardening and cruising on Narragansett Bay. The Bissells winter in Anna Maria, FL.

1936

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Dr. **Nelson Marshall** is a professor emeritus from the University of Rhode Island at Kingston.

1937

Allen Benjamin's watercolors were featured in the main branch of the Wayland (MA) Public Library in February. Since 1983, he has participated in student and member exhibitions at Arts Wayland and the DeCordova Museum. More recently, he has had solo exhibitions in galleries at WPI and Babson College.

1939

John Busada, president of Busada Manufacturing Corp., makers of rigid transparent plastic tubing, spoke on the topic, "The Wonderful World of Plastics," at the May meeting of The University Club of Long Island. He is a director of the Mid-Atlantic Chapter of the Society of the Plastics Industry and Governor Plastics Pioneers Association. Previously, he was associated with GE, the Northern Industrial Chemical Co. and with Omni Products Corp. He is a past president of the Long Island chapter of the WPI Alumni Association.

Harold Humphrey of Harwinton, CT, recently received the 10th Annual Arthur B. Poole Memorial Award in recognition of his contributions to the town and society. Chairman of the board of finance since 1975, he has served on the board for 20 years. He was chairman of the town zoning commission from 1957 to 1964 and was a member of the economic development commission for six years. An active Republican, he was a former chairman of the nomination committee and treasurer for two years.

Now a consultant for the Torrington Company's Needle Division, in 1983 he retired from the firm as chief mechanical engineer for the division. He is a registered professional engineer, and a past chairman of the Society of Manufacturing Engineers, Central Connecticut Chapter. Currently, he operates a sailboat chartering business in the summer.

Elmer Nutting retired in March following 45 years in the firearms industry, holding various positions from chief engineer to vice president and board member. He was associated with Savage Arms, Noble Mfg. Co. and Smith & Wesson during his career. He recently received a product award of merit from the National Association of Federally Licensed Firearms Dealers and *American Firearms Industry* magazine for the Smith & Wesson Model 1000 Super 12 shotgun which employs a revolutionary gas metering system. The gas metering system, which for the first time enabled an auto-loading shotgun to handle any hunting load, was designed by Nutting. "It's not limited to shotguns," he says.

Al Stone has retired from Industrial Risk Insurers.

Lou Stratton is retired as manager of the Western New England College laboratory in Springfield, MA. He writes "Have 10 grandsons (7 Strattons) and three granddaughters."

Clarence Barrington: No. 1 in Bassoons!

Clarence Barrington '22 EE, who was with Riley Stoker Corp., Worcester, for 31 years, currently has a second career repairing bassoons. At 85, he is also a sales agent for Fox Bassoons, the leading bassoon maker in the U.S.

"I've always been surrounded by music," he says. "My father was a church organist and my mother played the piano. They met when my mother took lessons from my father."

The bassoon is not the only musical instrument that Clarence plays. He played one of the first saxophones seen in the Worcester area back in 1916. "Kids would come around and ask what it was." Playing the sax at the Worcester Country Club and local functions, he helped put himself through WPI, where he and his roommate, Eddie Sholz, formed the original Tech Band, which performed at football and basketball games.

He reports that he took up the bassoon rather late in life, teaching himself to play. He took weekend lessons in Rochester, NY, then came back and practiced in the Riley boiler room during lunch! He and his late wife, an accomplished pianist and French horn player, used to perform professionally with the Worcester Philharmonic and the Worcester Oratorio Orchestras. They helped form the Springfield Symphony.

Always handy with tools, Clarence learned to fix his own bassoon. Then he'd fix his friends' instruments. Word spread throughout the professional community. There are only about a dozen bassoon specialists in the country.

"The bassoon is so complex, you really have to be able to play it in order

1940

Dave Zipser, formerly with the coil division of Singer Co., is now retired and looking forward to "spending many years in Wilmington, NC."

1941

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Albert Bellos has been appointed vice president for the Pulp Machinery Division at Sandy

Clarence and the "complex instrument."

to repair it," Mr. Barrington says.

Recently, he got into sales because he'd repair college students' bassoons, and when they'd graduate they'd ask him to recommend an instrument. As a result, Fox offered him the job of agent.

Clarence Barrington enjoys his "retirement." "I was looking forward to instrument repair work when I retired from Riley in 1965," he reports. "I was prepared." His philosophy is, it's all right to be growing older, as long as you don't just grow old!

Hill Corp. of Hudson Falls, NY. He has responsibility for overseeing all pulp mill-related activities and will also serve as vice president of manufacturing for Sandy Hill South Inc. in Pell City, AL. The latter company was opened in 1984 to provide service to Southern pulp mills for Kamyr-designed and other pulping equipment. After briefly working for United States Steel and serving as a naval officer in World War II, Bellos joined Sandy Hill in 1946 and became vice president of engineering in 1977. He belongs to TAPPI and the Glens Falls Country Club which he has served on the board of governors.

Frederick Chamberlin and his wife, Virginia, who travel extensively, have been to the Middle East, Egypt, South America, the Orient, Australia and Hawaii. Fred retired three years ago after 32 years with Du Pont.

Joseph Jurga is retired as a consultant for General Electric in Harrison, NY.

Stanley Majka writes, "I'm very busy working with recent retirees and small corporations as a certified financial planner."

Charles Smith, professor of mechanical engineering at Rose-Hulman Institute of Technology, Terre Haute, IN, has been selected as a fellow of the American Society for Engineering Education. He was also recently named to the Accreditation Board for Engineering and Technology which evaluates the quality of college and university engineering programs. A member of the Rose-Hulman faculty since 1981, he is considered an authority in the area of product liability and design. He is the author of four textbooks; a frequent lecturer in Europe, Japan and the U.S.; and the first recipient of the Fred Merryfield design Teaching Award presented by the ASEE.

Berkeley Williams, Jr., retired from Rotron in 1982 and moved to Florida to "enjoy the good life."

1942

Gordon Raymond says that after three years of retirement with some travel and consulting on the side, he still can't find time for any hobbies.

William Wheeler is retired as a project engineer with Diamond Shamrock and lives in Wilmington, NC.

1943

George Fairhurst is director of community services at the Downey (CA) Community Hospital. He is also a board member and secretary of the Downey Symphonic Society and vice president and board member of Downey's Second Century Foundation.

John Huckins, who retired in 1983, writes that he enjoys Cape Cod and leisurely living.

Dr. **Arthur Lindroos** serves as manager of engineering at Penick Corporation, Lyndhurst, NJ.

William Walker, who retired from The Torrington Co. in 1983, writes that he's enjoying retirement very much.

1944

Walter Brown, Jr., is district fire chief with the City of Worcester Fire Department.

1945

In June, the Webster-Dudley-Oxford (MA) Chamber of Commerce honored **John Bayer** by presenting him with its 1985 Life Membership Award. President of Bayer Motors, an automobile dealership in Dudley, Bayer is past president and director of the Webster-Dudley C of C, as well as past president, director and secretary of the Webster Rotary Club. He was a member of the commission that formed the Webster-Dudley Credit Bureau, and he belonged to the study committee that resulted in Interstate 395, and served on the committee that helped revitalize the South Village Business Enterprises after the disastrous South Village flood.

In Thompson, CT, Bayer has been chairman of the Board of Education and past president of the local library and the Village Improvement Society. A charter member of the Thompson Industrial Development Commission, on many occasions he has served as a town meeting moderator. He has long been active with the Congregational Church.

During World War II, Bayer was a civilian scientist with the Manhattan Project, which developed the atomic bomb. At the time, he had no idea of the scope of the project. He only knew that he was refining uranium. Later, he received a letter from the Navy telling him that he had participated in certain tests essential to the development of the bomb. Following the war he worked for a time at the Naval Research Laboratory in Anacostia, DC, and at Procter & Gamble in Cincinnati, where he was granted a patent on one of his inventions.

Bayer, who holds a BS and MS in chemical engineering from WPI and who briefly taught physics at WPI, is a past senior member of the ACS and of the American Institute of Chemical Engineers.

Owen Kennedy, dean of academic computing at WPI, recently graduated from the 1985 Greater Worcester Executive Program run jointly by WPI's Department of Management and Clark's Graduate School of Management. He and his wife, Nancy, celebrated their 40th wedding anniversary in July.

Dick Lawton of Longwood, FL, is president of RGL Sales Co. Inc.

1946

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Frank Mazzone continues as manager of business development at Bechtel Inc., Gaithersburg, MD.

1948

Richard Horne retired from Cincinnati Milacron Marketing Co. in September.

MacLean Kirkwood, Jr., who retired from ATT-Long Lines in 1982, is now vice president and director of operations for ITT U.S. Transmission Systems.

Lynwood Lentell is enjoying retirement in Fresno, CA. Recently he visited with Anita and **Roger Staples** from Santa Barbara.

1949

Russell Bradlaw is a construction management consultant to Turner Construction Co. on the Charlotte (NC) coliseum to be built between 1985 and 1988.

Thomas Coonan III retired from Du Pont in April. He plans to remain in northern Illinois in the summer and Cancun, Mexico, in the winter. "May stay active selling in the plastics field."

Len Fish holds the post of senior vice president at American Gas Assoc. Inc., Arlington, VA.

Howard Tinkham retired as professor emeritus from Southeastern Massachusetts University (SMU) in June. He joined the faculty in 1949 and had a strong hand in the establishment of the mechanical engineering department at SMU. Cited for his excellence in engineering teaching, he headed the ME department for 18 years and was the first chairperson to prepare the department for its initial professional accreditation visit.

1950

John Cocker, no longer with Bell Labs, is now with Bell Communications Research in Red Bank, NJ.

George Engman, formerly a product support engineer for DEC, Maynard, MA, has been retired for a year "and enjoying every minute of it."

William Griggs has retired as president of W.C. Griggs Inc., Denver, CO.

Arthur Joyce was recently appointed administrative assistant for the Industrial Polymers Division of the Polymer Products Department of Du Pont, Wilmington, DE.

Francis Norton serves as a construction site manager for Monsanto (Carondelet) in St. Louis, MO.

1951

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Mark Baker continues as a project engineer with Hamilton Standard in Los Angeles.

Robert Mongilio writes, "My three sons have now all graduated from WPI—'81, '84 and '85!"

Charles Peirce is a senior quality engineer at Sippican Corp., Marion, MA.

1952

Michael Essex, Jr., holds the post of supervisor of price administration at Norton Co., Worcester.

Chester Inman, Jr., resigned from Kodak in Rochester, NY, in August.

1953

John Gearin is now director of AT&T's new manufacturing development center in Princeton, NJ.

1954

Dr. **Malcolm McLeod** is a senior scientist with BTS Inc., Seabrook, MD. He holds an MS and PhD from UCLA.

William Robinson writes, "Children grown up and out. Most of the time now spent with investments (self-employed) and travel. Everything good here in beautiful downtown Burbank!"

1955

Edouard Bouvier holds the post of staff manager of fleet operations at Southern New England Telephone in North Haven, CT.

Robert Chang continues as an engineering specialist for Ford Aerospace & Communications, Palo Alto, CA. He has an MS from the University of California.

Daniel Grant, an electrical engineer for Fay, Spofford & Thorndike Inc., Lexington, MA, has been elected chairman of the Boston chapter of the IEEE Power Engineering Society for 1985–1986.

Richard Loomis continues as a senior engineer for GE in Syracuse, NY.

1956

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Richard Basil, Jr., is now chief scientist for Hughes Aircraft, Los Angeles.

Charles Healy has been promoted to senior vice president of the Asia/Pacific area for Ebasco Services International Inc. He will be responsible for securing new contracts in the area, which is expected to provide the electrical generation and distribution business with its most promising opportunities. Since joining the firm in 1956, Healy has served in a number of posts including supervising engineer, then manager of Standards and Procedures, project manager for the Angaa Nuclear Power Station in Brazil, and project manager for the Philippine Power Project.

Most recently, he was managing director of Ebasco Energy Pty. Ltd., Sydney, Australia, a position he will continue to hold in his new capacity with the company. He is a professional engineer in Massachusetts and Queensland, Australia, as well as a fellow in the Institute of Engineers Australia and the Australian Institute of Energy. He belongs to the Company Directors Association of Australia, the ASME and the American Association of Cost Engineers.

Hank Nowick, co-chairman of the Western Massachusetts Coalition for Safe Waste Management, has been cited for his work in disposing of and treating hazardous waste with an award from the Pioneer Valley Planning Commission. Hank was one of three recognized for upholding the commission's goals of planning and regional cooperation. An employee of the Monsanto Co., he is also a member of the statewide Site Safety Council.

1957

Crosby Adams is on temporary assignment in Barbados for a year.

Neil Carignan, who is a senior naval architect for CDI Marine Co., Jacksonville, FL, writes that he is concerned with the engineering of ship structures and foundations. He is a registered professional structural engineer. "In 1981 I became a grandfather."

Sy Friedman has sold his interests in Tri-K Industries and founded International Sourcing Inc., Ridgewood, NJ, which he serves as president. The firm supplies specialty chemicals to the food, cosmetic and pharmaceutical industries.

George Prozzo serves as manager of sales administration and support at Fairchild Weston Systems, Sarasota, FL.

Michael Spiegel holds the post of associate professor at New Hampshire Vocational Technical College in Manchester.

1958

Jim Demetry, professor of electrical engineering and chairman of the Division of Interdisciplinary Affairs at WPI, was reelected to a three-year term on the board of selectmen in Holden, MA, in May. Before being elected as a selectman in 1981, he had served nine years on the Holden planning board. He currently represents

Want to Study Law? See the Blodgetts!

If you were a WPI student headed for a career in patent law and wanted to learn the ropes, all you'd have to do is walk from campus down to the corner of Highland and Lancaster streets in Worcester. There, in an unobtrusive brick house, are the patent law offices of Blodgett & Blodgett, whose doors are always open to WPI students interested in careers in law.

"WPI professors have been sending prospective lawyers to us for advice for years," says Norman Blodgett '44 ME, who heads the firm which was started by his father, the late A. Gerry Blodgett '21, and which currently includes his sons, Gerry '69 CHE, a patent lawyer, and David Blodgett '81 MGE, office manager.

The three-generation family firm has counseled dozens of students. Also, through WPI connections, the Blodgetts have been introduced to other WPI patent attorneys, including Paul Kokulis '45, a senior partner in one of the largest patent law firms in the nation, Cushman, Darby & Cushman, Washington, DC. Paul received the Goddard Award for outstanding professional achievement from WPI in May 1985.

"Paul is one of the foremost patent lawyers in the country," says Norm. Other successful WPI patent attorneys that the Blodgetts know and work with include Martin Flink '45 and Paul Craig '45, Washington; Bill Dorman '48, Tulsa; Phil Sheridan '45, Denver; and Mal Wittenberg '68, San Francisco.

Blodgett & Blodgett has had other ties with WPI. Both Norm and Gerry have lectured at the Institute on patent law. Also, the firm handled the legal affairs for the old Washburn Shops when the facility housed what was once a profitable commercial venture.

"My father obtained a patent for a centrifugal coupling used on helicopters to pick up loads during World War II," Norm reports. "The Rawson coupling was developed in the Washburn Shops and is, I believe, still being manufactured locally." When the Shops discontinued commercial activities in the 1950s, Blodgett & Blodgett negotiated the sale of its patents.

Norm's son, Gerry, has close current ties on Boynton Hill. Although he already holds both his BS and MS in chemical engineering from WPI, he is now enrolled in the biomedical engineering program.

"You have to keep studying to keep up with the times in patent law and technology," he says. "A few years ago, no one believed living organisms, computer programs, or holographs could be patented or copyrighted. It turns out they can. We must keep up with new technologies so we can anticipate how the law will react."

Patent lawyers must also be able to take a flexible stance on almost any issue. "One day we may have to say black is white and the next day white is black," says Gerry. "It depends whether we're representing the inventor or a company at the time. We also have to be able to see merit in a variety of pretty strange proposals."

Among the more exotic proposals that have obtained patents through Blodgett & Blodgett are a zipper for the human body (used following autopsies), a program for doing computerized horoscopes and an air-freshening snorkel device for toilets.

Some of the products didn't sell, of course, Gerry says, and some sold so fast that the manufacturers couldn't keep up with the demand. "A lot of teamwork is involved to make a product a success after the patent is granted," he adds. "The inventors, the manufacturers and the merchandisers have to pull together to effectively commercialize a new product or idea."

Norm and Gerry Blodgett, both graduates of George Washington University School of Law, share an enthusiasm for their profession that is contagious. Although Norm is thinking of retiring to Cape Cod, he doesn't want to be cut off from what's going on in Worcester: "With a home computer terminal I'll be able to keep in touch."

On the side, he says, he hopes to restore his 1910 Crosby catboat and his ancient Bentley automobile. "I like my Bentley," he remarks. "Nobody realizes that it's really a Rolls Royce."

Gerry plans to continue with the law practice. "Artists and inventors, as well as businessmen, need to be protected," he says. "For centuries creative people have been taken advantage of. Patent lawyers see to it these creative people have protection, allowing investors to more safely invest money in new inventions and ideas. This way, the ideas are most effectively and efficiently commercialized and the public gets the benefit of the new technology. Everybody wins!"

Metzger Wins National Jr. Achievement Award

John Metzger, group vice president at Du Pont.

John Metzger, Jr. '46, a WPI trustee and group vice president for Du Pont, has been named a 1985 winner of the Gold National Leadership Award by the Junior Achievement (JA) corporation. Cited for "exemplary national leadership in promoting economic understanding and career education through Junior Achievement," Metzger received the award during the JA National Leadership Conference held in April in Cleveland.

He is a member of the board of directors of Junior Achievement of Delaware and of the JA national board of directors. He also serves on the Long-range Planning Committee for the national board. In 1975, when he began his tenure as chairman of the Delaware board, there were fewer than 300 members in one program. At the completion of his tenure in 1981, there were 1,400 members in three programs.

Metzger joined Du Pont in 1946 as a chemical engineer and subsequently held technical and supervisory posts in various plants in the U.S. After serving as a new venture manager with the Development Department, he was promoted to director of the Poromeric Products Division of the Fabrics and Finishes Department and director of the Flurocarbons Division.

Further promotions included assistant general manager of the Polymer Intermediates Department and of the Photo Products Department. Currently, he is group vice president of the Photosystems and Electronic Products Department.

Metzger is a member of the WPI Fire Safety Advisory Committee and the Trustee Finance Committee. He is chairman of the class anniversary gift committee. In 1981, he received the Goddard Award for professional achievement from WPI.

elected public officials on the board of directors of the Central Massachusetts Health Systems Agency and chairs the agency's Projects Review Committee.

Joaquim Ribeiro has been appointed vice president of finance and administration at Infocom Inc., a developer, manufacturer and marketer of software for personal computers. He will be the financial officer, a new post in the four-year-old firm based in Cambridge, MA. Previously, he had been vice president of business development and financial officer at Jamesbury Corp., Worcester, which has now been acquired by Combustion Engineering. In Worcester, Ribeiro has served as a director of Mechanics Bank; a trustee and treasurer of TMH Inc., the Memorial Hospital holding company; a visiting committee member of Clark University's Graduate School of Business; the chairman of the administrative committee for the WPI/Clark Greater Worcester Executive Program; and a trustee of Central Mass United Way. A director of Multibank Financial Corp., a parent company of Mechanics Bank, he is also a prior officer of the Worcester Visiting Nurse Association.

David Ripple is materials management manager for Avon Products Inc. He resides in Fairfield, OH.

Robert Simmonds, senior systems engineer in the Machinery Division R&D Lab, received Emhart's Technology Innovation Award on May 23 in Farmington, CT. The award is one of four given for outstanding technological innovation by the Emhart Board of Directors' Technology Committee. It acknowledges the effort and accomplishments of Bob and others in the USM Machinery Division for the development of the PRM powder reinforcing machine. Introduced in 1984, it was enthusiastically accepted by the footwear industry. Bob, who joined USM in 1960 as a design engineer, has worked in the area of product development and since 1979 has been a senior systems engineer in R&D.

1959

Joe Bronzino wrote "Clinical Engineering Education—The Internship Approach," which appeared in the June issue of *IEEE Engineering in Medicine & Biology*. He is a professor at Trinity College and director of the joint Trinity College/Hartford Graduate Center Program.

David Holloway is manager of product engineering at Gemini Valve Co., North Raymond, NH.

Geza Ziegler, a professional engineer, has been elected vice chairman of the Area 9 Cable Council. He is with Cognitronics Corporation in Stamford, CT.

1960

Jerry Gibbs is now employed as a senior cryogenic engineer by Cryogenic Consultants, Inc., Allentown, PA.

Alfred Materas, Jr., serves as vice president of human resources for AVCO Systems Division in Wilmington, MA.

Bruce Schoppe holds the post of manager of manufacturing and engineering for Free Flow Packaging Corp., Redwood City, CA.

1961

Reunion June 5–8, 1986

Paul Sledzik has been named manager of automation programs for GE's Automation Products plant in Charlottesville, VA.

Edmund Wozniak continues as vice president and general manager at Sterling Die/Colt Industries, Cleveland, OH. He has an MBA from Babson.

1962

In June, **Michael Davis** was awarded his MD from the University of Massachusetts Medical School, Worcester. "I have the distinction of being the oldest graduate in the school's history!" Currently, he is a resident in radiology and holds the dual role of professor of radiology and nuclear medicine, as well as director of the Radiologic Science Research Laboratories.

Bernard Meister has been appointed senior associate scientist in the Styrene Molding Polymers Laboratory, Michigan Applied Science and Technology Laboratories, Dow Chemical. The appointment recognizes his technical leadership and contributions to the process and product technology of styrene plastics and other polymers. Most recently, he developed a "master" simulation computer program for polystyrene, HIPS, ABS and Tyril styrene-acrylonitrile resins, that is used around the world in Dow production plants and technology centers. Meister joined Dow in the Special Assignments Program in 1966. He worked in the Process Fundamentals Laboratory as a rheologist from 1968 to 1972, when he transferred to the Styrene Molding Polymers Lab. He holds a PhD in chemical engineering from Cornell.

Currently, **William Properzio** is with the department of administrative affairs in the Division of Environmental Health and Safety at the University of Florida in Gainesville.

Thomas Quinn is principal sanitary engineer for the New York State Environmental Conservation Division of Water in Albany.

1963

Dick Allen serves as chief of the radiological division for the U.S. Army Chemical School at Fort McLellan, AL.

Dennis Heath works as an industrial products specialist at GE in Plainville, CT.

Bryan Leclair holds the post of manager of C3I program development at Sperry Corp., Clearwater, FL.

Kenneth Olsen now serves as chief patent counsel for Schlumberger Limited in New York City.

Stephen Otis, who currently resides in Mill Valley, CA, continues as vice president of Merrill Lynch Pierce Fenner in San Francisco.

Bill Sweetser has been named president and CEO of Howard P. Foley Enterprises Inc., an Alexandria-based holding company which is affiliated with such firms as Vista Construction and Skyline Construction in Virginia, as well as other national electrical, mechanical and general contracting companies. A professional engineer, Sweetser had previously worked for Stone and Webster and Burns and Roe, where he was in charge of all corporate construction activities.

1964

Charles Connolly, principal of Lynn (MA) Classical, and his wife, Alice, recently enjoyed a trip to Bermuda.

Gary Goshgarian, author of *Atlantis Fire*, a novel published in 1980 by Dial Press, was guest speaker at the Tea With The Authors program presented at the Scituate (MA) Town Library in March. His second novel, *The Stone Circle*, will be published this fall. Currently, Gary is an associate professor of English at Northeastern University.

Gene Killian holds the post of sales manager for CPI Plants Inc., Southport, CT.

Harold Monde recently worked with Don Zwiep, head of the ME department at WPI, at a meeting of the ASME National Nominating Committee.

William Museler has been elected vice president of Electric Operations of the Long Island Lighting Company in New York. With the company since 1973, for the past year he has served as assistant vice president of Electric Operations.

Dr. **Robert Peura,** professor and director of the biomedical engineering program at WPI, wrote a book review of "Cardiovascular Devices and Their Applications," which appeared in the June issue of *IEEE Engineering in Medicine & Biology*.

Kenneth Robbins serves as an advisory engineer at IBM in Research Triangle Park, NC. He has an MS from Union College.

John Ryder holds the post of president of Fifth Dimension Engineering. He lives in Massillon, OH.

J. Paul Theroux is with GE Semiconductors in Syracuse, NY.

1965

Lee Chouinard has returned from a four-year assignment with Amoco Petroleum Additives Co. in Geneva, Switzerland, where he was responsible for petroleum additives marketing in Europe, Africa and the Middle East. Now residing in Chesterfield, MO, he has been named vice president of marketing for the firm, a wholly owned subsidiary of Amoco Corp.

Leo DeBlois continues as a senior engineer at Polaroid Corp. in Cambridge. He has an MS and an MBA from Boston University.

Arthur Dickey is R&D section manager at Hewlett Packard in Andover, MA.

Philip Giantris is vice president and director of marketing at Metcalf & Eddy Inc., Woburn, MA.

James Keith owns and operates Concord Microsystems Inc., a software consulting company.

Larry Phillips, P.E., P.S., a partner in the consulting civil engineering firm of Hammontree & Associates Ltd., North Canton, OH, has been named a fellow in the ASCE. Only 8 percent of active members of the Society obtain the grade of fellow. The requirements include being in responsible charge of civil engineering projects for at least ten years. Hammontree recently acquired Allied Engineers & Surveyors Inc., Lake Wales, FL. Their services include environmental engineering, highways, hydraulics, and urban planning and development.

Charles Seaver holds the post of senior marketing programs manager for the Polyethylene Ethylene Polymers Division at Du Pont in Houston, TX.

Bruce Yung serves as a senior scientist at Ciba-Geigy, Summit, NJ.

1966

Reunion — June 5–8, 1986

BORN: to Cheryl and **Lawrence Pihl** a daughter, Lauryl, recently. Lauryl has a brother, Wesley, 2. Pihl is an independent representative of RF and microwave components. He lives in Groton, MA.

Richard Goodell has been named president and CEO of Pennsylvania Glass Sand Corp., Berkeley Springs, WV. With PGS since 1983, previously he held the title of senior vice president of operations. He had been with the minerals, pigments and metals division of Pfizer Corp. Earlier in his career, he was with Sikorsky Aircraft.

Raymond Hopkins is packaging manager at Sun-Maid in Fresno, CA.

Roberto Huyke-Luigi is a professor in the civil engineering department at the University of Puerto Rico in Mayaguez.

Skip Kunz holds the post of president of Advent Products, North Lauderdale, FL.

Dilip Mistry is now program manager for Ingersoll-Rand in Princeton, NJ.

Thomas Shepelrich has been appointed to estimating manager at McCarthy, a Tampa (FL)-based full-service construction company. Previously he was chief estimator for Metric Constructors Inc. Besides WPI, he attended SUNY (Alfred State).

Robert Zahnke is plant manager for the Pepsi Bottling Group in Mesquite, TX.

1967

MARRIED: Robert Dashner and Kay Monahan in California on April 13, 1985. She graduated from the University of Santa Clara and is a personnel specialist at Litton Mellonics, Sunnyvale, CA. He is president of Landmark Systems Inc., Cupertino.

John Feldman was recently named manager of occupational safety and health at Raytheon Company, Lexington, MA. He joined Raytheon in 1984 as manager of industrial hygiene and material safety. Earlier he served as manager of environmental programs for eastern operations for GE's aircraft engine business group. Before working for GE, he was a supervisory industrial hygienist with the Occupational Safety & Health Administration. He has an MS in environmental health science from Harvard's School of Public Health and an MS in chemical engineering from the University of Pennsylvania. A registered professional engineer, he is a member of the American Board of Industrial Hygiene and Sigma Xi.

Robert Gohsler serves as an advisory systems engineer at IBM in San Diego.

Frank Jodaitis holds the post of general manager and superintendent of the Plainville (CT) Water Co. He has an MBA from RPI.

John Rogozenski is a real estate director for Dunkin' Donuts in Randolph, MA.

Dr. **Neil Shea** has been appointed associate professor of physics at Kutztown (PA) University, where he is in charge of the physics program and advisor to engineering students. He has an MS and a PhD from RPI.

1968

Donald Aldrich is a research associate for Du Pont in Wilmington, DE.

Paul Arruda serves as a task force superintendent at Du Pont in Newark, DE. He has an MS from the University of Delaware.

Norman Brunell and **Bob Seldon '69** are patent attorneys and partners in the law firm of Brunell & Seldon in Los Angeles.

Daniel Creamer, a registered professional engineer, is a project analyst at United Technologies in East Hartford, CT.

John Holmes, a science teacher at Lynn (MA) Classical High School, writes that he is active with the Appalachian Mountain Club, serving on various campgrounds and trails committees. He also owns and operates a small "home-agriculture" business.

David Hopkinson holds the post of production manager at Teknor Apex Co., Attleboro, MA.

Larry Klein is with the Johns Hopkins Applied Physics Lab. in Laurel, MD. He has an MS from Johns Hopkins.

Phillip LaRoe is studying for his PhD in surface physics at Montana State University.

Raymond Lundgren holds the position of project manager at John R. Jurgensen Co., Cincinnati, OH.

Roger Pryor is manager of information products at Energy Conversion Devices Inc., Troy, MI.

Timothy Schaffernoth has been admitted as a shareholder to Rist-Frost Associates, Glens Falls, NY. Currently, he is manager of industrial process and environmental engineering at the firm. A licensed professional engineer in New York, he is also a member of the National Society of Professional Engineers, TAPPI, Instrument Society of America and AWWA. He has an MS from the University of Maine.

Kevin Sullivan writes that he recently spent 104 days in a hospital in Seattle, survived leukemia, and is apparently cured. Since May 10, he has been home and is "recovering well." He hopes to be working again by February.

Scott Wilson is chief of technical design at McGuire AFB in New Jersey.

1969

BORN: to Mr. and Mrs. **Neil Glickstein** a son, Zachary, last November. Neil teaches chemistry and biology at Governor Dummer Academy. The Glicksteins reside in Rockport, MA. . . . to Pat and **Bob Reidy** their second son, Kevin Michael, on November 9, 1984. Kevin joins his brother, Brian, 2.

Army Lt. Col. **Michael Delleo, Jr.**, has been decorated with the second award of the Meritorious Service Medal at the U.S. Military Academy at West Point. An executive officer with the department of chemistry, he received his MS from WPI.

Rick Follett serves as area technical manager at Advanced Micro Devices, managing field engineering for the firm in New England, Canada, and upstate New York.

Dr. **Emanuel Furst** wrote "DRGs and Prospective Payment: An Introduction to the Issues Facing Clinical Engineering Programs," which appeared in the June issue of the *Journal of Clinical Engineering*. He is director of biomedical engineering at the University Medical Center in Tucson, AZ. The department provides a full range of services to the teaching hospital and to the College of Medicine. Dr. Furst's primary interest is in the cost-effective management of technology with special regard to the effect of engineering support at all stages of the medical device life cycle. He belongs to the board of directors of the Association for the Advancement of Medical Instrumentation and of the AAMI Foundation. He is an associate editor of the *IEEE Transactions on Biomedical Engineering*, a member of the editorial review board of the *Journal of Clinical Engineering*, and a member of the American Society for Hospital Engineering. He holds a PhD from WPI.

George McCandless, Jr., continues as assistant professor in the department of economics at Dartmouth College. He has a PhD from the University of Minnesota.

Michael Ouellette, an advance manufacturing engineer at General Electric Ordnance, is also a partner in a firm called Plum Associates, which is currently drawing up preliminary plans for a firehouse in Cheshire, MA. He is a registered professional engineer in Massachusetts and New York. For six years he has served as a member of the Adams (MA) Zoning Board of Appeals.

1970

Paul Akscyn holds the post of regional sales manager for Forney Engineering Co., Houston, TX. His wife, Gail, was recently named chairman of the Houston Symphony's 1987 Annual Fund Campaign.

Francis Belisle is manager of the technical department at Hughes Aircraft Co., Englewood, CO.

John Galvin has been named director of systems development at State Mutual in Worcester. He joined the firm as an actuarial assistant in 1970, and was a systems analyst and consultant until 1983, when he was promoted to manager of systems development.

Bill Hillner is currently a senior staff engineer at EXXON Company, U.S.A, in Houston, TX.

James Lovendale is a senior consultant with Comp Tech Inc. in Glastonbury, CT.

John Moskel is a minister for the Worldwide Church of God of Pasadena, CA. He resides in Hudson, NC.

Raymond Paulk serves as a senior development engineer at Tambrands Inc. in Palmer, MA.

Fred Tuttle serves as manager of product engineering at Oak Materials Group Inc., Hoosick Falls, NY.

Recently, **Steven Udell** joined Interocean Leasing Ltd., as general manager for North and South America. Interocean, a New York City-based firm, sells and leases intermodal transportation equipment throughout the world.

Frank Vernile is now the structural engineer for the City of Hartford (CT) Department of Public Works. He, his wife, Sally, and daughters, Sarah, 5, and Heather, 3, reside in East Hartford.

1971

Kenneth Kowalchek is currently a budget and management officer with U.S. Mission Geneva. The Kowalcheks have two children, Stephen, 4, and Katherine, 6.

Dr. **Amrik "Rick" Pabley** has opened a new office for the practice of ophthalmology at the Medical Arts Center adjacent to Holden (MA) Hospital. His special interests are in the field of microsurgery of the eye, including extracapsular cataract extraction with lens implantation, radial keratotomy or surgical treatment of nearsightedness, and Argon and Yag Laser surgery for glaucoma, diabetes, and other eye diseases. He received his MD from the University of Louisville School of Medicine, where he completed a rotating internship in internal medicine. He also was a resident in ophthalmology at the University of California Davis Medical Center. Until recently, he had a private practice in ophthalmology in Sacramento, CA.

Formerly a senior manufacturing engineer for Anderson Power Products Division of High Voltage Engineering, **Stanley Sotek** now holds the post of manager of industrial engineering and magnetics at Raytheon in Waltham, MA. He is also consulting in automation to several Boston area firms.

Thomas Werb serves as an engineering specialist at General Dynamics/Electric Boat in Groton, CT.

1972

Stephen Domeratzky now works for Prescott Drywall, Prescott, AZ.

Denis Kokernak holds the post of president of Interventional Medical Inc., Danvers, MA.

Paul Lavigne is general manager of Honematic Machine Corp., Boylston, MA. He has an MBA from WPI.

Richard Meighan serves as branch manager and sales engineer for Werner Pump in Framingham, MA.

Recently, **John Powers** was promoted to major in the U.S. Army Reserve and says he continues to participate actively in troop drills. He is a senior engineer with Westinghouse in Pittsburgh.

1973

BORN: to Mr. and Mrs. **Stuart Wallack** a son, Jacob Seth, in February. Jacob has a sister Rachel, 6, and a brother Nathan, 5.

Bruce Beverly has been named an associate and vice president of Haley & Aldrich Inc., consulting geotechnical engineers, geologists and hydrogeologists, in Cambridge, MA. He was also named manager of the firm's tunnels and underground construction group. He joined the company in 1975. Currently, he is geotechnical group chairman of the Boston Society of Civil Engineers section of the ASCE.

Mark Erasmus is now chief resident in neurosurgery at Eastern Virginia Graduate School of Medicine in Norfolk. He received his MD from UConn.

Dave Haflich works as operations engineer at Envirotech Operating Services, Suisun City, CA.

Roger Lavallee has been named senior consultant for Annuity and Pension Operations (Financial Planning and Reporting) at Aetna Life and Casualty.

Kenneth Levy holds the post of purchasing supervisor at Rogers Corporation in Chandler, AZ.

Barry Mendeloff serves as a group engineer for Sundstrand Corp. in Rockford, IL.

William Nutter, who works for Lockheed in Orlando, FL, is now senior engineer in charge of data processing system activity for the newest member of the Space Shuttle fleet, Atlantis.

Richard Olson and his wife, Marieke (Van den Brande), have two children and reside in Belgium. An account manager for CIGNA for seven years in Belgium, he writes, "It seems likely that I will remain here indefinitely."

Joseph Osgood works for Abacus Programming Corp. in Van Nuys, CA.

William Ploran is general manager of Rock Valley Pattern & Tool, Inc., Holyoke, MA.

Stephen Robinson, director of strategic planning for Centronics Corp., has been elected president of the Community Council of Nashua, which serves the mental health needs of citizens in Nashua (NH) and the surrounding area. Formerly a vice president of the Community Council and a member of Litchfield's Budget Committee, Robinson is currently chairman of the local selectmen. He is the charter president of the Litchfield Jaycees. In 1983, he was elected one of New Hampshire's Ten Outstanding Young Men.

Mark Whitley holds the post of district production manager for Mitchell Energy Corp. in Columbus, OH. He and his wife, Janice, have two sons, Matthew and Patrick.

Michael Zack continues as chief executive officer of Launder-Rite Inc., Wakefield, MA. He holds an MBA from Northwestern.

1974

Douglas Borgatti is chief of pollution and treatment for Passaic Valley Sewage Comm., Newark, NJ.

Kenneth Charak, a technical brand manager for Procter & Gamble in Cincinnati, recently received his MBA from Xavier University of Ohio. He and his wife, Adrienne, have two daughters, Rachel, 8, and Jessica, 5.

Richard Corey is with Pro-Tech Alarm Systems in Cheshire, CT.

Steve Dacri recently appeared on "TV's Bloopers and Practical Jokes," and has been signed for appearances on "Good Morning America," "Entertainment Tonight," "The Fall Guy," and "Merv Griffin." Part of Steve's act is his famous Houdini-type escape from a water torture cell, a performance which was televised live from Hollywood Blvd. in March.

Edward Gordon holds the post of systems analyst and president of Data Systems Associates in Sunrise, FL.

Richard Grisdale is employed by Alexander Kusko Inc. in Needham, MA.

Mehrdad Habib continues as a structural designer for Stone & Webster in Boston.

Glenn Loomer works as an electrical engineer for Stone & Webster in Boston.

Hercules Paskalis holds the post of product manager for plastics at Vista Chemical Europe, Brussels, Belgium.

David Scott is a partner in a new law firm, Morisi, O'Connell & Scott, which opened offices for general practice of law in Springfield, MA, recently. After graduating from WPI, he entered the U.S. Army under a postgraduate scholarship, rising to the rank of captain. For three years he was a law clerk, then a member of the formal legal staff with Fein, Schulman, Resnic, Pearson & Emond. A member of the Massachusetts and Federal Bars, he concentrates on probate and domestic relations matters, as well as administrative law and appellate practice. He is past chairman of the WPI Springfield Regional Program.

William Stafford is vice president of Professional Service Industries of Chicago, a civil engineering firm. He is in charge of the Atlantic Division, which includes six offices in the Carolinas, Virginia and Maryland.

In February, **Robert Trotter** received his MBA from Western New England College, Springfield, MA.

Mary Lynch Voshell works as a process engineer for Chas. T. Main Inc., Charlotte, NC.

1975

MARRIED: Francis Schlegel and Suzanne Pataky on June 29, 1985, in Darien, CT. She holds degrees from Southern Connecticut State College and the University of Bridgeport and is employed by the Stamford School System. He received his MS in chemical engineering from the University of New Haven and is employed by UniRoyal Geismar.

BORN: to Mr. and Mrs. **Ed Griffin** a daughter, Leslie, on June 27, 1985. Leslie has an older sister, Sheena, 18 months old. In May, Ed joined Nissho Electronics (U.S.A.), Irvine, CA, where he serves as a sales engineer. The company imports computer boards from Japan and sells them in the U.S. market. . . . to Mr. and Mrs. **Abdul Khan** their third child, a son, Ehsan, on March 30, 1985. Khan is with Chas. T. Main in Nigeria.

Arthur Aikin has received an MS in engineering from Widener University, Chester, PA.

Jon Anderson is now in private practice with Goldstein, Manello & Burak, counsellors at law in Burlington, VT. The firm has offices in Boston and is affiliated with another in Montreal. The major part of Jon's practice is utility related. Active in his community, he previously served as vice president of the Barre (VT) Jaycees, and he was just elected president of the Montpelier Kiwanis Club. He is also vice chairman of a committee to promote the commercial and industrial development of Montpelier and chairman of a City Council-appointed committee to investigate what should be done to improve Montpelier's water system. Jon's wife, Betsy, was recently named the Deputy Tax Commissioner for the State of Vermont.

Robert Andren has been promoted to project manager for Millstone Unit No. 1 generation-betterment projects by Northeast Utilities in Connecticut.

J. Hunter Babcock is currently a senior design engineer with KCR Technology, East Hartford, CT.

Nick Baker, a mid-level manager at Data General, Southboro, MA, is also involved in community service in Shrewsbury, where he lives. He is a town meeting member, a special police officer, a civil defense worker, an Explorer Scout adviser and an officer of the Rotary Club. He finds that volunteer organizations are the true test of management skills.

Paul Bianchet works as a construction engineer for Combustion Engineering in Windsor, CT.

Norton Bonaparte has joined the staff of the Institute for Governmental Service at the University of Maryland, where he serves as a management consultant to municipalities, counties and state agencies in the Maryland and Washington, DC, area. Most recently he was a consultant on a special joint task force of the U.S. General Accounting Office and the U.S. Department of Health and Human Services. In 1977 he received his master's in public administration from Cornell.

Fred Borys is a real estate appraiser at Dolan & Rossi Appraisers in Springfield, MA.

Robert Donle continues as project manager at Pacific Construction Co. Ltd., Richmond, CA.

Martin Fugardi, P.E., is president of Fugardi Construction Company Inc., in River Edge, NJ, a general contracting, engineering and construction management firm.

David Irvine serves as a physician assistant at Vassar College, Poughkeepsie, NY.

Dr. **Mohsen Kavehrad** is a member of the technical staff at ATT Bell Labs, Holmdel, NJ.

Ken Lannamann writes that for the past ten years he's been a professional yacht captain, a job which has taken him as far west as New Zealand and as far east as Turkey. During the last five years, he has been based mainly in the Caribbean and the Mediterranean areas where he has been involved in chartering. "At the moment," (June 1985), "I'm captain of *Cynra*, a Bowman 57 ketch. I've just sailed up from St. Thomas and even though it's summer here, I'm wearing sweaters and sleeping with blankets." He says that his big news is that in June 1984, he was married.

Stephen Mealy serves as engineering manager for Pilot Corporation, Pocasset, MA, a firm he founded last spring. The consulting firm deals in product development and manufacturing engineering. It has done a variety of work from designing and manufacturing a machine for an international filter manufacturer to produce filter medium to developing smaller, bench-size equipment for a medical supply manufacturer.

Stephen Murphy serves as a systems engineer for GTE Corporation in Westboro, MA.

Richard Newhouse is now a structural engineer for McDermott Inc., Lafayette, LA. The company is a world leader in the engineering and construction of offshore oil and gas facilities.

Judy Nitsch, vice president and chief engineer of Allen & Demurjian, Inc., Boston, has been elected president of the Boston section of the Society of Women Engineers (SWE) for her second year. She is also vice president of the Boston section of ASCE and a member of both the National Society of Professional Engineers and the Massachusetts Association of Land Surveyors and Civil Engineers.

Alex Vogt serves as construction supervisor for WASCO Products Inc., a manufacturer of skylights in Sanford, ME. The Vogts have a daughter, Marissa, 1½.

Dave Westerling is a consulting engineer for the U.S. Fish & Wildlife Service in Newton, MA.

After ten years of service, **Jeffrey Yu** has been promoted from international sales manager for Morse Industrial Corp. to an international management assignment with Emerson Electric Co. in Beijing (Peking), China. He has managed Morse's international sales efforts since 1981.

1976

MARRIED: Stephen Anstey and Teresa Boykin in Cocoa Beach, FL, on April 13, 1985. Teresa has a BA in elementary education from the College of William & Mary and a master's of education in administration-supervision from Virginia Commonwealth University. She is employed by the Brevard County School System. Stephen continues as a field engineer for GE Ordnance Systems at Cape Canaveral, FL.

Alan Briggs holds the post of division engineer at Mylar Manufacturing in Circleville, OH. He has an MBA from the University of New Orleans.

Roland Gravel continues as a mechanical engineer with the Department of the Navy in

Washington, DC.

Paul Grogan is a senior air pollution control engineer for the Massachusetts Department of Environmental Quality Engineering in Boston.

Bruce Haffty, an oncologist, has completed his internship and has entered his residency at Yale-New Haven Hospital. He received his MD from Yale.

James Hall has been promoted to senior associate at Index Systems Inc., a management consulting company in Cambridge, MA.

Sulekh Jain is a forging process engineer for GE in Cincinnati. He holds a PhD from the University of Birmingham, U.K.

Gregory Kedderis serves as a senior research biochemist at Merck-Sharp & Dohme Research in Rahway, NJ.

Kenneth Korcz serves as nuclear licensing engineer for Niagara Mohawk Power Corp., Syracuse, NY.

Charles Lauzon serves as an economist for ESSO Chimie in Paris, France.

Wayne Lundblad is a research engineer for the Southern Research Institute in Birmingham, AL.

Donald Moore is currently with Prime Computer. Earlier he had been employed at Codex and Data Terminals.

Roland Moreau has been promoted to staff engineer and transferred to EXXON Co., USA, production department, Midcontinent Division, in the Regulatory Affairs Department. Midland, TX.

Dr. **Kas Pauliukonis,** who holds an MD from Georgetown, is now a self-employed physician in Alexandria, VA.

Edward Perry II, a captain with the U.S. Air Force, is currently a doctoral student in systems engineering at Ohio State University.

1977

BORN: to Donna and **Robert Bowser** a daughter, Michelle Yvonne, on September 28, 1984. Michelle joins brother Geoffrey who was born in 1982. Bowser continues as a project engineer with the Naval Sea Systems Command.

Wayne Civinskas is manager of project development at RCA Corporation, Burlington, MA.

Joseph Danko serves as an optical scientist at Northrop Corp., Norwood, MA. He has an MS from the University of Rochester and a PhD from Boston College.

Albert DeFusco, Jr., has accepted a post as a chemist in the research department of the technical division at the Allegany Ballistics Laboratory of Hercules Inc. in Cumberland, MD. He has a PhD in organic chemistry from UVM.

Donald Edwards, assistant to the president of the Yankee Atomic Electric Company, was co-author of "The Living Schedule, Progress or Problem," which appeared in the June issue of *Cost Engineering*. He started with the Yankee organization as a startup engineer on the Vermont Yankee reactor in 1970. In 1973 he was made lead operations engineer. In 1976 he became assistant to the vice president, responsible for coordination of licensing for three operating nuclear plants, and three years later he became manager of licensing. In 1980 he was named director of operational projects for three operating nuclear plants. Later he became director of strategic planning and services and assistant to the president. After receiving his BS in physics from UCLA in Los Angeles, he earned his master's in management science from WPI.

Capt. **Michael Gregory** of the U.S. Air Force has been reassigned to Tyndall AFB, FL. He is an instructor pilot with the Second Tactical Fighter Training Squadron and was previously stationed at Holloman AFB, New Mexico.

Kevin Healey works as a project planner for Carlson Group Inc. in Smyrna, GA.

James Howe was recently appointed assistant to the regional general manager of the Northeast region for Niagara Mohawk Power Corporation. He joined the firm in 1977 as a junior structural engineer in the Hydro Design Engineering section at Syracuse. Most recently, he was an associate structural engineer. He is a professional engineer in New York and a member of the ASCE.

Ronald Klimas has been named town engineer and assistant director of public works in North Haven, CT. As assistant director, he will oversee the work of the zoning enforcement officer and the building official. Previously, he was employed by the Veterans Administration in New York and Washington, DC.

Gary Loeb is a results supervisor for Niagara Mohawk Power Corp., Glenmont, NY. Once the manager of the WPI crew team, he says he's resuming his rowing interest by rowing with the Organization of Adirondack Rowers & Scullers (O.A.R.S.) on the Hudson River at Albany, NY.

Anthony Marrese serves as principal electronics engineer for Sanders Associates in Nashua, NH.

John Roman, who has an MS in electrical engineering (LSI semiconductor design and manufacture) from the University of Vermont, is currently with IBM in Boca Raton, FL.

Diane Roy is a computer programmer at Giant Food Inc. in Washington, DC.

Jeffrey Tingle has received an MS in geology from Brown University and plans to stay at Brown for his PhD.

Linda Weiss serves as a hydrologist with the U.S. Geological Survey in Urbana, IL. She has an MS from Virginia Polytechnic Institute.

1978

MARRIED: Carlton Klein and Karen Wechsler on June 30, 1985, in Belmont, MA. She has her BA from Wheaton College, Norton, MA, and works for Stride Rite Corporation. A senior investment manager for venture capital with General Electric Investment Company, he is a graduate of Harvard Business School. . . . **Robert Pierce, Jr.,** to Marita McKendall on May 26, 1985, in Providence, RI. Marita graduated from Boston College School of Nursing and the University of Pennsylvania Graduate School of Nursing, and is with the Visiting Nurse Association Inc., Providence. Robert works for Eastern Utilities Associates, Lincoln, RI. . . . **Jennifer Pollard** and John Clark on May 25, 1985, in New Braintree, MA. They are both civil engineers employed by the New York State Department of Transportation in Poughkeepsie.

BORN: to **Paul** and **Lisa Moore Cody '80** their second son, John Michael, on December 23, 1984. Brother Richard is now 3. . . . to Eva and **Ken Steinhardt** twin daughters, Tara and Alana, on January 10, 1985. Prior to moving to Minnesota last year, Eva worked at WACCC (computer operations) at WPI. Currently, Ken is an executive consultant with the DEC sales organization in Bloomington, MN. Last year, as a consultant with corporate sales training, he taught in nine countries in Europe and the Far East.

Paul Avakian has been named marketing manager for dataCon Inc., the leading independent wirewrap service in the U.S. He is responsible for the development of corporate marketing plans and strategies, as well as advertising and sales promotion. In addition, he has assumed responsibility for dataCon's CAE-related product areas. Formerly, he was a senior product marketing engineer with the microcomputer division of NEC Electronics. He holds an MBA from Babson.

Ian Cannon is currently working as a systems engineer in welding robotics for Rockwell International, Canoga Park, CA. He is responsible for the development and implementation of state of the art sensors which determine weld penetration in real time. These sensors, robots and associated controls will be used to improve manufacturing productivity for the Space Shuttle main engines. As a side business, he teaches windsurfing. The Cannons have a son, Taylor Douglas, 2.

John DiBiasi currently holds the post of engineering manager for Sikorsky Aircraft in Stratford, CT.

Pat Donahue, a liaison engineer for Du Pont, is working on a project to immobilize high-level radioactive waste in bordsilicate glass. He writes that Du Pont has subcontracted Bechtel National to design the defense waste processing facility to be built at the Savannah River site which Du Pont manages for the U.S. DOE. The $910 million plant is scheduled to start up in 1989.

John Downes serves as senior sanitary engineer for the Massachusetts Dept. of Environmental Quality Engineering in Springfield. Last April he moved from Kentucky back to Massachusetts, where he has started to work for DEQE's Springfield office on hazardous waste issues and projects.

Mark Duchesne holds the post of manager of technology programs at Harris Graphics Corp., Melbourne, FL.

William Emerson holds the post of vice president of Sterling Enterprises in Leominster, MA.

Bruce Filgate is a consultant-engineer for DEC in Shrewsbury, MA.

James Fisher is a design supervisor for vehicle test equipment at Hamilton Test Systems, Tucson, AZ.

Mark Freitas works as a senior engineer for Codex Corp., Mansfield, MA.

William Gagne is a project engineer at Cochrane Associates Inc., Boston.

Carl Gerstle continues with DEC in Maynard, MA, where he is a principal engineer.

Richard Gottlieb, an engineer estimator for Perini Corp., is currently located in Helwan, Egypt.

Last year, **Austin Kalb** received an American Vacuum Society scholarship for research in optical thin film deposition. He is with Rockwell International in Anaheim, CA.

Stephen Koch, who holds the post of vice president of software engineering at Cadnetix Corp., Boulder, CO, wrote "Improved CAE to

CAD Communication Smooths Design," which was published in the June issue of *Computer Design*.

Yun-Shang Lin, who has been employed by the Ford Motor Company's Scientific Research Laboratory, Dearborn, MI, has received his PhD in engineering science from the University of Toledo in Ohio. He has an MS in chemical engineering from WPI. The Lins have two children.

Bettina Tuttle Potter continues as engineering manager at Polyclad Laminates in West Franklin, NH.

Gary Sowyrda has been promoted to senior supervisor in charge of acquiring oil and gas properties for the Central Division of EXXON in Houston, TX. His area extends from north of Houston to Canada and west of Ohio to the Rockies.

Paula Stoll serves as a research scientist for Kodak in Rochester, NY. She has a PhD from the University of Illinois.

Ricardo Wever sends "Regards from Aruba."

1979

MARRIED: Raymond DiMuzio and Karen Sprinkle on May 18, 1985, in Salisbury, NC. Karen graduated from Salisbury Business College and Southeastern Academy. She is a travel consultant with Trans-Charlotte Inc. Raymond serves as an engineering supervisor for National Starch and Chemical Corp. . . . **Stephen Lesniewski** and Anna Kiljanska in Warsaw, Poland, recently. Anna and Stephen are fifth-year veterinary students in Warsaw.

BORN: to Kim and **Mark McCabe** a daughter, Sarah Elizabeth, on Christmas Day, 1984. Mark serves as a project manager for Wendel Kent & Company. He and his family reside in Sarasota, FL.

Donald Abells continues with Raytheon in Sudbury, MA.

Kent Backe has changed jobs and is now a member of the technical staff at Pathway Design Inc., Wellesley, MA. The firm develops computer networking software.

Scott Booth works as a project engineer at Turner Construction Co., Philadelphia.

Jack Craffey writes, "I'm making millions of video cassettes for Minnesota Mining & Manufacturing in the great town of Wahpeton, ND."

Charles Curtis works for the Commonwealth Electric Company in Wareham, MA.

Michael De La Cruz holds the post of director of manufacturing technology at Apple Computer in Fremont, CA.

Douglas DeSimone, who received his PhD from Dartmouth in June, is now a National Institutes of Health postdoctoral research fellow at the Center for Cancer Research and Department of Biology at MIT.

Andrew Faiss received his MBA from RPI in June.

Alwyn Fitzgerald holds the post of vice president of marketing for Connecticut Valley Biological Supply, Southampton, MA.

Peter Greer is a production engineer for American Cyanamid Co., Willow Island, WV.

Scott Hansen was recently promoted to man-

Former Presidential Advisor Captains Worcester Codes

Ten years ago the City of Worcester had one of the worst building code inspection departments in Massachusetts, according to state inspectors. Today, the inspectors point to the Worcester building department as one of the best in the state. And most of the credit for the transformation goes to Norton Remmer '60 CE, city code commissioner.

When Remmer arrived on the scene nine years ago, there were virtually no inspections, he says today. "The city didn't even know about half the lodging houses in existence. Two-thirds of what appeared on building permits was obsolete, and no certificates of occupancy were awarded." The management of the department was in a word, he says, "informal."

Remmer had the credentials to turn things around. One of the reasons Worcester hired him was because he'd just written the state building code. A professional engineer with degrees from Yale and Oxford, he had worked as a consultant with governmental and professional agencies and as a member of a commission in Saudi Arabia. He served as a science and technology consultant for former President Gerald Ford and taught at Oxford University in England. He still teaches part time at WPI and is widely published in the field of earthquake-resistant building design.

Remmer smiles when asked why he's chosen Worcester to practice his trade.

"It's been interesting," he says. One

Worcester Telegram & Gazette Inc.

"interesting" aspect has been his involvement with the construction of the Centrum in Worcester, the city's popular auditorium and civic center. "It was an impossible situation," he reports. "There'd be up to five design changes a week and I wouldn't receive any of them." Nevertheless, the Centrum was completed and has served as the centerpiece of a revitalized downtown Worcester.

A project manager for a local construction firm sums up Remmer's contributions to Worcester's Code Inspection Department by saying, "He's smart and can rule the roost. Before he got here, the department was a ship without a captain."

ufacturing supervisor of Intermediates at Monsanto's Decatur (AL) plant. With Monsanto since 1979, he has served as a process engineer in acrilan manufacturing and was promoted to senior process engineer in 1983. He, wife Leslie, and their daughter reside in Decatur.

John Haponik serves as a plant engineer at Spencer-Kellogg in Valley Park, MO.

Robert Hart serves as marketing manager of power line filters for Cornell Dubilier (CDE) in Santa Monica, CA.

Henry Hazebrouck, a staff engineer at Priam Corp., San Jose, CA, was co-author of "Half-Height Drive Packs 70M-Byte Power," which appeared in the February issue of *Mini Micro Systems*. Before going to Priam, he designed disk-drive actuators and magnetic tape transports at Ampex.

Bill Herman holds the post of manager at Arthur Andersen Company, Hartford, CT.

Robert Howe is now a senior design engineer for Hamilton Standard, Windsor Locks, CT.

Bruce Jenket, a quality engineer for Varian Associates of Palo Alto, CA, is also a student at the micro campus of the University of Arizona in Tucson. He spent five years in the Navy.

Richard Jenkins is now a civil engineer for PRC Engineering in Iselin, NJ.

Capt. **Steve Kanevski** has been decorated with the U.S. Air Force Commendation Medal at Mountain Home AFB, Idaho. The medal is awarded to those individuals who demonstrate outstanding achievements or meritorious service in the performance of their Air Force duties. Kanevski is an instructor navigator with the 391st Tactical Fighter Squadron.

Tony Marini serves as a senior design engineer at Micro Networks in Worcester. Currently, he is completing his MSEE degree at WPI.

Gail D'Amico Mason and her husband, Mark Mason, were the first married team to receive veterinary medical degrees from Tufts University. During graduation ceremonies held last spring, Gail received the American Animal Hospital Association's Small Animal Practitioners' Award for clinical proficiency. She holds an MS from Mount Sinai School of Medicine. Her husband graduated from Bowdoin and has an MS from UConn. The couple has accepted one-year internship posts in medicine and surgery with the West Los Angeles Veterinary Medical Group in California. Eventually they hope to practice in Connecticut.

Jeffery Mills is a senior engineer in the Electric Boat Division at Groton, CT.

Kaveh Pahlavan wrote "Wireless Communications for Office Information Networks," which appeared in the June issue of *IEEE Communications Magazine*.

Tom Rockwood serves as department manager, disposable diapers, for Procter & Gamble in Mehoopany, PA.

James Sears holds the post of supervisor of projects and industrial engineering at Norton Co., Worcester.

Rich Seifert works as a consulting engineer for Industrial Networking Inc. in Santa Clara, CA.

Joe Silva is a test engineer at Computervision in Bedford, MA.

Alan Smelewicz is with Associated Electro-Mechanics in Springfield, MA.

John Wheeler holds the post of president and director of Lytton & Tolley Inc., a general contracting company in Citrus County, FL.

1980

MARRIED: Allison Avery and James Powers III on May 18, 1985, in Granby, CT. Allison is a support engineer for Stone & Webster, where James, a Northeastern graduate, is also an engineer. . . . **John Cermenaro** to Maria Scalise recently. Maria graduated from Union College with a BSCS. John, who is a sales engineer of movable shelving systems for Spacesaver Systems in Santa Fe Springs, CA, still plays drums for a rock 'n' roll band. . . . **Brian Chapman** and Maria Salarda in May. Brian is a field engineer at Nine Mile Point Unit 2 nuclear power plant. . . . **Frances Fortin** and Erik Rasmussen on June 8, 1985, in Great Falls, VA. Frances receives her MS from George Washington University this year. Erik graduated from Rutgers and has an MS from George Washington University. They are structural engineers at the David Taylor Naval Ship Research and Development Center in Bethesda, MD. . . . **William Guilfoile, Jr.**, and Elizabeth Donovan in Quincy, MA, on April 27, 1985. Betty graduated from Regis College and is a private consultant for Military Information Systems. William, chief controls engineer for Bodine Corp., Bridgeport, CT, is studying for his MBA and MSCS at the Hartford Graduate Center.

MARRIED: Bruce Jacobson and Maria Hickey in Worcester on May 19, 1985. Maria, a graduate of Boston College Law School and Manhattanville College, recently passed the Massachusetts Bar examination. Bruce, general manager and special equipment engineer for Photopanels of New England Inc., Princeton, MA, is an MBA candidate at WPI. He was recently elected to a three-year term on the Princeton Planning Board. He is also vice president of the Princeton Business Association and a captain and emergency medical technician for the local fire department. . . . **Peter LaBelle** and Julia Reed, an alumna of the University of Nebraska, on July 6, 1985. Julia works for Texas Instruments as a mathematician. Peter is with Bell Northern Research in Richardson, TX. . . . **Susan Lowney** and Dr. Roy Bondurant in Wayland, MA. Susan, who has an MSEE from WPI, also graduated from Clark. Roy holds degrees from MIT. Both are employed at M.I.T. Lincoln Laboratory, Lexington, MA. . . . **Donald MacKinnon III** to Leslie Potter in Osterville, MA, on June 1, 1985. Leslie, a nursery school teacher, has an associate's degree from Endicott College and a bachelor's degree from Bridgewater State College. Donald works for New England Telephone Co. . . . **Louis Palecki** and Michele Bordogna on May 26, 1985, in Shrewsbury, MA. A certified public accountant, she graduated from Holy Cross and is a master's degree candidate at Babson College. He serves as a senior systems engineer at Killmorgen Corp., Northampton, MA.

BORN: to Lisa and **Ron Lesnikoski** a son, Steven Andrew, on January 16, 1985. Ron is now a senior applications engineer at Megatest Corp. . . . to Bonnie and **Peter Schoonmaker** a son, Christopher Mark, on April 23, 1985. The Schoonmakers reside in Woburn, MA.

John Apostolou is a body panel-bumper development engineer at Du Pont.

Craig Autio is currently with Controlonics Corporation in Westford, MA.

Amos Barnes works for Southern Connecticut Gas Co. in Bridgeport.

Raymond Cronin, who recently graduated from Harvard Business School, is now regional manager for Megatest Corporation.

Thomas De Bellis serves as a systems programmer at Columbia University, New York City.

Duane Delfosse, who received his MS in materials science from Stanford University in December, is now a senior associate engineer for IBM in San Jose, CA.

David Drevinsky has completed all requirements for an MS in environmental engineering from Northeastern University.

Curtis Dudley is now with AT&T Technologies, Boston.

David Fox left Digital's Software Engineering Group two years ago and is now with the firm's Software Services Group in the Bedford, NH, sales and service office. In January he was promoted to senior software specialist and in June celebrated his fifth year with Digital.

Cathryn Ricci Giunta has been promoted to project specialist for field service at DEC in Woburn, MA.

Dave Gura was recently advanced from general field engineer to sales engineer at Schlumberger Well Services in Corpus Christi, TX.

James Gustafson is a senior engineer at United Technologies in Springfield, MA.

Douglas Hawks serves as a microelectronic packaging engineer for DEC in Marlboro, MA.

David Hazen has joined the Advanced Systems Group of Aerodyne Research Inc. as an applied mathematician. He will work in the area of infrared background and aircraft signature phenomonology. He has an MS in applied mathematics from MIT.

Greg Heath works as a senior staff engineer for Metcalf & Eddy in Wakefield, MA.

Mike Herberg holds the post of manager of silicone technology at Emerson & Coming Inc., Lexington, MA.

James Idelson is now associated with Analog Devices.

Paul Kidder is studying for his MS in management at Purdue University.

Gareth Kucinkas is a manufacturers' representative in the aerospace/military market.

Edward Kurdziel is now with Combustion Engineering in Windsor, CT.

Capt. **Stephen Lawry** has been decorated with the second award of the Air Force Commendation Medal. He is an assistant professor of aerospace studies at St. Joseph's University in Philadelphia. He has a master's degree from WPI.

Don Maki now holds the post of project engineer at Ahlstrom Machinery Inc., Glens Falls, NY.

Serge Molinari is area supervisor-power at Du Pont in LaPlace, LA.

In June, **Art O'Leary** received his MSME from Northeastern University.

William Perkins serves as a project engineer for ARDC in Dover, NJ.

Rodney Poole is now employed by the Michelin Tire Corporation, Greenville, SC.

Joseph Roberts currently serves as a principal planner for Woodbridge Township, NJ. He had been with the Morris County Planning Board for three years.

Martin Rowe serves as supervisor of technical support for Varian/Extrion, Gloucester, MA. He joined the company in February.

George Tobin has been employed as an investment counselor with the Shrewsbury, NJ, office of First Investors Corp. of New York City.

Michael Vicens is a test engineer manager for Storage Technology Corp., Ponce, Puerto Rico.

Scott Wade received his MBA from Drexel University in Philadelphia in June. He is now a staff industrial engineer for Texas Instruments Inc., Attleboro, MA.

Pamela Wright serves as a senior research biologist at Lever Research Inc., Edgewater, NJ.

1981

MARRIED: Gregory Stanford and Melissa Park in Columbia, MD, on November 17, 1984. Melissa graduated from Mount Holyoke College with a BA in French literature. She is a linguist for the Department of Defense. Greg still works at Greiner Engineering in Baltimore where he is currently with the geotechnical engineering department.

BORN: to Christopher and **Judy Batchelor Paquette** a daughter, Rebecca Anne, on September 27, 1984. Judy is an analytical engineer at Hamilton Standard in Farmington, CT. . . . to **Ray** and **Lynn Dunphy Perigard '82** a daughter, Danielle, on June 13, 1984. Ray serves as a process development engineer for Union Carbide in Tarrytown, NY.

Arthur Bainton is now a test equipment engineer for Raytheon in Portsmouth, RI.

Timothy Bazinet is with the Los Angeles County Public Works.

Capt. **Daniel Beliveau,** USA, graduated from the Infantry Officers' Advance Course in February. Currently, he is responsible for development of Special Forces training and evaluation. Dan, who is stationed at Fort Bragg, NC, resides with his wife, Terry, in Fayetteville.

Joseph Celentano recently received the Bechtel Award of Merit for an article which appeared in the magazine, *PC World.* Joe is a microcomputer applications specialist for Bechtel in San Francisco. Currently, he is in Riyadh, Saudi Arabia, consulting on the King Khaled International Airport project.

Paul Chetham has received his MD degree from the University of Massachusetts Medical School, Worcester. He will serve his residency in internal medicine at George Washington University Hospital.

James Connor holds the post of product marketing manager at Gould/AMI Semiconductors in Santa Clara, CA.

Thomas Cotton currently holds the title of manager of modem development at Infinet Inc., Andover, MA. He is married to Rhonda Lynne Bolivar, a graduate of Hartwick College.

Eleanor Cromwick is an estimator for Turner Construction Co. in Washington, DC.

Rick Cunneen has been promoted to international sales manager at Morse Industrial Corporation, having most recently worked in San Francisco and Philadelphia for the firm. He is located in Ithaca, NY.

Daretia Davis is a research engineer for EXXON Production Research Co., Houston.

Bradford Drury has graduated from UMass Medical School and is now continuing his training with the Department of Surgery at Massachusetts General Hospital.

Russell Ellis is a product engineer for The Foxboro Co., Plymouth, MA.

Richard Laflamme works as a manufacturing analyst for Teradyne Connection Systems in Nashua, NH.

Paul Laurienzo is a test engineer at Raytheon Co., Waltham, MA.

Dennis Moulton is with Stone & Webster in Shippingport, PA.

David Normen returned in September from an 8-month "great adventure" of hiking, cross-country skiing, and mountain climbing, including Mt. McKinley in Alaska.

Michael Pugh holds the post of project engineer for Burroughs Corp., San Diego, CA.

Stuart Ross serves as manager of R&D at Gridcomm Inc., Ridgefield, CT.

Maryanne Valinski Spillane is a support engineer with Stone & Webster, temporarily assigned to the Millstone power plant, Waterford, CT.

Peter Tiziani is pursuing an MSME at the University of Connecticut.

Jeff Trask has transferred to the process engineering division of Chevron USA at the firm's El Segundo, CA, refinery.

Gary Winer, who holds a JD from New England School of Law, is now a patent attorney with Dennison Mfg. Co., Framingham, MA. He and his wife, Soheyla, reside in Ashland, MA.

1982

MARRIED: Bob Addiss and Doreen Daly at Castle Hill in Ipswich, MA, on May 24, 1985. The wedding took place over live television on Channel 5's "Good Day Show," which is aired in New England. Doreen graduated from Chelmsford High School and works in the design department of The Leather Shop, West Concord, MA. Bob is an electrical engineer at Transkinetic Systems Inc. in Canton. . . . **John Hanly** and **Michele Giard** in Leicester, MA, on June 1, 1985. Michele, who did graduate study at the University of Connecticut, is a structural engineer with Christopher Marx Associates, New Haven, CT. John serves as a process engineer at Pfizer Chemical Company in Groton, CT. . . . **Mark Jennings** to Cheryl Machado in Dracut, MA, on April 13, 1985. She attended the University of Lowell and is a production control coordinator-expeditor at Wang Labs, Lowell, where he is a software engineer. . . . **David Pecevich** and Brenda McQuillan in Auburndale, MA, on June 15, 1985. She graduated from Clark University, Worcester. He serves as a field engineer with the Square D. Company.

Donald Aitken has been commissioned a second lieutenant in the U.S. Air Force upon graduation from OTS at Lackland AFB, TX. He is stationed at Keesler AFB, MS.

Jane Bulejcik Becker holds the post of distribution assistant at Eastern Edison Co., Brockton, MA.

Michael Bickford recently accepted a post as sales representative in the Detroit area for Data General of Birmingham, MI.

Jay Dempsey is a machine engineer specializing in industrial ultrasonic applications at Kodak in Rochester, NY.

No longer with Florida Power & Light, **John Dougherty** is now an associate engineer in the facilities engineering department at IBM in East Fishkill, NY.

Brian Dunne is a design engineer for Westinghouse in Baltimore, MD. He has been on leave as a research assistant at MIT.

Drew Erickson is an associate engineer at IBM in Hopewell Junction, NY.

Brian Haendiges serves as an actuarial associate at Union Mutual Life in Portland, ME.

Nils Jacobson is a process engineer with ECC Corporation, Holden, MA. The firm manufactures high-density multi-layer and double-sided printed circuit boards.

Richard Nicholson works for Martin Marietta in Denver, CO.

Steven Oxman, who holds an MSCS from WPI and a BS from the University of Maryland, wrote "Selecting a DBMS for Large Systems—A Real-Life Case Study," for the October 1984 issue of *Data Management.* His career has included data processing and computer science positions in the public sector.

Timothy Roughan is a consumer service representative for Mass. Electric in Leominster, MA.

John Sansoucy works as a manufacturing engineer for Parametrics in Orange, CT.

George Schultheiss is with Natick R&D Center, Natick, MA.

Ingrid Slembek was recently promoted to senior software engineer at DEC's midrange systems group in Littleton, MA.

Garrett Thompson works in CEO development for Data General in Westboro, MA.

Janice Thornton is a senior industry associate for The Foxboro (MA) Co.

Steve Tuch is with Chromalloy PMT (porous material technology) in Dallas, TX.

Brian Walker is with the engine design group of Mack Truck, Hagerstown, MD.

1983

MARRIED: Jane Adamson and Stanley Pawlukiewicz in New London, CT, on April 27, 1985. He graduated from UConn. They are both electronics engineers at the Naval Underwater Systems Center in New London. . . . **Daniel Alcombright** to Nancy Squitieri of Billerica, MA, on April 27, 1985. Nancy, a graduate of Tufts University, is a chemical engineer at Procter & Gamble, Cincinnati, OH, where Daniel serves as an electrical engineer. . . . **Elizabeth Aspden** and Michael Tavares in May in Somerset, MA. Elizabeth is a buyer for Texas Instruments Inc. Michael, a graduate of Providence College, is a financial analyst for Raytheon Co. He is also an MBA candidate at Bryant College. . . . **Douglas Butler** and Nancy Nickerson in Barnstable, MA, on May 5, 1985. Nancy attended Cape Cod Community College. Douglas is a design engineer. . . . **William Lamberti** and **Christine Cataldo, '84,** in Cranston, RI, on June 9, 1985. She is a mechanical engineer with GE, and he is an electrical engineer with Hamilton Standard. . . . **Michael Valiton** and **Anne Saunders** last April. Anne has a new job working for Digital in Littleton, MA. . . . **Adrian VanderSpek** and **Shari Deiana '84** in Milford, MA. He is an electrical engineer with Bany'n Systems Inc. in Westboro, MA.

Sonia Adrianowycz continues as a general engineer at Naval Underwater Systems Center, New London, CT.

No longer with Rockwell in Los Angeles, **Roy Arsenault** is currently with RACAL in

The Class of 1989 contains nearly 20 sons and daughters of WPI alumni. These families are pictured above, on the steps of Alden Memorial with President Jon C. Strauss (front row, far left) at Freshman Orientation in August. Congratulations, one and all!

Westford, MA, where he is an application engineer.

Christine O'Connor Cataldo is a test engineer at Computervision in Bedford, MA. Her husband, Michael, is a sales manager at TDX Systems.

Eric De Rivera works for Warner & Swasey Co., Worcester.

Matthew Falco is a development chemist at MacDermid Inc., Waterbury, CT.

Pamela Fearn serves as a product engineer for a small semiconductor company, Xicor Inc., in Milpitas, CA.

Charles Gordon holds the position of engineering manager at Monet Jewelers in Pawtucket, RI.

Susan Godbout Hersey is an associate planning engineer at EUA Service Corp., Lincoln, RI.

Sean Leach holds the post of chief of field operations at GHR Engineering in New Bedford, MA.

Stephen LeClerc works as a performance engineer at Maine Yankee Nuclear Power plant in Wiscasset, ME. He and his wife, Debbie, reside in Freeport, ME.

Douglas Macarthur serves as a manufacturing engineer at Sanders Associates in Nashua, NH.

Donald Mackay is a mechanical engineer for Dataproducts in Milford, NH.

Bernard Mara is a corporate industrial engineer at AMPAD Corp., Holyoke, MA.

Peter Marino works as a sales engineer with M.A. Olson Co., Topsfield, MA.

Fernando Motta is a marketing executive with Felipe Motta Liquors in Panama. In June, he received his MS from Sloan School of Management, MIT.

John Nicholson, Jr., holds the post of project engineer in the retained-earth branch of VSL Corporation, Springfield, VA.

Charles Pappis works as a process engineer at Tegal Corporation in Hopkinton, MA.

Joe Phelan serves as a production control specialist for GE's Aircraft Engine Business Group in Cincinnati.

Vivian Hiscock Podsiadlo continues as a reliability engineer at Data General in Westboro, MA.

David Shatford is a software engineer II at Wang Labs, Lowell, MA.

Eric Soederberg is a staff engineer at C.S. Draper Labs in Cambridge, MA.

Michael Splaine has graduated from the Basic Civil Engineer Corps Officer Course at Port Hueneme, CA. He is an ensign with the Navy.

Daniel Statile received his MS from RPI, Troy, NY, in May.

Bill Wheeler has been attending a Navy submarine officer basic course in New London, CT.

Wayne Whippie is an engineer-in-training in electric construction at Downing Engineering in Harrisville, NH.

Stephen Wright continues as a mechanical design engineer with Kollmorgen Corp., Northampton, MA.

Tien-Chung Ying is a senior scientist associate at Lockheed Missiles & Space Co., Palo Alto, CA. He has an MS from WPI.

1984

MARRIED: Robert Bunce to Pamela Hagaman in Pompton Lakes, NJ, on May 5, 1985. Pam graduated from Fairfield (CT) University and works for IBM in Poughkeepsie, NY, as an accountant. Robert is with IBM (East Fishkill), Hopewell Junction, NY. . . . **Bruce Daube, Jr.,** and Pamela Shanley in Avon, CT, on March 30, 1985. Pamela graduated from Hartford College for Women and Connecticut College. She was registrar and teacher of children's art at Farmington Valley Arts Center. Bruce is a graduate student at California Institute of Technology. . . . **Glen Reed** and Carol Esmeraldo on May 25, 1985, in Attleboro, MA. She graduated from Dean Junior College. He works for Raytheon. . . . **Paul Thurston, Jr.,** and Terry Hazlewood on April 28, 1985, in Plymouth, MA. Terry graduated from Becker. Paul is a lieutenant in the USAF stationed in Colorado Springs, CO.

Betsy Barrows, who has a master's in math from WPI, is chairman of the math department at Gateway Regional High School in Huntington, MA.

Mary Bartos continues with Babcock & Wilcox, Lynchburg, VA.

Gregory Baumann is a senior design engineer with Sperry Corp., Blue Bell, PA.

Joel Bernstein is a manufacturing engineer for GE in Wilmington, MA.

Dr. **Peter Bradley** serves as a research associate in the biology department at Northeastern University, Boston.

Fabio Carrera is a hardware design engineer for BTU/Bruce Corp., North Billerica, MA.

Charles Chandler works as a project engineer at M/A-COM Microwave in Burlington, MA.

Laurie Cocchi continues as an associate engineer at Westinghouse Electric Corp., Baltimore, MD.

William Duffy has joined AT&T, North

Andover, MA.

Linda Dunn serves as a systems programmer-analyst at Pratt & Whitney Aircraft in East Hartford, CT.

John Herrin works for Norton Co. in Fairport, NY, where he and his wife, Lisa, reside.

Michael Hoyt serves as a field marketing engineer at Hewlett-Packard in Andover, MA.

Joseph Ledoux has been employed as a scientific analyst by Xon Tech Inc., Van Nuys, CA.

Philip Litchfield works for RCA Automated System, Burlington, MA.

Larry Manor is with RCA Government Systems Division in Burlington, MA.

William McCauley is now a logic products marketing manager for Chancellor Computer Corp., Mountain View, CA. He graduated from UConn and holds an MSME from WPI.

Waman Nawathe holds the post of test engineer for Gould Electronics of Andover, MA.

Michael Ortolano is a junior engineer with the U.S. Navy in Washington, DC.

Joseph Parisi continues as a field engineer for DCM Corp., Framingham, MA. He and his wife, Pamela, reside in Gloucester.

Michael Powers is in the manufacturing management program at GE in Wilmington, MA.

Wayne Risas is a graduate student at Cornell University.

Peter Schibly is employed by Sanders Associates, Nashua, NH.

Christopher Scholl serves as a junior sanitary engineer for the Department of Environmental Quality in Worcester.

Leslie Schur is employed as a programmer I with Atex Inc., Bedford, MA.

Roy Seelye works for Hewitt Engineering of Berlin, CT.

Philip Sheridan has been employed as a structural engineer by Camp Dresser & McKee, Boston.

Andrea Siano has joined Bendix Corporation, Utica, NY.

Keith Silver has been employed as a diagnostic engineer by GenRad in Concord, MA.

Kathy Spieler is a quality assurance engineer for Du Pont's textile fibers department in Richmond, VA.

Jeremy Spraggs has accepted a post with St. Lawrence Explosives Corp. in Adams Center, NY.

Paul Stephenson is on the staff at Raytheon Company in Sudbury, MA.

Andrew Stewart works as a hardware engineer for DEC, Littleton, MA.

Mark Stockwell serves as a packaging engineer at Astra Pharmaceutical Products in Westboro, MA.

Michael Stone works as a patent examiner for the U.S. Department of Commerce in the Patent & Trademark Office, Arlington, VA.

Jonathan Super is a design engineer at MassComp in Westford, MA. He has an MSEE from WPI.

Richard Tashjian, who holds an MBA from WPI, is employed as a senior engineer at Norton Co., Worcester.

Eric Thune is a design engineer for Burroughs Corporation in San Diego.

John Truesdell serves as a design engineer at Sturtevant Co., Boston.

Tom Turano, who has his MSEE from WPI, works as a senior software engineer at DEC, Marlboro, MA.

Karla Twedt has joined AT&T Technologies-Western Electric, North Andover, MA, as a product engineer.

Jennifer Udall works for Mitre Corporation, Bedford, MA.

Timothy Ufert has joined RCA-Astro Electronics, Hightstown, NJ. He is an associate member of the technical staff.

Tim Urekew works for the Gillette Co., Boston, as an associate engineer.

Douglas Valentine serves as assistant scientist at Pfizer Inc., Groton, CT.

Erik Van Bork is currently with OMYA Inc., Florence, VT.

Dale VanLandingham has accepted a post with Raytheon Company.

Edward Vassar holds the post of principal engineer at Raytheon in Sudbury, MA. He has an MSEE from WPI.

Ensign **Joseph Veilleux** is on active duty as a student at the U.S. Naval Nuclear Power School in Orlando, FL. As a midshipman, he served aboard the *U.S.S. Mississippi* and the nuclear powered submarine *U.S.S. Skipjack.* He is designated as a submarine warfare officer.

David Williams works for Cybermation Inc., Cambridge, MA.

1985

MARRIED: Laura Mackertich and Michael Scanlon in Worcester on March 21, 1985. Laura is employed by Rice-Barton Corp. Michael has been attending the University of Maine at Orono. . . . **Andrew Powell, Jr.,** and Betsy Bolinser in Merrimack, NH. She graduated from Sherburne-Earlville High School and is an assistant manager at Pizza Hut in Nashua. He is employed by Wendy's in Merrimack.

Mark Carpenter has accepted an advance networking systems post with IBM at Palo Alto, CA.

Christopher Claussen serves as a marketing representative for Sperry Corporation in Wellesley, MA.

Ann Marie Gagnon has accepted a post with the Arthur Andersen Company of Hartford, CT. Currently, she resides in Brookfield, MA, with her husband, Darrell, and daughter, Jessica Lea.

John Hachey is a staff scientist for EIC Laboratory Inc., Norwood, MA.

Richard Hilow works as a design engineer at Harris Graphics-Press Division in Dover, NH. He and his wife, Ginger, reside in Dover.

Stephen Hooley is a sales engineer for Texas Instruments in Dallas, TX.

Teresita Icaza serves as assistant parts manager for F. Icaza in Panama.

Arthur Kingsley is an associate engineer for Baltimore (MD) Gas & Electric.

Robert Labonte is a member of the technical staff at Mitre Corp., Bedford, MA.

Edward Leonard III works for Olektron Corporation in Webster, MA. Besides his MSEE from WPI, he holds degrees from Washington & Lee University and the University of Bridgeport.

Tom Lucey, who has his MBA from WPI, serves as a project engineer for Data General in Westboro, MA.

Catherine Marinelli is now a management intern with Consolidated Edison in New York City.

John Martin plans to pursue a PhD in medicinal chemistry at the University of Maryland in Baltimore.

John Miller, who holds an MBA from WPI, serves as a quality control engineer and a chemical planner for the Polaroid Corporation in New Bedford, MA. He has a BS from the United States Military Academy at West Point and a master's in engineering from the University of Washington in Seattle.

Patricia Nugent has been granted a fellowship for graduate studies at RPI, Troy, NY.

Paul Saucier has been employed as a senior project member at RCA Corp., Burlington, MA. He has an MSCS from WPI and a BS from Central New England College.

Robert Sweeney is enrolled in the PhD program at California Tech in Pasadena.

Richard Sylvestre, Jr., has accepted a post with Hughes Aircraft Co., Fullerton, CA.

Thomas Tillman works for Yankee Atomic Electric Co., Framingham, MA.

School of Industrial Management

Milton Steen '79 has been appointed district manager of Massachusetts Electric's Southeast District. He is responsible for the overall operation of the district, which serves more than 96,000 customers. He joined Mass. Electric, a retail subsidiary of New England Electric System, in 1961, and has held sales management posts in the company's Marlboro, Weymouth and Worcester offices. In 1982, he was promoted to manager of Mass. Electric's Southeast District, after having served as assistant director of consumer services for New England Electric. He has a BS from the University of Rhode Island. . . . **Dennis Lynch '82** has been promoted to manager of materials and production control at Coes-Knife Co., Worcester. A metallurgical engineer at Coes since 1976, he has a BS from Northeastern. . . . Bay State Abrasives, Westboro, MA, has named **David Guild '83** sales respresentative in the Boston area of the New England region. He joined the firm in 1973 and has held posts in the production, drafting, customer service and pricing departments. He attended Franklin and Marshall College. . . . **Wayne Everett '84** recently graduated from the Greater Worcester Executive Program (GWEP), which is run jointly by WPI's Department of Management and Clark University's Graduate School of Management. Wayne is manager of laboratory services at Wyman-Gordon, where he's been employed since 1974. He has a BSME from Northeastern and an MS in metallurgy from Rochester Polytechnic Institute.

Natural Science Program

Donovan Lewis '78, a science and math teacher at Rocky Hill School in East Greenwich, RI, was chosen to participate in the 1985 Woodrow Wilson Institute on High School Physics held at Princeton University. He was one of 50 physics teachers from 250 applicants nationwide to receive the award. During the four-week summer program, he studied methods of enriching the physics curriculum with prominent physicists. Before joining the faculty at Rocky Hill, he did research in high-energy physics at Brown University.

COMPLETED CAREERS

Dr. Glen A. Richardson, of Terre Haute, IN, head of the electrical engineering department at WPI from 1958 to 1973, passed away on August 12, 1985.

Born in Havensville, KS, on July 15, 1915, he received his BS from the University of Kansas in 1941, and his MS from the same university in 1947. In 1952 he received his PhD from Iowa State College (ISU). After teaching at both universities, he joined the WPI faculty as a professor and head of electrical engineering in 1958. In 1972, he received a professional achievement citation from ISU.

Active in his professional societies at the New England and national levels, in 1971 he was named chairman of the American Society for Engineering Education (ASEE), New England section. He had been a national vice president of ASEE. Besides serving as secretary of the Kansas-Nebraska section of the ASEE in 1946-47, he also worked on the Committee on Correlation of Teaching Aids. Later posts were as chairman of the Electrical Engineering Division and as a steering committee member for the Council of Technical Divisions. He was national director-at-large for the Institute of Electrical and Electronics Engineers from 1969 until 1972, as well as a member of the Student Development Committee and an accreditation visitor for the Engineers Council for Professional Development.

His professional experience was with Commonwealth Edison Co., Chicago; Radio Corp. of America, Camden, NJ; and Wilcox Electric Co., Kansas City. He was the author of publications on radio subjects and the co-author of 19 technical manuals for aircraft receiving and transmitting equipment, as well as a book on the principles of radio. At one time, he was editor of the Electronics Series at Charles M. Merrill Books Inc.

While at WPI, Dr. Richardson and Prof. Harit Majmudar correlated a report that helped initiate a program to stimulate interest in the electric power industry among students in both undergraduate and graduate fields of study. He served on Gov. Volpe's (MA) Advisory Committee for Science & Technology and presided over a session on Societal Problems, Technology and Public Policy for the ASEE in Boston in 1972. He belonged to the Masons and the Methodist Church.

Arthur F. Barnes '08, former chairman of the board of Texas Engineering Corp., Houston, TX, passed away recently.

He was born on May 28, 1886, in Worcester, and graduated with his BSME from WPI. During his career, he was associated with the University of Pennsylvania (instructor), Middlebury College (assistant professor of engineering), New Mexico A&M College (dean of engineering), and Barglebaugh & Barnes. For many years he owned and operated Texas Engineering Corp., Houston.

Mr. Barnes, a professional engineer, belonged to the ASME, the Engineers Club of Houston, the Shrine, the Knights Templar and the Masons, as well as the American Society of Heating, Refrigeration, and Air Conditioning Engineers (past president, Houston chapter). He was a former chairman of the board of health of the City of West University Place and a charter member and past director of the Houston Rotary Club.

J. Francis Granger '12, class president, died in Worcester on May 4, 1985, at the age of 94. A Worcester native, he received his BSCE in 1912.

For 30 years he was superintendent of streets in Marlboro, MA. Earlier he was city engineer for two years. After retirement, he became a partner in the engineering company of Granger, Thompson & Liston Inc., Marlboro.

He served as clerk of the works on the addition to Marlboro Hospital in 1960 and was appointed chairman of the building committee which oversaw construction of the new Marlboro High School.

From 1912 to 1917, he was an inspector and draftsman for the Fitchburg Sewage Disposal Commission. He joined the Ohio Department of Public Health in 1917, as head of Ohio's sewage treatment plants.

He was an Army captain in World War I, seeing duty in France. During World War II, he served for four years as a captain, major and lieutenant colonel in the Army Corps of Engineers. After discharge, he remained in the active reserves and was commanding officer of the 357th Engineer Construction Group from 1946 to 1950.

Mr. Granger was a registered professional engineer and land surveyor in Massachusetts. He had served as a trustee of the board of governors of Marlboro Hospital. A 50-year member of the Massachusetts Highway Association, he was secretary for the past 32 years. He was a former clerk of the Marlboro Planning Board and deputy director of Civil Defense. He belonged to the Immaculate Conception Church, the Knights of Columbus, the American Legion, the VFW, the American Public Works Association, the Tech Old-Timers and Tau Beta Pi. In 1958, he received the Samuel A. Greeley Service Award from the American Public Works Congress for his service.

James W. Armour '13 of Grosse Pointe Park, MI, a retired vice president of Riley Stoker Corp., died on May 11, 1985, at the age of 93. He was born in Worcester and received his BSME from WPI.

Following graduation, he joined Armour's Pattern Shop. From 1917 to 1919 he was with U.S. Army Ordnance. He was employed by Riley Stoker from 1919 to 1957. After retiring from Riley Stoker, he served as secretary of W. Hawley & Co. Inc. He belonged to SAE, PTS and Skull, the ASME and Engineering Society of Detroit. He was a registered professional engineer.

Arthur H. Burns '14 of Woodbury Heights, NJ, passed away on April 30, 1985. A graduate electrical engineer, he was born on November 22, 1891, in Salem, MA.

In 1956, he retired as division equipment engineer from AT&T, Wayne, PA, after many years with the company (1915-56). He saw service in Pawtucket, RI; Boston, MA; Providence, RI; Washington, DC; New York City and Philadelphia.

He was a former member of the AIEE Communication Group and of the Public School Board in Riverton, NJ. He belonged to Lambda Chi Alpha, and he had served as president of the Philadelphia chapter of the Alumni Association, as well as an Alumni Council representative. His son, Arthur, Jr., graduated in 1948.

George Ross '14 of North Augusta, SC, passed away on December 31, 1984, at the age of 94. A native of Kensington, CT, he was born on Oct. 12, 1890.

A graduate civil engineer, during his career he was with Fiske-Carter Construction Co., Oregon Lumber Co., Welborn-Ross Lumber Co. (partner), and George Ross Lumber Co. (owner). He had served as president and chairman of Ross Builders' Supplies before his retirement in 1964. At one time he was chairman of Rosco Supply. During World War II, he was director of purchasing for Daniel Construction Co.

Active with his local Presbyterian Church, Mr. Ross also held executive posts with the Kiwanis, the Red Shield Club and the Berea Sewer and Water District. He belonged to Skull.

William L. G. Mackenzie '17 of Spartanburg, SC, retired president of Fiske-Carter Construction Co., died September 26, 1984. He was born on March 22, 1896, in Uxbridge, MA, and graduated as a civil engineer.

From 1917 to 1920, he was with the Corps of Engineers, U.S. Army, where he rose to captain. From 1920 until he retired in 1969, he was with Fiske-Carter Construction Co., Spartanburg, serving as vice president and president during the last 12 years.

Mr. Mackenzie belonged to the National Society of Professional Engineers and the Consulting Constructors Council of America. In 1961 he received the "Engineer of the Year Award" from the South Carolina Society of Professional Engineers. For many years he was chairman of the city planning commission of Spartanburg. He was a member of Tau Beta Pi and Sigma Xi.

Past president of the local Rotary Club, he was also a former director of the local chapters of the Red Cross, the Salvation Army, the Chamber of Commerce and the Tuberculosis Association, as well as of the Piedmont National Bank. He was a four-term director of the Carolinas Branch of the Associated General Contractors of America Inc. He was the brother-in-law of **Edward Colesworthy '22,** who died March 17.

Raymond E. Taylor '19 died recently in a retirement home in Evanston, IL. He was born in Worcester on November 5, 1896, and later studied electrical engineering at WPI.

He spent his entire career (1921-62) with Norton Co., as a methods engineer, salesman and district sales manager. A Mason, he also belonged to the Scottish Rite Bodies. He was a member of Phi Gamma Delta and the brother of **Ernest Taylor '12.**

Carroll Stoughton '21 passed away in Corapolis, PA, on February 2, 1985, at the age of 87. He was born in Montague, MA.

After studying at WPI, he later received his BS from the University of New Hampshire. For 36 years he served in education. From 1920 to 1929 he taught at Lancaster (NH) High School, where he was principal for 27 years. In 1958 he moved to Wells River, VT, and taught until his retirement in 1965.

During his career, he served as a coach and counselor and was a teacher of manual arts, physics, chemistry, geometry and advanced mathematics.

Mr. Stoughton, who was a World War II Army veteran, was past president of the N.H. State Teachers' Association, and the North Country Principals' Association, as well as a member of the local selective service board, the Noyes Free Lecture Fund Committee and the North Country Science Fair Committee. He was a past commander of the local American Legion, a former president of the Rotary Club and the Lancaster Golf Club and a former officer of the Knights Templar. He belonged to Phi Sigma Kappa.

David P. Ashley '22 of Mineola, NY, passed away recently. He was born September 6, 1899, in Quincy, MA, and graduated from WPI as an electrical engineer.

During his career, he was with Worcester Electric Light Co., New York Edison and E.L. Phillips & Co. For many years he was employed by Long Island Lighting Company, Hicksville, NY, retiring in 1964.

Besides being a life member of the IEEE, he held professional engineering licenses in New York, Massachusetts, New Hampshire and Vermont. He belonged to the New York State Society of Professional Engineers.

Alden I. Brigham '22 died in Bellevue, PA, on April 12, 1985. A graduate electrical engineer, he was born in Worcester on Aug. 10, 1900.

From 1922 to 1961 he was with Westinghouse Electric Corp. At retirement he was manager of market analysis for the Manufacturing and Repair Division in Pittsburgh. He belonged to Phi Gamma Delta.

Edward H. Colesworthy '22 of Zellwood, FL, died March 17, 1985. A Worcester native, he was born on May 17, 1901.

After receiving his BSME, he joined Worcester Pressed Steel Co. Other employers were Union Twist Drill Co., Chicago; Union Bag & Paper Corp., New York City; Robert Gair Co., Toronto, Ontario, Canada; Central Paper Co., Muskegon, MI; Fulton Bag & Cotton Mills, Atlanta; U.S. Navy Construction Battalions and Gustin-Bacon Mfg. Co., Kansas City. After retirement, he became a self-employed consulting engineer specializing in glass fiber processing equipment.

Active in town affairs, he was a former member of the ASME and of the Society of Military Engineers. He belonged to Skull, ATO and the Poly Club. He was the brother-in-law of **William Mackenzie '17**, who died on Sept. 26, 1984.

Frank R. Mason '22 of Detroit, MI, a retired general manager from Riley Stoker Corporation, Worcester, died March 1, 1985. He was born in West Springfield, MA, on July 16, 1899. In 1922 he received his BSCE.

During his career, he was with Eastern Bridge and Structural Co., Worcester, and Riley Stoker, from which he retired in 1969. He belonged to the Engineering Society of Detroit, Skull, Phi Sigma Kappa and the Poly Club.

George F. Parsons '22 died in Dover, NH, on April 13, 1985, at the age of 84. A native of Rye, NH, he graduated as a civil engineer.

He had been employed by Fiske-Carter Construction Co., the Worcester Sewer Department, New Hampshire State Highway Dept., Norton Co. (Worcester) and the Mass. Dept. of Public Works. In 1965 he retired from the DPW after serving as a highway engineer for many years. A life-member of the Boston Society of Civil Engineers, he was also a registered professional engineer and land surveyor. He belonged to the Massachusetts State Employees' Association and the Retired State, County and Municipal Employees Association of Massachusetts.

Other memberships included the Rye Historical Society (charter member), the Congregational Church, the Masons (50 years), the Shrine, the Knights Templar and the Scottish Rites and the Massachusetts and New Hampshire Councils of Thrice Illustrious Masters and the Tech Old-Timers. He was the brother of **Arthur Parsons '26.**

George S. Cary '23 of Tucson, AZ, an early aviation enthusiast, died January 28, 1984. A native of Cincinnati, OH, he was born on Aug. 10, 1900. He was a graduate mechanical engineer.

In 1924 he bought a house and 65 acres of land in Torrington, CT, discovering after the purchase that he'd bought the only flying field (later, Cary Field) in the area. His interest in flying whetted, he went to Cincinnati for flying lessons.

Prior to World War II, he was a private pilot and instructor. During the war, he taught instrument flying in the armed forces. After the war, he flew for Charter Airlines. As president of Central Connecticut Aviation Association, he was active in the struggle to save a portion of Brainard Field for general aviation. For his efforts, he was cited as "Outstanding Airman" of the year in 1957 by the Civil Air Patrol.

In 1963, he retired from commercial instruction and piloting, but continued with recreational flying when he moved to Tucson. Over the years he owned several planes, including a Waco 10 and a Cessna 180, and air-toured the country with his family. He belonged to Theta Chi.

Dr. **Raymond L. Copson '25,** an authority on chromium chemicals, died at his home in Boca Raton, FL, on May 1, 1985, at the age of 80. He was born in Easthampton, MA.

After receiving his degree in chemistry from WPI, he received advanced degrees from WPI and Yale. Early in his career, he was a chemical engineer for Socony. From 1935 to 1945, he was chief chemical engineer in the research division of the Tennessee Valley Authority. Other employers were Rumford Chemical Works and Mutual Chemical Co. of America, which he served as research director. In 1970, he retired from the Allied Chemical Corporation where he had been assistant director of research in the Solvay Process Division, Syracuse, NY.

Besides being an authority on chromium chemicals, Dr. Copson was a pioneer in research on phosphorus fertilizers and the author of many professional publications. A licensed professional engineer in New York, he belonged to the ACS, A.I.Ch.E. and the AAAS. He was a member of the Chemists' Club of New York City, Lambda Chi Alpha, Tau Beta Pi and Sigma Xi.

John W. Curran '25 passed away on January 21, 1985, in Springfield, MA. He was born in West Springfield on October 7, 1901.

After receiving his BSEE from WPI, he joined the New York Central Railroad as draftsman-assistant engineer in Albany, NY. He retired from a 39-year railroad career in 1963 as administrative signal engineer (system), in New York City. Previously he had served the firm in Boston, Cleveland and New York as assistant signal engineer, system chief inspector and assistant chief signal engineer (system). He wrote several articles and reports on signaling systems and received a patent for his coded track circuit signaling system for railroads.

The grandfather of **Joseph Fitzgerald '88,** he belonged to Lambda Chi Alpha Fraternity and Skull.

Frederick C. Pomeroy '27, a retired longtime supervising engineer for New England Telephone Co., died on December 15, 1984, in Westfield, MA. He was born in Westfield on April 5, 1905, and he was graduated as an electrical engineer.

After spending two years with Strathmore Paper Co., Mr. Pomeroy joined New England Telephone, where he was employed for 41 years. During his career, he served as transmission engineer, district plant engineer and joint line practices engineer. At the time of his retirement in 1970, he was outside plant supervisor in Springfield, MA. He was a member of ATO and the father of **Collins Pomery '57.**

Russell G. Whittemore '27, a pioneer in the development of laminated safety glass, died June 30, 1985, in San Diego, CA. The Framingham, MA, native was 78, and held a BS in chemistry from WPI.

Long an executive with PPG Industries (formerly Pittsburgh Plate Glass), Mr. Whittemore was instrumental in the development of laminated safety glass, the forerunner of today's automobile windshields. During World War II he was a technical representative dealing with the glass needs of the aircraft industry. He also was a glass consultant for Howard Hughes's famous "Spruce Goose" airplane.

He began his 43-year with PPG in 1928, serving in various technical and advisory posts. After the assassination of President Kennedy, he was a consultant on the safety glass requirements for a new presidential limousine. In 1971 he retired from PPG as director of automotive glass product development. Early in his career, he had worked briefly for Du Pont.

From 1974 until 1982 he served on the board of the San Diego Symphony, and he was active with the San Diego Opera Association, Aerospace Museum, Museum of Art, Zoological Society and the Kiwanis Club. He was a member of Lambda Chi Alpha and the Poly Club.

Julian A. Witkege '28, a 44-year employee of AT&T, died at his home in Worcester on January 10, 1985. He was 78, a native of Worcester, and a former civil engineering student at WPI.

Following two years with Morgan Construction, he went with AT&T Long Lines in New York City as a test man. He retired in 1972 in the Worcester office. He belonged to the Telephone Pioneers of America and Notre Dame Church. His brother was **Francis Witkege '38.**

Robert S. Heald '29, former vice president of Heald Machine Co., Worcester, died in Norwalk, CT, on July 27, 1985, at the age of 78. He was a Worcester native.

For many years he was with Heald Machine, retiring in 1959. He had served as president of the Worcester County Music Association and as a sponsor of the Worcester Music Festival.

A former member of the Unitarian Church, Worcester, he was also on the board of the Worcester chapter of the American Cancer Society. He belonged to ATO and to several country clubs in Connecticut and California.

Andrew J. O'Connell '29, a former teacher and dean at Worcester Academy, died June 29, 1985. He was 77, a native of Beverly, MA, and a graduate chemist.

From 1929 to 1933, he was a chemical engineer for GE. In 1942 he joined the faculty of Worcester Academy as an instructor of chemistry. In 1974 he retired after teaching at the academy for 32 years. He had also served the school as dean of citizenship, Science Club adviser, bookstore manager and adviser to the Class of 1949.

Active in WPI alumni affairs, he had been class treasurer and chairman of the class reunion committee. He belonged to the New England Association of Chemistry Teachers, the Worcester Chemists' Club and the American Chemical Society, as well as the Tech Old-Timers.

Michael R. Boyle '30 of Wilton, CT, a retired power plant operator for South Norwalk Electric Works, died recently. He was born in Darien, CT, on January 8, 1907.

After graduating as an electrical engineer, he joined Management & Engineering Corp., and then was employed by Metropolitan Life Insurance Co. and A.F. Holden Co., New Haven, before joining South Norwalk Electric Works.

Mr. Boyle belonged to the American Society for Metals and the Holy Name Society. He was the father of **Thomas Boyle '64.**

John R. Parker '30, a former senior design engineer for Rocketdyne, Canoga Park, CA, passed away on October 8, 1984. A native of Lunenburg, MA, he was born on November 30, 1907. He was a graduate mechanical (aero) engineer.

During his career, he was with Buffalo Forge Co., Buffalo Pumps Inc., Pacific Pumps Inc. and Peerless Pumps as a design and sales engineer. He was also involved with technical writing and inventing. Prior to retirement, he was senior design engineer for the Rocketdyne Division, North American Rockwell-North American Aviation International Inc. After retirment, he worked for a time as a mailman in Woodland Hills, CA.

He was a licensed professional engineer in California and a member of Lambda Chi Alpha and the Poly Club.

Clarence L. Buell '31 of Trumbull, CT, died July 14, 1984. He was born in Hebron, CT, on December 31, 1906, and later studied mechanical engineering at WPI.

He had been employed by United Engineers & Constructors, Bryant Electric Co., Du Pont, Remington Arms Co. and Bedford Hills Concrete Products Co. For many years he was self employed with Buell Sales Company, a lawnmower and garden tractor sales and service firm in Trumbull, CT, from which he retired in 1972. He belonged to the Lions Club and the local fire department.

C. Hall Covell '32, a former comptroller from East Providence, RI, died November 27, 1984. He was 74 and a native of Barrington, RI.

After studying at WPI and Bryant College, he became a public accountant and auditor and an associate partner of W.A. Brackett & Co., Accountants. Later, he was with Narragansett Machine Co., and he also served as comptroller at J.C. Hall Co., Pawtucket, RI. For 15 years prior to his retirement in 1978, he was with the Rhode Island Department of Employment Security.

He was a founding member of the Barrington Players and belonged to SAE, the Barker Players of Providence, the Lions Club, the Netopian Club and the National Association of Accountants.

George W. Lyman '33, class president and former plant superintendent and chief engineer of Reed Rolled Thread Die Co., Holden, MA, died August 20, 1985, in Hartford, CT, at the age of 73. Born in Meriden, CT, he was a graduate mechanical engineer.

He was with Reed for 24 years, with Landis Machine Co., Waynesboro, PA, for five years and with Henry G. Thompson Co., New Haven, CT, for eight years. For a time he was with Spartan Saw, Springfield, MA, which had been acquired by Armstrong-Blum Mfg. Co. In 1980, he retired as executive vice president.

Mr. Lyman, who also graduated from WPI's School of Industrial Management in 1954, was a member of Lambda Chi Alpha, Skull, Tau Beta Pi, the Tech Old-Timers and the Poly Club. Other memberships were with ASTME, Worcester Engineering Society, and SME, as well as the Springfield, MA, Kiwanis Club and Suffield Country Club. He had been chairman of the building committee of Waschusett Regional High School in Holden, MA, and a former vice president of the Connecticut Valley chapter of the Alumni Association.

An avid golfer and square dancer, Mr. Lyman also enjoyed skiing both in the U.S. and Europe. He and his wife, Barbara, recently returned from a two-week tour of the Scandinavian countries with a side trip to Leningrad, Russia. He was the brother of **Richard Lyman '37.**

Wright H. Manvel '33 of Warren, MI, passed away last year. A graduate mechanical engineer, he was born in Pittsfield, MA, on July 23, 1910.

He was a longtime GE employee, having worked for the company as supervisor of accounting (Bridgeport, CT), as well as supervisor of methods and standards and manager of industrial engineering. Other posts included manager of wage and salary administration and personnel manager (Louisville) and manager of employee and public relations for GE in Detroit, MI.

Mr. Manvel belonged to Phi Gamma Delta, Tau Beta Pi, Sigma Xi and Skull, as well as GE's Elfun Society, his local Chamber of Commerce education committee, the Kiwanis Club, Workman's Compensation Committee and the Industrial Relations Association. He was a trustee for two hospitals and was active with the Boy Scouts.

Arthur E. Smith '33, retired chairman of United Aircraft Corporation (now United Technologies), and a former WPI trustee, died August 6, 1985, at his home in Manchester, CT, following a long illness. He was 74.

A native of Malden, MA, Mr. Smith graduated as a mechanical engineer from WPI. Early posts were with Mack Truck in Allentown, PA, and Manning, Maxwell & Moore in New York.

He joined the Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, CT, in 1935 as a test engineer. From 1942 to 1944 he was chief engineer of the P&WA plant in Kansas City, MO, which was established during the war years to help meet the nation's urgent need for aircraft engines. In 1949 he was named chief engineer for the entire Pratt & Whitney Aircraft Division. He was promoted to division executive vice president in 1957 and president in 1967.

He became president of United Aircraft Corporation in 1968. In 1973, he retired as chairman of United Aircraft, now known as United Technologies. He remained a member of the board of directors until 1980.

Mr. Smith, an engine scientist and inventor, made numerous contributions to the improvement of World War II aircraft engines. He is credited with an important role in the development of the J-75 turbojet engine used by the Air Force and Navy. In 1964 he was named to a six-man committee by the Aerospace Industries Association of Washington, DC, to study the development of a supersonic transport.

A fellow of the American Institute of Aeronautics and Astronautics, he also served on several committees with the Society of Automotive Engineers. He was a director of The Travelers Corp. and the Savings Bank of Manchester, as well as the Manchester (CT) Memorial Hospital and the Connecticut Bank and Trust Company. He was also a trustee of RPI, Troy, NY, and a member of Sigma Xi.

Elected to a five-year term as a WPI trustee in 1975, Mr. Smith was honored by his alma mater with the Robert H. Goddard Award for professional achievement in 1967, an honorary doctor of engineering degree in 1969, and the Herbert F. Taylor Award for service to the college in 1979. He was a member of the WPI President's Advisory Council and had held posts with the Hartford chapter of the Alumni Association. At the rededication of the Washburn Shops and Labs in 1984, the Materials Processing Laboratory was named in his honor.

Survivors include his widow, Frances Smith, and son, **David Smith '62.**

Walter W. Tuthill '33, a retired member of the technical staff at Bell Laboratories, died May 27, 1985, in Morristown, NJ, at the age of 74. He was born in Orient Point, NY, and he received his BSEE and MSEE from WPI.

Early in his career, Mr. Tuthill was with U.S. Rubber Products. For 39 years he was with Bell Telephone Labs in Whippany, NJ, retiring in 1976. He belonged to Sigma Phi Epsilon, Sigma Xi, and the Oyster Pond Historical Society of Long Island, as well as the Telephone Pioneers of America.

Active with the Morris County Canal Society, he was also active in the County Stroke Club, the Boy Scouts, the Red Cross and the Congregational Church. He was a former vice president of the Northern New Jersey chapter of the Alumni Association.

Lloyd S. Jenkins '34 died in Worcester on December 6, 1984, at the age of 72. A Worcester native, he studied civil engineering at WPI.

He owned and operated Robert G. Pratt Co., makers of textile machinery, in Worcester for 25 years, retiring last July. He wrote the "Wake Robin" bird column for the *Sunday Telegram* for 27 years. His last column appeared Nov. 25, 1984. During World War II, he was a first sergeant in Co. "B," Ordnance School Battalion, U.S. Army.

For many years he was president of the Forbush Bird Club (of which he was a life member). A life member of the Hawk Mountain Association, he belonged to the Massachusetts Audubon Society, the Brookline Bird Club, the Nashua River Watershed Association, the Henry J. Thoreau Society and the National Bluebird Society. He was also affiliated with the Worcester Area Chamber of Commerce and the Paxton Conservation Commission.

V. Thomas Ratkiewich, Jr., '34, a former Naugatuck state representative, died at his home in Prospect, CT, on April 4, 1985, at the age of 75. He was a native of Naugatuck, and a former chemistry student at WPI.

He had served Thomas Ratkiewich Co. Inc. as president and treasurer. Also, he had been president of Rakie Bros. Co. Inc. and employed as an accountant for Gay Price of Milldale, CT, for more than 25 years. He was a charter member of the Naugatuck Exchange Club, a director of the local chapters of the Red Cross and Little League, and a member of Theta Chi and St. Anthony's Church.

George W. Axelby '35 died in the Veterans' Hospital in Brockton, MA, on February 17, 1985, following a long illness. He was 71, a former chemistry student at WPI and a native of Northfield, CT.

In 1971, he retired from Chase Brass and Copper Company, Waterbury, CT, where he had been a draftsman and tool designer for many years.

An Army veteran of World War II, he was with the 88th Field Artillery Division in Italy. He was an honorary deacon of his local Congregational Church.

Harry S. Press '37 of Flushing, NY, passed away last November. He was born in Cincinnati, OH, on November 6, 1915.

He was vice president of sales at Kay Mfg. Corp., Syosset, NY, and had been with the firm since 1935.

R. William Leckie '38, vice president of Allen, Ross & Leckie Inc., Buffalo, NY, passed away last November. Born on August 23, 1916, in Bridgeport, CT, he studied electrical engineering at WPI.

He had worked for Revere Copper & Brass as Cincinnati manager and as Midwestern sales manager in Chicago before becoming associated with Allen, Ross & Leckie. He belonged to Phi Sigma Kappa.

Daniel G. Mazur '38, who retired in 1973 as associate deputy director for engineering of the Goddard Space Flight Center, Greenbelt, MD, died in Washington, DC, on December 16, 1984. He was 68 and a native of Buffalo, NY.

An electrical engineer, he began his federal career at the Philadelphia Navy Yard in World War II. He transferred to Washington in 1946 and was at the Naval Research Laboratory until he joined NASA at its inception in 1958. In 1964, he received NASA's Medal for Exceptional Scientific Achievement for his work on communications satellites.

After retiring in 1973, he was a consultant to various private corporations for several years. He belonged to IRE, ARS and AEPi. He was the father of **Samuel Mazur '78.**

Peter P. Holz '42, a retired senior development engineer from Union Carbide, Oak Ridge, TN, passed away on March 31, 1985. A native of Koeningsberg, Germany, he was born on December 15, 1921. He was a graduate mechanical engineer.

In World War II and the Korean conflict he served in the U.S. Navy, and attained the rank of commander in the Navy Reserve. During his career, he was with ALCOA, Harrison Corry Co., Glazer Steel, Maxon Construction and Rust Engineering. In 1983, he retired from Union Carbide, Oak Ridge National Laboratory.

Mr. Holz, who was active with the ASME and community affairs in Oak Ridge, was associated with the U.S. Junior Chamber of Commerce, the Jewish War Veterans and the Boy Scouts.

George E. Kent, Jr., '47 of Westboro, MA, passed away on January 14, 1985. A native of Jersey City, NJ, he was born on October 19, 1921, and received his BSME from WPI.

For a number of years, he was a sales engineer for Gulf Oil Corp. and an industrial engineer for Hobbs Manufacturing, both in Worcester. At the time of his death, he was self employed.

Albert D. Farnum '56 SIM, a former official of Wyman-Gordon Co., died January 27, 1985, in Hyannis, MA, at the age of 84. He was born in Providence, RI.

Mr. Farnum was director of community relations and exhibits and special events at Wyman-Gordon in Worcester and North Grafton, where he worked for 29 years, retiring in 1970. He began his career in 1941 at Norton Co. as assistant to the plant engineer in charge of forge shop maintenance in Worcester. In 1955, he was named director of community relations at Norton. At one time, he published a magazine in Worcester.

A life member of his local Masonic lodge, Mr. Farnum also belonged to the Lutheran Church, the Brewster (MA) Men's Club, and the Brewster Sportsmen's Club (secretary). While living in Worcester, he was vice president of the Worcester Industrial Council, treasurer of Crompton Park Senior Citizens Club and a director for the Worcester Chamber of Commerce. He was active with the National Safety Council, the Worcester Advertising Club and the former Community Chest. He was a past president of the Personnel Directors Council.

Robert W. Franklin '57, a retired captain with the National Oceanic and Atmospheric Administration, died February 4, 1985, at his mother's home in Falmouth, MA, following a long illness. He was born in Winthrop, MA, on May 23, 1935.

After graduating with his BSCE, he joined the U.S. Coast & Geodetic Survey (now NOAA) and traveled throughout the U.S. He had worked on the Alaska Aerial Survey Project. In 1977, he retired with the rank of captain. He belonged to Phi Sigma Kappa, the American Concrete Institute and the Society of American Military Engineers.

Stanley J. Andrysiak '64 of Orchard Park, NY, passed away on December 27, 1984. He was born in Kamianka, Poland, on February 2, 1942.

In 1964 he graduated from WPI as a mechanical engineer. He had worked for Bell-Aerospace, Buffalo, NY.

Franklin A. Harrald '64 SIM died January 15, 1985, in Kaneohe, Oahu, Hawaii, after an illness while visiting relatives. He was 72 and a native of Essex, CT.

He graduated from Tufts University in 1934. Before retiring in 1975, Mr. Harrald was director of engineering services at American Optical (AO) Corp., Southbridge, MA. He joined AO in 1941 and held posts in the personnel, manufacturing and engineering departments. He was plastic lens development manager before being appointed manager for technological and administrative services of the optical products division in 1971.

A former member of the Southbridge Planning Board, he had been serving as treasurer of the Congregational Church. He was a former Sunday school teacher and local scoutmaster for the Boy Scouts.

Richard S. Parzuchowski '64, vice president of Chromalloy R&T, died in Pound Ridge, NY, on April 18, 1985. He was born in Danbury, CT, on March 13, 1942. In 1964 he received his BS in chemical engineering.

His former employers included Whitfield Laboratories, Bethel, CT; Union Carbide; and Pratt & Whitney Aircraft, Middletown, CT. He belonged to TKE, the ASM and to A.I.Ch.E.

Peter A. Heibeck '65 of Malvern, PA, a flight systems engineer for General Electric, passed away recently. He was born on November 10, 1943, in Bryn Mawr, PA.

Following graduation as a chemical engineer, he worked a year at Bethlehem Steel Corp. (Looper) in Sparrows Point, MO. In 1966, he joined GE as a flight evaluation thermodynamicist in Philadelphia. He belonged to Sigma Phi Epsilon and to the Poly Club and the A.I.Ch.E.

Joseph N. Passaro, Jr., '66, of Mountain View, CA, died suddenly on May 6, 1985. He was 42.

After receiving his BS in management from WPI, he got his master's at Columbia. For many years he served with General Electric in various capacities. He belonged to Theta Chi and APO.

Engineer A Happy Holiday

(1) **Hooded Pullover Sweat Shirt...** With front pocket. 50/50 blend. White with maroon imprint. Sizes S-M-L-XL. $15.95@

(2) **Special Hooded Pullover Sweat Shirt...** With front pocket. White with raspberry inner-hood, stripes on sleeves, piping, and imprint. S-M-L-XL. $16.95@

(19) **White Painter's Cap...** Grey and maroon stripes and "WPI". S-M-L. $1.50@

(20) **Canvas Tote Bag...** Maroon can with white seal and line drawing of Bo ton Hall. $6.50

°(11) **Toddlers' Hooded Sweat Suit...** Acrylic. Grey with maroon full-front imprint. Toddler sizes. $12.95@

°(12) **Infant Snap-Up Hooded Sweat Suit...** Maroon with white imprint, snaps, and leg piping. 3 mos., 6 mos., 9 mos., 12 mos. $11.95@

°(13) **Child's Traditional Grey Tee-Shirt** ...With maroon WPI seal. Youth S-M-L. $4.95@

°(14) **Child's Snoopy Tee-Shirt...** Grey with WPI logo. S-M-L. $5.95@

(15) **White Athletic Socks...** With maroon & grey stripe on top, maroon "WPI". L-XL. $3.99@

(16) **Imported Pure Wool Scarf...** Maroon with double grey stripe. 5½ feet long. $14.95@

(17) **WPI Ski Cap...** White Knit with maroon stripes and "WPI" imprint. $4.95@

(8) **Rainbow Tee-Shirt...** 50/50 blend. Multi-colored WPI imprint on maroon. S-M-L-XL. $6.50@

(6) **Snoopy Football Jersey...** 50/50 blend. Maroon shoulder gussets. Snoopy/ Cheers/WPI imprint. S-M-L-XL. $8.95@

(9) **Traditional Grey Tee-Shirt...** Polyester/Cotton blend. Maroon WPI imprint. S-M-L-XL. $5.95@

(21) **WPI Pennant...** 24 inches. Multi-colored seal. $3.95@

(3) **Sweat Pants...** 50/50 blend. Elasti waist. Grey with maroon logo on hip $12.95@

ITEMS NOT PICTURED...

(4) **Jersey Knit Shorts...** Elastic waist Maroon & gold stripes down sides, maroo imprint. S-M-L-XL. $7.95@

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WPI ENGINEERS 1985–1986 WINTER SPORTS SCHEDULE

MEN'S BASKETBALL

Date	Home/ Away	Opponent	Time
12-3	A	Babson	7:30 pm
12-7	H	Bowdoin	4:00 pm
12-10	A	Amherst	8:00 pm
12-12	A	Wesleyan	8:00 pm
12-14	H	Thomas	3:00 pm
1-8	A	SMU	8:00 pm
1-14	A	Suffolk	8:00 pm
1-18	H	Bates	8:00 pm
1-23	H	Brandeis	8:00 pm
1-25	A	King's Point	4:00 pm
1-28	A	Trinity	8:00 pm
1-31	H	Coast Guard	8:00 pm
2-1	H	Anna Maria	8:00 pm
2-5	H	Williams	8:00 pm
2-8	A	Tufts	8:00 pm
2-10	H	Newport	8:00 pm
2-13	A	MIT	8:00 pm
2-15	H	NYU	8:00 pm
2-18	H	Nichols	8:00 pm
2-22	A	Clark	8:00 pm

JUNIOR VARSITY BASKETBALL

12-3	A	Babson	5:30 pm
12-10	A	Amherst	6:00 pm
12-12	A	Wesleyan	6:00 pm
1-28	A	Trinity	6:00 pm
1-31	H	Coast Guard	6:00 pm
2-1	H	Bridgeton Academy	6:00 pm
2-5	H	Williams	6:00 pm
2-8	A	Tufts	6:00 pm
2-10	H	WITTI	6:00 pm
2-15	H	Worcester Academy	6:00 pm
2-22	A	Clark	6:00 pm

WOMEN'S BASKETBALL

11-14	A	Lowell (scrimmage)	7:00 pm
11/22-23	A	City Tournament— Anna Maria, Clark, Worcester State, WPI, at Clark	6:00 & 8:00 pm
12-2	A	Fitchburg State	7:00 pm
12-5	A	Emmanuel	7:00 pm
12-7	H	Bowdoin	2:00 pm
12-9	H	Bridgewater State	7:00 pm
12-11	H	RIC	7:00 pm
12-12	A	Framingham State	7:00 pm
1-18	H	Bates	2:00 pm
1-21	A	Coast Guard Academy	7:00 pm
1-23	H	Anna Maria	7:00 pm
1-25	A	WNEC	2:00 pm
1-28	H	Wheaton	7:00 pm
1-30	H	Nichols	7:00 pm
2-1	A	Colby Invitational WPI-University of S. Maine	6:00 pm
		Colby-UMASS: Boston, at Colby	8:00 pm
2-2	A	Colby Invitational Consolation	1:00 pm
		Championship, at Colby	3:00 pm
2-5	A	Brandeis	7:00 pm
2-7	H	Manhattanville	7:00 pm
2-11	A	Amherst	7:00 pm
2-13	A	MIT	6:00 pm
2-18	H	Clark University	7:00 pm
2-21	A	SMU	7:00 pm
2-25	H	Trinity College	7:00 pm

MEN'S SWIMMING

11-22	A	Holy Cross	5:30 pm
11-25	A	Babson	6:00 pm
12-4	H	Boston College	7:00 pm
12-7	A	RPI Invitational	
12-10	H	Clark	6:00 pm
1-22	H	Conn. College	6:30 pm
1-25	A	Coast Guard	2:00 pm
1-29	H	U.Mass Boston	6:00 pm
2-1	A	SMU	1:00 pm
2-6	H	Trinity	7:00 pm
2-8	H	Tufts	2:00 pm
2-12	A	Bridgewater	6:00 pm
2-15	H	Keene State	2:00 pm
2-19	A	Brandeis	7:00 pm

WOMEN'S SWIMMING

11-25	A	Babson	6:00 pm
1-10	H	Clark	6:00 pm
1-21	H	Conn. College	7:00 pm
1-24	H	Southern Conn.	7:00 pm
1-29	H	U.Mass Boston	6:00 pm
2-1	A	SMU	1:00 pm
2-4	H	Regis	7:00 pm
2-12	A	Bridgewater	6:00 pm

WRESTLING

12-4	H	Boston College	7:00 pm
12-7	A	Trinity College	1:00 pm
12-11	H	Plymouth State College	7:00 pm
12-14	A	Harvard University/ University of New Hampshire/NYU	Noon
1-11	A	RPI/Williams, at Williams	1:00 pm
1-15	A	Amherst College	7:00 pm
1-18	A	Rhode Island College	1:00 pm
1-21	A	Western New England College	7:00 pm
1-25	H	University of Lowell	1:00 pm
1-26	A	New England Intercollegiate Invitational Tournament, at Cambridge	10:00 am
1-29	A	MIT	7:00 pm
2-1	H	Bowdoin	1:00 pm
2-4	H	Coast Guard	7:00 pm
2-8	A	Wesleyan/ University of Hartford, at Hartford	11:00 am
2-11	A	Bridgewater	6:00 pm
2/21-22	A	New England College Conference Championship, at Trinity	
2-28–3-1	A	NCAA Div. III National Tournament, at Trenton State College	

JUNIOR VARSITY DATES

1-22	H	Naval Academy Prep School	4:00 pm
2-16	H	New England J.V. Tournament	11:00 am

WPI Journal

WORCESTER POLYTECHNIC INSTITUTE FEBRUARY 1986

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A MESSAGE

From Dr. Richard H. Gallagher
Vice President and Dean of the Faculty

It is important to remember that a college, like a person, is not an island unto itself. The environment we work to enhance is populated with both internal and external issues, resources and opportunities.

Two elements in this environment of current and profound importance to WPI are the Massachusetts Microelectronics Center (MCC) and our efforts at more comprehensive integration of computers in all of the Institute's activities.

MMC began more than three years ago, a collaboration of Massachusetts engineering colleges and high technology businesses. Collectively, this group of educators and industrialists sought a scheme of laboratories, commercial enterprise and instructional facilities that would, in part, give to electrical engineering students exposure to microelectronics design and fabrication second to none. WPI will benefit directly from its association with MCC, which will be sited in nearby Westboro, MA.

In a related development, early in 1985, WPI received from Data General Corporation a gift of equipment for a state-of-the-art computer-aided WPI circuit design laboratory. This laboratory will give students hands-on experience in the materials processing technology associated with integrated circuits. Truly, a new era is dawning on the microelectronics concentration in electrical engineering at WPI.

Equally significant are our initiatives to enhance the computational resources of virtually every element of WPI operations. A year and a half ago, two key actions were taken. First, the Office of Academic Computing was created, with Professor Owen W. Kennedy, Jr. appointed dean. Second, the college selected the AT&T Model 6300 as the standard microcomputer for the campus.

These were critical steps in building a comprehensive computational network on campus, a network that will accommodate data communication among the many types of equipment already in use. In addition, we are creating more computer labs; faculty members are actively integrating microcomputers into the curriculum; and use of these tools is spreading to the administrative and secretarial functions of the college. This vital program has been helped immeasurably by a $1.2 million grant from the Alden Trust in 1984, and by substantial new allocations from the college's operating budget.

Already, we can identify many examples of the tangible impacts of the computer initiative on instruction at WPI. Last summer, we refurbished the Graphics Laboratory in Mechanical Engineering, a facility dedicated to instruction in introductory graphics. Microcomputers and computer plotters have been installed, and a computer-aided design (CAD) program of the type widely used by practitioners was introduced. The course has been oversubscribed since it began, and plans are already being laid for the expansion of these facilities.

Similar tales could be told about laboratories in other departments of the Institute. The challenge, of course, will be to acquire funds to achieve full campus computerization and to offer maintenance of equipment and the other services demanded in an environment where as many as 3,500 individuals are making use of computer equipment, with nearly as many different objectives for that use.

As a relative newcomer to WPI, whose experience is principally in the engineering sphere, I find the continuing development of the humanities especially impressive.

In 1984, you may recall, a $250,000 grant was received from the Mellon Foundation for the strengthening of the humanities program at WPI. Last year, we formed a group of off-campus supporters known as the "Friends of the Humanities."

What is more, the humanities faculty itself is being strengthened in such areas as communications and history. Today, exciting ideas about an even greater role for humanities at WPI are under discussion, and I believe that these are moves in the right direction.

By any measure, the WPI Plan has successfully withstood the test of time. Today, nearly half of WPI's living alumni have matriculated under the Plan. Although a significant block of faculty prefer retention of the Plan in virtually all of its present details, there is also considerable sentiment for change of one or another of its elements. Debates on these issues date back to the Plan's inception, but the major changes have taken place in only recent years.

One such change affects the grading system. At this point the recorded grades for course work are AD (distinction) and AC (acceptable). Last year the faculty voted for a future change of the recorded grades to A, B and C. Another change of recent years was to add "distribution" requirements, demanding of every student course work in science, mathematics and other disciplines.

What more of the Plan might be altered? If indeed there is on the horizon more change, it will result from intensive study and debate about how best to serve the objectives of undergraduate education at WPI. I am confident that the hallmarks of the program, in the form of the Major Qualifying and Interactive Qualifying Projects, together with the Humanities Sufficiency and the Competency Examination—will remain.

Encompassing all that I've mentioned here and certainly much more is a five-year plan we are currently conceiving for the Institute. In all of higher education, as in science and technology, times are changing—and more rapidly than some institutions can respond to. We intend to anticipate and pursue our dynamic environment actively. I know you'll be hearing more about these initiatives in the months ahead.

WPI Journal

WORCESTER POLYTECHNIC INSTITUTE

VOLUME 89, NUMBER 3

FEBRUARY 1986

Staff of *The WPI JOURNAL*
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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, Hartwick College, Johns Hopkins University, Rensselaer Polytechnic Institute, Villanova University, Western Maryland College, Worcester Polytechnic Institute) and appear in the respective alumni magazines of those institutions. Second class postage paid at Worcester, MA, and additional mailing offices.

Staff of the Alumni Magazine Consortium: Editor, Mary Ruth Yoe; Design and Production Coordinator, Amy Doudiken; Assistant Editor, Leslie Brunetta; Designer, Allen Carroll.

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

Diverse views on subjects of public interest are presented in the magazine. These views do not necessarily reflect the opinions of the editors or official policies of WPI. Address correspondence to the Editor, *The WPI Journal*, Worcester Polytechnic Institute, Worcester, MA 01609. Telephone (617) 793-5609. Postmaster: If undeliverable please send form 3579 to the address above. Do not return publication.

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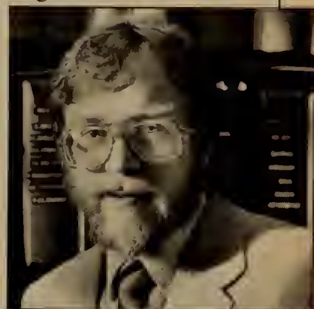

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Cover: Percy "Pete" Marsaw '30 EE, before one of his Sinclair Hall stained-glass creations, as photographed by Michael Carroll. Profile on page 18.

On the Road Again—Strauss Style

At the conclusion of his cross-country train and tandem-bicycle junket with wife Jean last summer, just after their wedding and prior to assuming the presidency of WPI, President Jon C. Strauss may have thought his whistle-stopping days were behind him. But in the spring of 1985, he'll be on the road again, this time to meet with alumni groups as well as with key foundation and corporate individuals. His visits will take him from Boston to Los Angeles, Detroit to New York City, with stops along the way.

The tour, to occur in March and April, is part of Dr. Strauss's busy pre-inaugural calendar of activities, culminating with his official induction as WPI's 13th president on May 10, the 121st anniversary of the signing of WPI's charter. In all, Dr. Strauss will visit some 20 cities, making scores of appearances at luncheons, dinners, receptions and alumni events. It's an opportunity for him to meet with graduates and friends of the college and to share his thoughts on WPI's next five years.

"We recognize that not all of the WPI family will be able to join us in May," says Strauss, "so we want to acquaint ourselves with as many alumni and friends as we can before then."

Where schedules conflict, vice presidents Richard H. Gallagher, dean of the faculty, and Donald F. Berth '57 CHE, University Relations, will convey Dr. Strauss's message. Each visit will be complemented by a video presentation highlighting the Institute's plans for enhancing all elements of the WPI experience—academics, faculty, facilities, student life.

Following his inauguration, Dr. Strauss hopes to continue his tour, visiting additional locations, alumni groups and individuals into the fall of 1986. WPI will announce the tour schedule early in the year.

Funding Sources More Generous than Ever

WPI received a total of $6,944,190 in gifts and bequests during fiscal year 1984–85, a 10-percent increase over comparative figures in 1983–84, according to Donald F. Berth '57, vice president for University Relations.

"This was the last fiscal year under Dr. Edmund T. Cranch's overall leadership," he says. During the seven years of Cranch's presidency, WPI realized an impressive $31,691,600 in gifts and bequests. "This is a great foundation from which Dr. Strauss can further enhance the resources of WPI during his presidency," Berth adds.

WPI's endowment market value was at $31.5 million when Cranch began his service in July 1978; it was at a record $65 million at June 30, 1985, at the time of his resignation.

"We're most pleased with our sustained momentum, especially during a year when the presidential leadership was changing," says Berth. "Our alumni continue their fine record of Annual Fund support, which accounts for about one out of every five dollars received by WPI from all sources."

In the year ended June 30, 1985, 40 percent of the alumni body contributed another record-breaking total of $1,063,000 combined with employer matching-gift funds of over $354,000.

Raytheon Leads New WPI Hiring

According to figures released recently by William F. Trask, director of the Office of Graduate and Career Planning (OGCP), Raytheon Company hired more Class of 1985 graduates than any of the other 130 reporting companies.

Of graduating seniors notifying OGCP of their employment results, 33 say they are now receiving paychecks from Raytheon. Other leading employers include Digital Equipment Corporation, United Technologies Corporation, General Electric Company, and General Dynamics/Electric Boat Division.

Electrical engineering and mechanical engineering majors far outdistanced all other majors in numbers of positions accepted. EE was also the winner in terms of salary, with graduates' median starting salaries reaching $28,800. Chemical engineering was less than $200 behind, followed by, in descending order, ME, computer science, management, mathematics, and civil engineering. No valid salary information was reported for chemistry and physics. The greatest increase in median starting salary came to mathematics majors, with a 7.5 percent jump, to $25,500.

Kimball R. Woodbury Is Schwieger Award Winner

Preferred residence: Worcester or Honolulu. So reads the placement office questionnaire Kim Woodbury filled out during his days at WPI. The guy seemed to know what he wanted.

Today, four decades later, Kimball R. Woodbury '44 ME, '56 SIM, is still in Worcester—or, more accurately, residing with his wife Betty in Boylston, MA.

Whether or not the Honolulu listing was just for effect, these days it matters little, for the war-time graduate has more than made a name for himself here in his hometown. Woodbury is president of Woodbury & Co., of Worcester, one of the nation's leading printers of fine commercial stationery. What's more, he continues to give unselfishly to his community.

And on January 14, 1986, Kim Woodbury was recognized by WPI's School of Industrial Engineering at its annual banquet as the 1986 recipient of the Albert J.

Kimball R. Woodbury '44 ME, '56 SIM

Schwieger Award for professional achievement.

Woodbury's college career, like those of many of his classmates, was interrupted by the second world war, in which he served in the Air Force in the Pacific theater. Following graduation in 1947, he joined the family stationery business. He's been with the firm ever since, rising to president in 1966.

Kim Woodbury's presence on the Worcester civic scene is almost unparalleled. He is past president and an active volunteer of the board of the YMCA. Organizing the financing for construction of the Greendale branch of the Y was his responsibility. Today, this comprehensive facility is one of the nation's finest.

He has served on the Worcester School Committee, on the boards of Worcester Academy, his alma mater; Worcester County Institution for Savings, of which he was a corporator in 1969; and Worcester Memorial Hospital. He is past president of the United Way of Central Massachusetts and today serves on the Boylston Finance Committee.

It is noteworthy that *both* of Kim Woodbury's grandfathers were graduates of WPI—John C. Woodbury, in 1876, and Henry E. Kimball, in 1891. Congratulations to one of SIM's most distinguished graduates.

Alumni Boards Advising Faculty and Deans

Wilfred Houde '59 EE was a recipient in 1984 of WPI's Robert Goddard '08 Award for professional achievement. He has made his mark in the computer industry as founder and chairman of Vimart Corporation. George H. Long, Jr. '57 CHE, has achieved an eminent career, as well, as Manager of Engineering of Exxon Research & Engineering Co.

Now, Houde and Long, as well as other distinguished alumni, are bringing their organizational talent and technical expertise back to campus, to the aid of the departments that granted them their degrees. In their roles as chairmen of advisory committees for the Departments of Electrical Engineering and of Chemical Engineering, the two are leading other alumni, scholars and off-campus experts in helping chart the course for EE and CHE in the years ahead. In November, both the EE and CHE boards held their charter meetings on campus.

CHE and EE are the newest advisory committees at WPI. They are modeled after successful boards formed in the late '70s and early '80s in the Department of Management and the Center for Fire Safety Studies. Similar boards are in the formative stages in Civil Engineering and Mechanical Engineering.

Howard O. Painter '58 EE, owner of Painter & Co., is chairman of the Management committee; John A. Love, president and C.E.O. of Factory Mutual Engineering and Research Corporations, heads the Fire Safety Board of Advisors; and Philip A. Wild '50 CE, a vice president at Stone & Webster Engineering, chairs the CE board.

According to Dr. Richard H. Gallagher, vice president and dean of the faculty, the advisory boards contribute to the academic quality of their departments in several ways. First, the college regularly apprises each board of the directions the departments are taking in academic matters. The board members then meet to formulate responses to this information—advice and counsel on the merit of these plans. Finally, the boards assist the college in seeking the support—human and financial—to achieve its goals.

"Advisory boards provide an opportunity for alumni and other professionals in senior scientific and technical management positions to become involved in academic policy issues," says Gallagher. "They enable the Institute to draw on the informed advice of distinguished practitioners. By serving as respected sounding boards, their members help assure that our academic plan is designed to respond effectively to real-world needs and concerns."

Advisory board members are not charged with management or teaching responsibilities, he adds. "Still, the service they provide is an invaluable source of guidance, information and encouragement."

3R Campaign Passes $1-Million Mark

As the winter sports season rolls along—toasty inside Harrington Auditorium and Alumni Gymnasium—WPI's outside athletic facilities witness the presence of but the heartiest of souls—an occasional jogger trying to avoid the slosh of city streets; pick-up football games in the evening.

Still, while newly carpeted Alumni Field and the freshly seeded baseball facilities are blanketed with the white stuff, efforts go on to raise the funds needed to complete financing of the $1.9-million project.

Reports Raymond J. Forkey '40, chairman of the Fields Finance Committee, "WPI now enjoys one of the finest—and most attractive—athletic complexes in New England. Last fall, many of us got a close look at Alumni Field's Omniturf surface—either from the stands or in the heat of competition in field hockey, football or soccer. What's more, nearly a dozen regional high school playoffs took place on our all-weather surface. And believe me, many of those players—as well as WPI athletes—welcomed the sure-footed and relatively dry conditions possible on artificial turf.

"I'm happy to report that our efforts to complete the financing of the project are progressing at a gratifying pace."

At year's end, some $1.1 million, or 60 percent of the project's costs, had been raised. "Gifts from alumni, parents and friends continue to reach the college regularly," he says, "and we're especially pleased with the response parents have made on behalf of the 3R [Recreational Resources Renovation] project."

According to Stephen J. Hebert '66, director of development and alumni relations, the "new" fields, including renovation of Alumni Field's running track, are scheduled to be dedicated during Reunion Weekend, June 7, 1986. "By that time, final touches to the construction itself will be completed," he says, "and we hope to announce at those ceremonies the successful conclusion of our 3R fund raising efforts as well."

Brown Selected Student Affairs V.P.

Bernard H. Brown has been named vice president for student affairs, effective December 1, 1985. Dean of students at WPI since 1981, Brown succeeds Robert F. Reeves, who last spring announced plans to step down from the post after a successor was chosen.

Brown was one of three finalists selected after a nationwide search by a campus committee appointed by WPI President Jon C. Strauss. In announcing Brown's selection, Strauss said, "Dean Brown has been at WPI for almost two decades, yet he retains a fresh perspective on, and enthusiasm for, the important issues of student affairs. I am pleased to note his ambitious plans for student affairs and his demonstrated abilities to work well with all constituencies here at WPI."

Bernard H. Brown

Brown joined WPI in 1966 as assistant dean of student affairs. He had previously served as administrative assistant to the dean of men at the University of Connecticut and as head resident director at Northeastern University. He earned both his bachelor's and master's degrees at Springfield College. He earned his advanced professional degree in administration of higher education at the University of Connecticut in 1972.

He has been instrumental in developing a summer orientation program for incoming freshmen and their families, earning him two national awards. In 1984, he was the recipient of the Donald L. McCullough Award for outstanding contributions to the field of campus activities programming by the National Association for Campus Activities.

In his new role, Brown will have administrative responsibility for all student affairs activities, which include admissions, financial aid, placement, campus housing, campus health services, student counseling, fraternities, minority student programs, international student assistance, and student clubs and activities.

Reeves came to WPI in 1979 as vice president after 11 years in student affairs posts at Lehigh University. At the time of his appointment to WPI, he was associate dean of students at Lehigh. When he announced plans to step down, Reeves indicated a desire to reassess his future career goals. He and his family have purchased a home in Maine.

"Bob Reeves virtually changed the course of student affairs at WPI," comments president emeritus Edmund T. Cranch. "He steadfastly directed his efforts toward enabling the Institute and its students to achieve their fullest potential. I known Bernie will carry on in Bob's footsteps. He has long been close to students; their welfare is always his first concern."

Howard Freeman '40, chairman of the WPI Board of Trustees, worked closely with Reeves. "Bob had the great ability to share with the trustees his views on both the problems and the opportunities of student affairs," he says. "WPI has lost one of its strongest assets in Bob Reeves, but I respect his decision to pursue other of his many interests. And I know that in Bernie Brown this important vice presidency continues in good hands."

Loss of Insurance = Goat's Head Changes

Your next visit to WPI may bring with it some surprising changes to an old watering-hole. As of November 25, 1985, the Goat's Head Pub is no longer serving alcoholic beverages, this in response to WPI's loss of adequate liquor liability insurance.

But, according to David E. Lloyd, vice president for business affairs and treasurer, because of the loss of insurance coverage, the Pub is not the only campus function that has given last call.

If music be the food of love . . . Pictured above, in the publicity photo by Kenneth Malkin '88 CS, of Norwalk, CT, are members of the cast of **Twelfth Night**, *William Shakespeare's play about the courtship of the Countess Olivia in the mythical country of Illyria.*

Staged in Alden Memorial on November 21–23 by the Masque, a student theatrical group, the production was directed by Humanities Professor Susan Vick. Lee Lopes '88 EE, of Springfield, MA, composed much of the music for the production.

Though Masque employed modern props and costumes as well as bare stage, Shakespeare's script was not altered. The effect, together with the intimacy of theater-in-the-round, was nothing less than fascinating, proving once again the timelessness of Shakespeare's work and the competence of Susan Vick as a director.

Cash bars associated with campus events, tailgate parties, faculty luncheons and other functions are also precluded from serving alcoholic beverages, he says.

Only "host functions"—those sponsored officially by WPI at which representatives of the college entertain guests—are exempt from the new "dry" treatment. Meetings or luncheons at the president's home exemplify such host functions.

As Bernard H. Brown, vice president for student affairs, points out, WPI is far from alone in having to deal with the insurance issue. Many colleges and universities, he says, are having difficulty obtaining liquor liability insurance. "In fact, all state schools have had to close their pubs because of the situation."

The dilemma stems from the fact that the cost of liability insurance for all types of coverage has been skyrocketing nationwide in the past few years. In the case of liquor liability coverage, says Lloyd, the heavier premiums are partly the result of the rapidly increasing frequency and severity of law suits arising from the actions of allegedly intoxicated patrons.

WPI's loss of coverage is not the result of any infraction at the college, according to Roger N. Perry, Jr. '45, director of public relations. "We're just victims of the system," he says, "like everyone else."

According to Lloyd, WPI's insurance carrier didn't want to turn down WPI's request for a policy renewal. Instead, it hiked the premium to $500,000 for $1-million of coverage, a payment that would not have been "cost-effective," he says. Efforts to employ other carriers, he adds, have been equally unfruitful.

Still, the Pub will live on, says Brown, though outfitted in a new suit of clothes and possibly wearing a new name—hopefully by the start of the 1986 winter term. "We're exploring several options for use of the Pub's attractive space in Alden Memorial."

THIRD IN A SERIES

THE ENTREPRENEURIAL SPIRIT

The Redemption of William M. Lester, '28 ME

Michael Shanley

By Michael V. Shanley

For 33 years, Bill Lester owned and operated a highly successful injection molding company. But to *his* pioneering mind, that represented little more than an extended holding pattern.

William Lester had to retire before he could get back down to work again. What he had really wanted to be doing for the three-plus decades of his "active" career was inventing, exploring, creating—as he had in his early days when he was a pioneer in the field of injection molding.

Now, in a renovated chicken coop in Livingston, NJ, Bill Lester is exploring again. And his two creative periods, one coming early in his career and one late, stand as bookends to the decades when he was too busy with the day-to-day affairs of running a business to indulge himself in inventive pursuits.

Lester, 77, says he has felt a tremendous sense of release since retiring from the strains of traditional business some 15 years ago.

"On my way to work at Pyro [Plastics Corporation, the custom injection molding company he owned], there was a fork in the road," Lester recalls. "One road went to the office, and one went to the country club. I found myself always wanting to

go to the club. Since retiring I don't think that way anymore. Now, I'd rather go to the office."

The office for him now is the chicken coop, which is like no other you've ever seen—unless you happen to have run across one stocked with a full line of machine shop equipment, paneled offices, a kitchen, tool rooms, and, as an added touch, a pristine 1937 P-3 12-cylinder Rolls Royce and an equally gorgeous 1941 Packard convertible.

The cars represent one of Lester's passions from years gone by. ("That was a hobby, but I don't have time for hobbies anymore.") Now, he'd much rather discuss his latest project: a one-step packaging process for the food, drug and beverage industries. He and two partners—Dr. Edward J. Towns, who has a long background in the packaging industry, and Edward M. Brown, a former farmer who owns the land the coop is on—have formed the TBL Development Corp.

Working out of the refurbished coop, they've perfected several new plastic container closures and hope to soon set up an

William Lester '28, in the "Chicken Coop" with his prized P-3 12-cylinder 1937 Rolls Royce.

automated, computerized injection molding facility to produce these caps.

The TBL prototype differs from others in that the cap, liner, seal and tamper-proof features are all produced in one step. This, Lester believes, will give them an edge over the rest of the market.

"Our competition has to first mold the cap, then manufacture and install a liner, and then decorate," he explains.

Like the aluminum caps now popular on beverage bottles, the TBL cap utilizes a breakaway ring. Once the container is opened, the ring drops down and cannot be reattached.

TBL has developed an application for every major industry that uses such closures. For motor oil containers, the TBL design would eliminate the need for induction-sealed aluminum foil on the neck of the container.

In addition to a child-resistant model, there is one for food that is packed hot (jams, jellies, baby food.)

"The caps now on the market use a dimple to show if the package has lost pressure and has thus been tampered with," says Lester. "But it's very difficult to see the dimple. I'll bet most mothers never even notice it on baby food. Our cap uses a button that pops up when the cap is unscrewed. It's an obvious indication, and there's no way to get that button back down. Our final design is a few years down the road yet."

Lester's work on container closures began soon after retirement, when he set up an office in East Orange, NJ. There he designed and patented an automatic closure for squeezable containers, like those used for laundry detergent bottles. Lester's model, which uses a disc-like membrane, automatically closes and won't leak even when in the open position.

He was looking for a place to make experimental molds when he heard about Ed Towns and Ed Brown. "They had the facilities for machine shop tooling and invited me to set up an office with them."

Lester didn't work exclusively on the closures until after the Tylenol scare in 1982. In that tragedy approximately eight people died as a result of ingesting Tylenol that had been tainted with a powerful poison prior to the drug's retail sale. Before that episode brought the problem of tamper-proof containers into the public eye, Lester spent a good deal of time designing and building an internal combustion engine.

"I started thinking about the rotary engine even before I founded Pyro, but I didn't have time to make the engineering drawings and build a prototype," he says.

Since his official retirement, he has completed the drawings, been awarded two patents, and built a prototype.

"After the caps are in production," he says, "I'll go back to the engine. Then there's a new die-casting machine I want to work on, and a few other projects."

That new die-casting machine will take Lester back to his roots, back to his early period of creativity.

While at WPI, Lester did a considerable amount of die casting and machine design after hours and during vacations. He even lectured in the foundry course on die casting and alternate methods of casting non-ferrous metals.

After graduation from WPI in 1928, he went to work as a plant engineer in Fayetteville, NY. For two-and-one-half years, he redesigned and rebuilt production equipment; then he headed for Cleveland to become chief engineer of his father's tool and die company. There, he was involved in the design of the die-casting machines licensed by Worcester's Reed Prentice Co., the first successful injection machine manufacturer.

Working for Lester at the time was a young draftsman named Philip Graham, who would eventually join the Foster Grant Company in Leominster, MA, and be widely credited with designing one of the first Foster Grant injection molding machines.

"Graham had been privy to all my machine design, and he used a lot of it when he went to Foster Grant," says Lester. "I have always felt a 'pride of authorship' not only for my machines, but also for Foster Grant's."

Die casting and injection molding, he explains, are basically the same operation—each forces under pressure a molten material into a mold. Die casting is the term used when metal is the material involved, injection molding when plastic is the material. Thus much of what Graham learned from Lester about die casting was applicable to injection molding.

In 1933, Lester began his own consulting company, Lester Engineering, and started designing and building his own die-casting equipment. Some of his patents from those days were the basis for what would become the automatic injection molding machine.

Meanwhile, the New England Novelty Co., in Leominster, heard about Foster-Grant's injection molding efforts and were quite eager to enter the new field. Officials of the company asked Lester to help, so in 1934 he returned to Massachusetts

Michael Shanley

Bill Lester working on a miniature part for an injection molding machine with TBL Corporation partner Edward M. Brown.

Lester with the prototype of the rotary engine he hopes to resume work on—once he puts a new container cap into production.

to co-found Commonwealth Plastics Co.

In just 10 weeks, Lester completed the design and construction of the injection molding machine. As it turned out, Foster Grant and Commonwealth unveiled their machines almost simultaneously.

Within a year, Lester and his partners had assembled 40 of the machines in their shop and were turning out costume jewelry, plastic utensils, combs, radio parts and other custom industrial moldings.

Lester went on to design molds that would become standards for the injection molding industry throughout the world. Also during this time, he helped his father's company branch out into the injection molding machine field. In fact, prior to that company's sale in 1950, Lester was a director, consultant and its largest individual stockholder.

Unhappy with the financial arrangements at Commonwealth, Lester headed to Westfield, NJ, in 1939 to set up his own company. As he puts it, "I'd had a belly full of partners."

With $13,000 and as much experience in the field of injection molding as virtually anyone in the world, Bill Lester established the Pyro Plastics Corp. (Pyro because "it's short and indicates heat.") He bought two machines, hired a half-dozen employees and began to turn out custom-molded buttons and cosmetics.

"At that time," Lester says, "the industry was limited by the materials, which weren't sophisticated enough to withstand much heat or pressure."

But with the onset of World War II, he explains, there was a serious shortage of metals, and plastics came into their own as a viable substitute. In addition to the cosmetics industry, Pyro began to go into production of parts for automobiles and military vehicles.

During this period, Lester developed a completely automatic small injection molding machine for Pyro's exclusive use. In 1945, he began to license one machine in each of 10 foreign nations. Later, in 1958, he would license one non-competitor in the U.S., Owens-Illinois, and he became a special consultant to that company.

For many years, Pyro's main product was the plastic hobby kit: ships, cars, planes, human anatomy. "The average toys in those days were insipid," Lester explains. "Hobby kits, on the other hand, had therapeutic and educational value."

Although the hobby kits sold well, another major effort, "disarmament in the nursery" toys, failed despite a public relations effort that included national media coverage. The toys, which were of the "fairyland and educational" variety rather than "tanks and guns," just never caught on.

Pyro itself, however, had grown spectacularly. By the late 1940s, the company employed hundreds of people—engineers, designers, model makers, molders, finishers and inspectors—and had the facilities to take products from idea conception all the way to final shipping.

Despite continued growth and success through the '50s and '60s, Lester had grown tired of the "drudgery" of day-to-day business.

"Pyro had become a routine sort of operation," he says. "My days were spent on things like payroll, collections and advertising. It had been years since I'd had the chance to be what I call creative."

Finally, in 1972, Lester called it quits. He sold Pyro to Gateway Sporting Goods and started anew. He turned his attention to creative pursuits: the internal combustion engine, tamper-proof packaging and new ideas for die casting machines. Soon he met up with Towns and Brown and moved into the renovated chicken coop.

"I've never been happier," Lester says today with the genuine excitement of a man who once again feels challenged after years of relative dormancy.

He does admit to one problem with being so tied to all these new projects, however. "My golf game," he notes, "has gone sour."

Michael Shanley is a freelance writer living in Holden, MA.

Seven weeks in the nation's capital can test the mettle of even the most inspired students. For the agencies they serve, the benefits are far-reaching.

The Boyntons Go to Washington

It's a warm day in October, even for Washington. Already at 8:30 in the morning, my wool suit feels too hot, and I wish I'd had the foresight of my two companions. Professors Arthur and Susan Gerstenfeld. Looking cool and crisp in their summer-weight clothes, the Gerstenfelds are well prepared for the long day ahead of us, a day they have been anticipating for the past seven weeks.

As our cab plunges through rush hour traffic, past postcard landmarks, we chat about Washington politics and the presentation we are going to hear. Our destination is the Department of Labor, where three WPI undergraduates have been examining ways to measure the return on investment of quality of work life (QWL) programs.

This is the first of six such presentations we will see in the next two days, the culmination of an intensive program of study known as WPI's Washington Project Center. As participants in the 11-year-old program, 18 juniors and seniors have spent seven weeks back in Worcester and seven weeks here in the nation's capital researching current issues for a variety of government agencies and private organizations.

Grouped in teams of three, the students have tackled problems involving some facet of the interaction between technology and society to fulfill their Interactive Qualifying Project (IQP) degree requirement. Now, as the final step in their work, the teams must present their findings in oral and written form to their respective agencies, as well as to the Gerstenfelds, who have been serving as resident faculty advisors for the term, and to dean of undergraduate studies William Grogan '46 EE, '49 MSEE, who is coming to Washington just to hear them.

Our taxi heads down Pennsylvania Avenue toward the Capitol. Shimmering in the morning haze, the building is wrapped in scaffolding and flanked by a crane. But even with the trappings of renovation, the Capitol's majestic aura remains intact, and its graceful architectural lines dominate the wide boulevard. Though I have been here before, I am once again captured by the excitement that is Washington, and I wonder what it has been like for the students who have lived and worked here for the past two months.

At the Department of Labor, a mammoth high-rise of glass and steel, we are met by Thomas Nowak '87, of Springfield, MA, who guides us through the maze of corridors to a room filled with round tables and padded chairs. There we meet his partners, juniors Ellen Klee, Acton, MA, and Philo Shelton, Fairfield, CT, nervously reviewing their notes and overlays at a long table in the front of the room.

It's nine o'clock, and no Labor Department staff members have yet arrived. The students laugh nervously, and the Gerstenfelds offer words of encouragement. Then, as if summoned by a bell, two dozen staff people enter, and the presentation begins.

The students have been charged with

By Evelyn Herwitz

Marilyn Pinaud

Dean William R. Grogan, Brendon F. Somerville, of the National Association of Manufacturers, Professor Sue Vernon-Gerstenfeld, Patrick Bannon, Sangeeta Patel, Radha Murthy and Professor Arthur Gerstenfeld outside NAM headquarters.

developing a method for determining the return on investment of QWL programs, a topic of great interest to the Labor Department's Bureau of Labor-Management Relations and Cooperative Programs. QWL programs include such activities as discussion groups that allow workers to become more involved in devising company policies. The team's research has included contacting nine companies of various sizes around the country to develop case histories of their QWL programs.

Taking turns, the students summarize their research, using overlays on an overhead projector to illustrate their findings. They distinguish between start-up and operating costs of QWL programs, then review benefits, such as increased productivity, before describing different ways of calculating return on investment.

Summarizing two formulas, Nowak is about to go on to the next overlay when he is interrupted by a question from the audience. Later, I learn that the questioner is deputy undersecretary of labor Stephen Schlossberg.

Nowak is trying to make the point that QWL programs are comparable only when return on investment calculations are based on the same formula, a factor which must be accounted for when assessing program evaluations. But Schlossberg points out that the distinction between the two formulae has not yet been made clear. Nowak tries to clarify his point several times by restating his original explanation, to no avail.

Red-faced, he takes a deep breath and stops for a moment. Then he tries again, but this time by analogy: "Suppose you had a lemonade stand . . ." The example works. Nowak sighs with relief and proceeds with his prepared notes. Though he apologizes for not being clear to begin with, Nowak has demonstrated one of the greatest benefits of his Washington experience: the ability to think on your feet under pressure.

The presentation continues with a summary of indices that could be used to quantify QWL program outcomes, such as reduction in absenteeism, and a discussion of the factors that can make or break a QWL program. The question and answer period focuses on the need for labor-management cooperation. As the students conclude their remarks, they are met with a warm round of applause.

Among those who have enjoyed and learned from the presentation is Leona Sibelman, an industrial relations specialist who has been the students' mentor and department contact. As some staff members remain to chat with the trio, Sibelman tells me that she hopes the students' report will become a bureau publication.

"This was a unique kind of internship experience," says Sibelman, "and one of the best I've seen. The students had a predetermined project and formed a team unto themselves. They have been a pleasure to be around. . . . I'm going to miss them."

The students are equally enthusiastic—and relieved—as we talk after the room empties. "I feel like we've accomplished something worthwhile here," says Shelton. "We put in a good eight to ten hours a day on the project."

"And three to four hours a day on weekends," adds Nowak. "You live, eat and drink the project. Then you combine that almost total immersion with an incredible atmosphere—historic sights, social happenings—even the tourist traps. You're in the Hub."

Although Shelton and Nowak are fraternity brothers, they didn't know each other well, and neither knew Klee until they began working together in preparation for their Washington term. All applied for the program in the fall of 1984 and were accepted just before Christmas. They were then grouped according to project preference and personality. Now, Shelton and Nowak intro-

Professor Sue Vernon-Gerstenfeld greets a National Research Council official following the presentation by Timothy Moran, Paul Hambelton and Dag Anderson.

duce Klee to me by her nickname—"Mom." It is a joke all three enjoy.

Learning to work well in a group is not the only skill the students have sharpened. "We developed some valuable communications skills, like how to speak in public and get information over the phone," says Shelton.

There was also the challenge of a new environment. "Being an engineer, you want to see things done," says Klee.

"This is a place that deals with ideas, and we're used to seeing something tangible," adds Nowak. But all agree that the Bureau of Labor-Management Relations doesn't suffer from some of the bureaucratic hangups of other agencies, a quality which has made their work life here in Washington enjoyable.

The sun is high in the sky and the temperature in the 80s as we move on to our next stop, the Department of Commerce. Inside the cool marble lobby of the Commerce Building, I study the high-vaulted, brass-plated ceiling and a large digital readout of the United States' current population as we wait in line for the receptionist to guide us to one of Commerce's many units, the Office of Trade Information Services (OTIS).

This time the presentation room is just a small office which has been filled with chairs. It seems that all the conference rooms were tied up at the last minute. But juniors Frank Childs, of Haydenville, MA, Neil Skidell, Bellmore, NY, and Joseph Tompkins, Derry, NH, seem unconcerned by the less than perfect space. They've already given variations of this presentation twice to key department staffers and will do it again for another interested party later today.

The project has been an analytical challenge as well as a test of the students' abilities to avoid political pitfalls. They have been asked to evaluate the effectiveness of a series of OTIS publications, or "products," for exporters. These Export Promotion Service (EPS) reports range from inexpensive pamphlets of Commerce and United Nations data on import and market share, to thousand-dollar customized statistical analyses. OTIS's problem, however, is that the availability of these products is not widely known. So, the team has had to come up with ways to improve the content and marketing of reports that can be implemented by the OTIS staff.

Most of the chairs, crowding through the door and into the adjoining office, are filled by the time the students are ready to start. They distribute handouts of all overlays and launch into their presentation, using the wall as a screen for the overhead projector. Their experience of the preceding two presentations is evident—none uses notes to speak, and all talk with confidence, directly to the audience.

Among the students' recommendations is the use of a "harmonized code" system of international market data, slated for Census Bureau implementation in 1987. The new code, they explain, will enable OTIS to collect comparable data from different countries, enhancing the usefulness of their reports.

Addressing marketing problems, the students advise EPS to publish an annual catalog with quarterly updates and product descriptions that emphasize what the document can do for the consumer rather than just summarize the kind of data available. They also suggest that the office reorganize along industry lines, so that each analyst becomes an expert in a given field and can better collect and assess the accuracy of data.

Although not everyone present accepts all of the students' recommendations, the response is warm, and the trio is commended on a job well done. One EPS staff member, Bruce Cromack, tells me that the team "has some valid points in certain areas, like product specificity, but we don't have the manpower to become industry experts. We would run into turf problems with other government agencies."

But another EPS staffer, Ray Prat, agrees with the findings. "I think their suggestions were useful, particularly regarding specializing along industry lines. I think I'd feel a sense of accomplishment learning about an industry, rather than just worrying about the mechanics of getting out the products."

Learning to function effectively within an environment where turf is well fenced was at times frustrating but not impossible, the students report. "I worked in industry for a while, and you find bureaucracy everywhere," says Joe Tompkins. "I anticipated it here, although I didn't expect the magnitude of the bureaucracy and all the politics. We had to be careful with our wording."

He goes on: "But we weren't looking to cast blame. We were just trying to make recommendations. The people here—I consider them our friends. They were *very* helpful."

During lunch with the Gerstenfelds and Dean Grogan, who joined us back at the Labor Department, there is time to talk about the Washington Project Center experience and the students who come here.

"Part of the success of project centers such as this one is that it's an honor to be here," says Grogan, himself a former resident advisor in Washington. Still, he admits, applicants have dropped from as high as 100 to about 50 students annually since the Washington center opened in 1974. But the group agrees that this is due in part to what may be a lack of publicity and a perception that "it's impossible to get in." Grogan says, however, that standards for acceptance remain high.


Marilyn Pinaud

Joe Tompkins (standing, center) clarifies a point as teammates Neil Skidell and Frank Childs look on during a presentation before Department of Commerce staffers. Professor Arthur Gerstenfeld is seated center.

There are 36 slots open for two groups of 18 students, one group in each of WPI's two fall terms. "We want students who are very solid academically, but we're not just slanted toward top honors candidates," Grogan explains. "We look for students with varied interests and backgrounds in different fields, students who tend to be outgoing—good, versatile students who will be able to learn."

The application process includes a written essay, a transcript review and an interview by a board of former resident faculty advisors. Once selected, students are then grouped into teams and begin work on their Preliminary Qualifying Project (PQP) during the seven-week term in the spring prior to their stay in Washington. The PQP involves defining and refining the problem each team has been assigned, and developing a proposal for how they will attack the issue.

The project topics come from the sponsoring agencies. It's the task of associate dean for projects Francis Lutz to work with the Center's agency contacts and to winnow out the best proposals and refine them into a form that students can manage and learn from.

Once in Washington, housed this year three to a room at the Georgetown Hotel, the students are immersed in full-time research. Most of their time is spent working on projects at their given agencies. In addition, to help the students refine communication skills, there are weekly meetings with faculty advisors for progress reports and practice presentations.

"It's a whirlwind existence," says Sue Gerstenfeld, a lecturer in the Division of Interdisciplinary Affairs. "They have little time to adapt. But it's astounding to watch them grow intellectually. By the time they're through, instead of thinking in small compartments, they're thinking in large systems."

"They have to do much more than just please the professor," adds her husband, Management Professor Art Gerstenfeld. "They're presenting to a very powerful audience. The expectations placed on them are tremendous. This isn't just an undergraduate paper. They have to do a literature search and know everything written on that subject."

Since faculty members live with the students, there is also the opportunity to get to know each other on a personal basis. "You get a sense of the ideal college student to faculty ratio," says Grogan. "You get to know them socially as well as academically. It has all the very best elements of education."

I ask whether the quality and the volume of work that the students produce within such a short time frame indicate that more could be asked of them—and received—back on campus. Sue Gerstenfeld answers with an emphatic "Yes!" Adds Grogan: "If anything, it proves they can do just about anything you insist they do. It teaches you—and them—to raise expectations."

As we prepare to leave for the afternoon's presentations, Grogan sums up his thoughts on the program. "You gain a real respect for students," he says, "—a new appreciation."

Two more presentations fill the rest of the day, one for the National Association of Manufacturers (NAM) exploring university–industry relations, and the other at the National Research Council (NRC) concerning the selection of software for precollege mathematics and science curricula.

The NAM team, juniors Patrick Bannon, of Manchester, NH, Radha Murthy and Sangeeta Patel, both of Shrewsbury, MA, illustrates the value of university–industry cooperation with a case history of the American textile industry. Describing the factors which have weakened the nation's $115-billion "textile complex," which includes the fiber, fabrics and apparel industries and employs 3 million workers, the students emphasize that the industry is labor intensive, faces stiff wage competition from abroad, and has low profit margins, with little money available for research and development activities.

One way universities can provide the research capability the textile industry lacks, they explain, is through cooperative efforts such as Draper Laboratories' Textile Clothing Technology Corporation, which operates in conjunction with Burlington Industries. The students point to the corporation's development of machines that will automate suit coat production.

The ensuing discussion brings out some of the problems of automating a labor-intensive industry, and the need for university research into ways to retrain displaced workers.

"I enjoy these seven-week encounters," says Brendon F. Somerville, NAM's director of innovation, technology and social policy, and a longtime supporter of the Washington Project Center. "We use the information to back up positions we take on legislation."

There is just enough time to walk over to the National Research Council for the day's final presentation. Here, juniors Dag Anderson, of South Easton, MA, Paul Hambelton, North Andover, MA and Timothy Moran, of Worcester, are concerned with how to help teachers select the appropriate computer software for math and science curricula from the 8,000 to 10,000 pieces of educational software currently crowding the market.

From their research, they have reviewed and categorized more than 100 criteria used by evaluators to assess software content, instructional value and technical quality. The presentation covers such issues as how to get information about new software and evaluator services, how to help teachers overcome "cyberphobia" through resources such as computer enhanceable textbooks, and the need to involve teachers in software evaluation.

After the presentation, Anderson tells me how the team tackled their project. "We addressed the problem in the same ways a teacher would," he says. "We wanted to find some of the problems with selecting software. One issue we thought we could handle was how to evaluate software. But once we got into it, we felt lost. We realized there are many evaluators out there. So we tried to develop a tool for educators to make the selection process easier."

For Anderson, the experience has led him to refine his career goals. "I'm thinking of changing my major to a dual degree in education and electrical engineering," he says. "I originally had the idea of going into business, but now I can see the real need for research in areas dealing with technology and society."

Back at their quarters at Washington's Georgetown Hotel, Professor Arthur Gerstenfeld walks Butter while Sangeeta Patel, Pat Bannon and Radha Murthy set off on their own.

The next day dawns warmer than the first, with weather predictions of temperatures in the '90s. We start out a half hour earlier, at 8:00, to allow sufficient time for the subway ride out to Alexandria, VA. There, at the National Society of Professional Engineers (NSPE), we listen to juniors Peter DeBellis, of Foxboro, MA, Daniel King, of Mattapoisett, MA, and Stephen Madaus, of Worcester, discuss ways of teaching engineering students about ethics.

For their project, the team has developed a scenario for a videotape on engineering ethics that the NSPE is planning to produce. The plot involves a group of engineers working for a bus company who are under pressure to develop a new brake system. One of the engineers designs a system that meets basic standards and is cheaper to produce than the old brake system, but not as safe. Another engineer objects that public safety is being sacrificed for profit margins, and must decide how far to press his case. The resolution of the dilemma is left to the viewers, to encourage discussion. Art Schwartz, NSPE assistant general counsel, is pleased with the idea and says it will help the society get funding for their video.

Our last stop is the high-rise complex at Crystal City, where we head for the Patent and Trademark Office (PTO) of the Department of Commerce. Juniors David Brunell, of North Attleboro, MA, and Michael Perrone, of Worcester, together with senior Michael Gualtieri, of Boxboro, MA, meet us in a conference room already full of staff people.

Like the team working for Commerce's Office of Trade Information Services, this group, too, has been asked to evaluate an internal problem. PTO has invested in a multi-million-dollar computer system, LEXPAT, which is designed to fully automate the agency's search and patent application processing functions. Although some 900 examiners have been trained to use the system, less than half are regular users. Continuing a project from the previous year, the team has been asked to suggest ways to reduce examiners' resistance to automation.

Their solution is to adapt training methods to learning styles. Using Kolb's theory of "experiential learning" to evaluate "learning style profiles" of a sample group of 100 examiners, the students observed that the majority favor "abstract" reasoning.

From this, they concluded that most examiners would probably benefit from training that first gives them a system overview and explains LEXPAT's underlying rationale, and only then offers hands-on experience. Others who favor a "concrete" learning style, they note, would probably prefer to be able to use the system as soon as possible, rather than get bogged down in theory.

"You have raised questions that have to be considered," William Lawson, documentation director, tells the students when they are done. "I hope after all the hundreds of millions of dollars invested in the Automated Patent System, we won't blow it on poor training. Your report is a valuable input in that effort."

"I don't think I've ever learned this much in seven weeks in my entire life," Mike Gualtieri tells me afterward. "I can't wait to get back to Worcester. My courses will be much more relevant."

Several weeks later, I speak with Frank Lutz about the transformation which occurs when students return to campus. "They develop a sense of self-confidence and accomplishment, more pride in who they are," says Lutz. "They learn they can make a contribution to problems they didn't think they could solve.

Once in Washington, the students are immersed in full-time research. Most of their time is spent on projects at their given agencies. And, to help them refine communication skills, there are weekly meetings with faculty advisors for progress reports and practice presentations. "In Washington," says Dean William R. Grogan, "our students and faculty get to know each other both academically and socially. The experience offers the best elements of education."

"One advantage of any IQP is that once the students complete the project, they feel more confident with open-ended problems," he continues. "In engineering and science curricula, it's difficult to present problems that have more than one correct answer. Here the students learn there is something in their engineering education that allows them to analyze non-engineering problems. It's a thought process that's not necessarily taught, but learned."

What kind of thought process? "If students are given a problem that is ill-defined and appears impossible to address, they'll first define the problem explicitly," explains Lutz. "They'll continue that process until they gain consensus that this is the problem to be addressed, and then they'll collect data in an attempt to quantify the problem. Even if the problem can't be quantified, this makes the assumptions explicit. The students order priorities, people respond, the students adjust their analysis, and repeat the process to refine the problem."

Currently students can hone those skills not only through the Washington Project Center and on-campus IQPs, but also via off-campus centers at Digital Equipment Corporation headquarters in Maynard, MA, and at Worcester's Norton Company, St. Vincent's Hospital and the University of Massachusetts Medical Center. Next year, opportunities will be expanded through a Municipal Studies Center that will involve projects in communities throughout Massachusetts.

Then there is the Institute's latest venture—a project center in London. Working with their Washington connections, WPI faculty, and professors at the City University in London, Lutz and Professor Lance Schachterle (chairman of the Division of Interdisciplinary Affairs) traveled to England last fall and returned with the names of 15 organizations that have expressed interest in a program similar to the one in Washington.

Next year, Lutz plans to talk further with those organizations, which include the U.K. Patent Office and Gestetner, Ltd., for project proposals. And by April 1987, he hopes to see the first group of 12 to 15 students on their way to London for a seven-week educational adventure.

Center co-directors will be Professor Schachterle and Maria Watkins, lecturer emeritus in the Electrical Engineering Department of the City University. The Center will build on the experience of IQPs done by more than 100 WPI students who have gone to London under a previous exchange program with City University.

Should that venture prove successful, Lutz says he would like to see more WPI project centers in other parts of the world, such as Southeast Asia. "It would make sense for engineering schools to set up international experiences for students," he says. "That's the direction the profession is moving in."

Evelyn Herwitz is a freelance writer living in Worcester.

From the Classroom to the Courtroom

By Michael E. Donnelly

Can engineering and science students serve our overburdened juvenile court system? Ask a lawyer-teacher who's deeply involved.

The question just posed is a fair one. For at first glance there may seem to be scant connection between the skills of students being educated in sophisticated technological principles and the needs of troubled youths.

Yet for several years now, I've had the pleasure of working with WPI undergraduates as they step out of the classroom to conduct their Interactive Qualifying Projects (IQPs) in Worcester's busy Juvenile Court.

Here's a sampling of IQPs students have done in the court system:

• In separate reports written for children and for judges and lawyers, an IQP team explained the scientific principles underlying various types of forensic technology, such as fingerprint analysis, breathalyzers used in drunk-driving cases, and biological and medical evidence in rape cases.

• Another IQP team developed materials based on laws of physics to help driver education programs produce better instructional tools.

• A third group explored the latest biomedical research on dietary and physiological imbalances that may produce antisocial behavior in juvenile offenders.

In every IQP, the goal is to bring science and technology to the aid of the Court and the children it serves. I've seen these students struggle with legal, scientific and ethical problems—the kinds of issues that they'll confront throughout their professional lives.

That these students—and the children the court serves—are better off for the struggle is abundantly clear to me. A closer look at the IQPs described above may help explain why.

In "Forensic Technology," Brian Coleman '84, Jeffrey Lenard '84 and Eric Langevin '84 had to develop not only a working knowledge of the criminal court system and how criminal charges are proved, but also a practical understanding of how scientific techniques are offered and accepted by the courts. To be able to present their reports effectively, the students had to learn how lawyers use such evidence when offering or challenging its admission to court. They also had to develop a knowledge of the law in this area equal to their knowledge of the scientific methods. But their work did not stop there. They had to use those two areas in combination to write intelligently for both lawyers and children.

With a nice blend of technical ingenuity and humor (*à la* drawings after the antics of *Saturday Night Live's* "Mr. Bill"), the "Driver Education" IQP team of Michelle Cutler '86, of Braintree, MA, James Granger '86 and Patrick Hester '86, both of Worcester, and John Williams '85, of Oxford, MA, fashioned materials that were at once contemporary and scientifically sound.

To test a particular question in physics concerning motor vehicle dynamics and accident reconstruction, the members of this group pressed into service the trusty, if somewhat dilapidated, automobile of Jim Granger.

To determine whether motor vehicle stopping distances would vary with the amount of weight placed in the car, the group designed several effective field tests. With the help of area police officers who volunteered their time, and the Worcester Airport, which volunteered an open runway, the tests were conducted, confirming scientific procedures of accident reconstruction technology.

The types of ethical problems often faced in IQPs were confronted by Timothy P. Mavor '86, of Bridgewater, MA, Matthew P. Vincent '86, of Granby, CT, and Gordon Walker '86, of East Granby, CT, in their IQP, "The Treatment of Juvenile Offenders by Orthomolecular Therapy." From their review of the literature and from interviews with experts, this group proceeded to write a protocol, or working checklist, for human-services and medical workers to use when screening children for nutrition-based disorders.

The students were left with the same ethical problem that the experts struggle with; *i.e.*, what level of intrusion into a child's life is permissible when an organization sets out to change that child's behavior? Or, as their final report asked, what is to be done with such children? Are delinquent offenders fit merely for punishment, or are they troubled children in need of treatment? The students learned that the best legal and medical evidence is still unclear on this point. Their approach was to state this ambiguity and to honestly reflect this as an unresolved problem.

Ambiguities aside, as a result of the project, each group member made a personal commitment to improve his diet. Incidentally, in meeting with this and other IQP teams at my home, my wife and I have been interested in this project in particular as we work to develop healthy diets for ourselves and for our growing toddler.

Each student who participates in the juvenile court IQP serves for a year as a volunteer probation officer for the Worcester Juvenile Court under the supervision of a professional juvenile probation officer. This is an extremely important element of the IQP. The student's commitment to the child on probation determines part of a student's final grade.

Contact with the children enriches the academic research element of the project by giving students first-hand knowledge of the problems and strengths of the children they wish to serve. It is not uncommon to hear these students comment on the children's sense of wonder at what are often their first visits to a college campus. The children are exposed to a wide range of new experiences, including computer labs and athletic facilities, often opening entirely new worlds to them.

But the experience runs both ways. I've often heard students say that they were initially reluctant to meet these "delinquents," whom they later find to be interesting and enjoyable people. Stereotypes and misconceptions fall away on both sides when the students and children have to interact with each other for a full year.

This IQP experience should not be overly romanticized, however, because providing supervision to children who truly need the help and attention of conscientious role models can be a difficult job. Students have to meet weekly with the children, a policy that some children resist. And sometimes matches of students and children fail.

Problems have to be talked out and worked on, and there is a constant requirement on the students' part to keep documented records of their contacts with these children—children who are on probation and whose commitment is *not* voluntary. It's this commitment by our students—to both the children and the Court—that makes the program work.

At the heart of the IQP is the notion that this experience is the first step in transforming students into professional engineers and scientists—professionals who can observe, think about what they see, express their ideas to others, and then act. Three particular experiences demonstrate how this education can happen.

Jim Granger, for example, spent several days for his group following a trial in which two competing expert witnesses in motor vehicle dynamics and accident reconstruction testified before a jury on the cause of an accident that led to the death of a passenger.

After the trial was over, Jim engaged the experts on their own turf, introducing himself and explaining his research project to them. They took the time to go over their calculations with Jim and pointed out reasons for reaching their separate conclusions.

The members of the "Forensic Technology" group chose to write a pamphlet that would help children understand special scientific tools used in court. Of particular note was the use of rape kits in sexual assault cases. To learn how to avoid technical jargon and to write clearly, simply and interestingly for children, these students sought the help of Regina Hannigan, a one-time school librarian and now owner of a children's bookshop in Worcester. In this IQP, the ability to communicate scientific ideas to special groups was paramount to the concept of the "humanistic technologist."

Gordon Walker of the "Orthomolecular Therapy" group observed during one of his weekly five-hour meetings with his "little brother" that the boy was extremely flippant and aggressive. Walker noted that this was out of character for the boy, who was usually very quiet and passive.

As the evening went on, Walker, who had taken his little brother bowling, watched as the boy threw the bowling balls erratically down the alley. Finally, though, the boy quieted down. Walker later found time to talk with him. The boy confided that before his meeting with Walker, he had eaten "all of his father's jelly beans."

This episode of mood-swing confirmed Walker's literature review of medical data on hypoglycemia—a rapid and dramatic change in blood sugar levels which often produces dramatic behavioral shifts. Here was actual observation based on research data of a key component in his IQP.

In these simple, often anecdotal though at the same time technological ways, students push themselves to new frontiers of experience, skill and viewpoint. By addressing the needs of often desperate children on a *very* personal level, students prepare for the kinds of professional, ethical and societal challenges they will soon face in a career and in post-collegiate life.

At the Worcester County Court House, assistant district attorney Michael E. Donnelly discusses a case with WPI students whose projects address problems in the Worcester County Juvenile Court system: James P. Granger '86 CE, Michelle R. Cutler '86 'MGE, and Matthew P. Vincent '86 CH.

Robert S. Arnold

Michael Donnelly is an affiliate assistant professor in the Division of Interdisciplinary Affairs. He is also Assistant District Attorney of Worcester County, as well as director of the D.A. Office's child abuse unit and coordinator of its elder abuse program.

Pete Marsaw '30: *Maker of Magical Light*

By Ruth Trask

When the Class of 1930 wanted to give a lasting senior-class gift to WPI, it turned to class artist Percy "Pete" Marsaw, EE. What we'd like, the gift committee told him, are some stained-glass windows for the chapel.

"I'll see what I can do," said Marsaw, who had seen his first stained-glass window at age five, and who had boarded briefly with a glassblower's family while attending high school in Worcester. With his artistic bent, he was certain he could design stained-glass, but he'd had no actual experience with its manufacture.

At almost the same time the gift committee requested his services, so did the now-defunct Worcester Stained Glass Company. "The company needed a part-time stained-glass designer," Marsaw reports. "I was recommended by the college, so they hired me." The amazing thing about all this is that, at the time, Marsaw was still an undergraduate.

"The gift committee commissioned me to design window seals representing the four branches of engineering," says Marsaw. "An interesting assignment, since no such seals were in existence! We decided to depict a monkey wrench, a hammer, calipers and a square for the mechanical engineering seal; a microscope and retort for chemical engineering; and a rod and transit for civil engineering. [See cover photo.]

"When it came to designing the electrical engineering seal," he says, "WPI president Admiral Ralph Earle lent a hand. He suggested that to our turbine and electric lamp we add a Leyden jar. Ultimately, the seals were to be enclosed in glass shaped like the shield pins from the various departments."

Much thought was given to the order of the four windows in the chapel (also once known as the library or Sinclair Hall, and more recently as the placement office or OGCP) on the top floor of Boynton Hall.

In the end, it was decided that the windows should be arranged according to the seniority of the branches of engineering within the WPI curriculum. The seal of the United States, which Marsaw considers to be his best effort in stained glass, and the seal of the State of Massachusetts, would also be included. When, with the assistance of Worcester Stained Glass Company, the windows were produced and installed, WPI had the only engineering seals of original design in the nation.

Marsaw eventually took other engineering and administrative posts, but he continued designing for Worcester Stained Glass until it closed its doors in 1940. "My experience with the design and manufacture of the engineering seals was such a positive one," he says, "that I've continued to make stained glass ever since."

According to Marsaw, stained-glass making is a time-consuming task. In creating a window, he makes a scale drawing of his design, then paints it with watercolors. His next step is a full-sized working drawing—a cartoon, it's called. With special shears, a tracing of the cartoon is cut into sections. The glass is then made to fit the cartoon pieces and the designs are painted on with vitrifiable colors or pigments, which are oxides of metals. Each piece is then placed in a kiln and fired at 1050 to 1200 degrees F. This actually causes the color to enter the surface and become part of the glass. The final step is putting the design together with lead strips and soldering the joints.

Marsaw has designed and made exquisite windows for Central Congregational Church, Christ the King Church, St. Ann's, St. Anthony's and the old Lincoln Square Baptist Church, all in Worcester, as well as for St. Mary's in Jefferson, MA, and the Pleasant Valley Methodist-Episcopal Church in Poughkeepsie, NY.

The three Poughkeepsie windows are his largest (18 feet high and 3 feet wide), and took him 15 months to complete. The center panel has a large illuminated cross, which required much hand painting and firing. The side panels depict symbols of the Old and New Testaments.

Besides creating, Marsaw is among the finest craftsmen anywhere at mending stained glass. After the 1938 hurricane, John W. Higgins asked him to make 360 pieces of glass to replace those lost at Worcester's Higgins Armory Museum during the storm. Marsaw replaced the broken glass in the Armory's beautiful 13th-century St. Adrian window, for which he also designed the tile floor and canopy.

"Mr. Higgins was very particular about his forge rose window, as well," he recalls. "It represented his ties with industry through Worcester Pressed Steel Company. He wanted the forge center flame to be exactly the color of the forge flame. Without describing to me in detail just what that was, he asked me to find the right glass."

Marsaw knew he'd have to go to New York City to get it. "When I returned to Worcester, I showed him what I'd found."

"That's it, Pete. Exactly," Higgins congratulated him. "You knew just what I was looking for!"

Michael Carroll

Percy "Pete" Marsaw '30 with three of the six Sinclair Hall stained glass windows he designed. Located on the top floor of Boynton Hall and once used as the library and as a chapel, Sinclair Hall is now occupied by the Office of Graduate and Career Planning.

Listing Pete Marsaw's interests and enthusiasms is an experience in itself. His many accomplishments have been noted in *Who's Who in the East.* At the moment, he's renovating the archives cabinets at the United Congregational Church (formerly the Central Congregational Church) in Worcester, a fitting task for the chairman of the church historical committee. In 1962, he wrote a booklet titled *Symbolism in Central Church.* In 1959, he served as chairman of the building committee for the church parish hall.

During World War II, while director of the Industrial Arts Division of Worcester Public Schools, Marsaw supervised the student manufacture of fighter plane models to aid in the identification of aircraft. He also wrote and illustrated the booklet, *How to Identify Aircraft of United States Armed Forces.*

For ten years, he played the violin with the Worcester String Ensemble. He designs his own Christmas cards, collects stamps, and enjoys woodworking, photography and jewelry making. He's been everywhere looking for stones for his jewelry. "Do you know," he asks, "that in The Smokies you can find real rubies and gem quality garnets and sapphires?"

Still, all this fun didn't keep him from finding a satisfying career. While an undergraduate, Marsaw was an electric designer with the St. Lawrence Valley Power Corporation. He even taught design courses at Northeastern University. From 1930 to 1939, he taught mechanical drawing in Worcester high schools. He was director of Industrial Arts in the Worcester Public Schools from 1939 to 1947. From 1947 to 1950 he was assistant plant manager of the Wickwire-Spencer Division of the Colorado Fuel and Iron Corp. in Worcester. He also taught at Worcester Junior College and worked for Universal Boring Machine Co. and Heald Machine.

Prior to becoming Holden Hospital administrator in 1954, he had served four years as purchasing agent and personnel manager for the Reed Rolled Thread Die Co. in Holden, MA. Later, he was administrator for Fairlawn Hospital in Worcester, from which he retired in 1972. For the next 12 years, he served as a consultant in industry, working for the Central Massachusetts Employers' Association.

While with Holden Hospital, he supervised the construction of its new building and purchased all the equipment. Along the way, he received a gold medal from the Massachusetts Hospital Association as its "Most Valuable Member." He smiles, "The medal is still in the bank!"

Active in civic affairs, he has been associated with the YMCA, the Rotary Club, the Worcester Junior College Board of Governors, the Massachusetts Hospital Association (former trustee and treasurer) and the Worcester County Hospital Administrators' Association (past president).

Pete Marsaw's brilliance is reflected in all he has ever done—from the facets of his gem-stone jewelry, to the enchanting light his windows create, to the students he has had a hand in molding. He is a true maker of magic.

Marsaw has not only made a lot of stained glass, he has also lectured about it extensively. While earning his master's degree at Boston University, he wrote a paper on the subject. It was so well received that he was invited to give lectures on the topic at B.U. He has also spoken before a number of other college, club and religious groups, occasionally branching out into the areas of religious symbolism and architecture.

How Sweet It Is!

By Paul Susca

In the small but sticky world of starch processing, Professor Jim Rollings is WPI's rising star. He's also WPI's first recipient of the Presidential Young Investigator award. His work on processing starch into sweeteners and fuels may one day change entire industries.

"I was high for about 48 hours after I received the award," Jim Rollings says. "Then I read what it said. It didn't say that I necessarily *did* anything. All it said is that I have the *potential* to do something."

Judging by the Presidential Young Investigator (PYI) program's emphasis on research of interest to industry, that probably means the potential to do something aimed at concrete applications. But although he is an engineer, Rollings doesn't always think in terms of *applying* technology in the same way many engineers do.

"When I talk with engineers, they say, 'You sound like a scientist,' and when I talk with scientists I get the opposite reaction." Rollings says his niche is "somewhere between pure research and applied work." He is explaining how he earned the distinction of being one of three biochemical engineering researchers in the country to be named Presidential Young Investigators.

The PYI program, funded by the Office of the President and administered by the National Science Foundation (NSF), provides exceptional young scientists and engineers the opportunity to begin building research programs. The PYI program provides $25,000 per year, and then sweetens the pot with up to $37,500 to match grants from industry. That's a total of up to $100,000 per year for five years. This amount of money could enable Rollings, who currently has three graduate students and one postdoctoral associate in his program, to build the biggest research effort in WPI's Chemical Engineering department.

But, does Jim Rollings *want* to build the biggest program in the department? He answers with a story: Around the time Rollings joined WPI, Professor Edward L. Cussler at the University of Minnesota wrote a tongue-in-cheek paper titled "How to Do Basic Research."

Cussler's system defines several types of research scientists. Some are "architects," who take the building blocks of research results and structure them into a framework of knowledge on a particular topic. "Bombers" are another type, setting their sights on a particular problem and attacking it until it doesn't exist anymore. Finally, there are the "princes," who amass large research programs, build dynasties, and then become administrators.

"My initial approach to any problem is as a bomber," Rollings admits. "But I don't get very far before I start asking about what's going on architecturally." So, Rollings concludes, "I have bombing initiatives with architectural tendencies."

Since Jim Rollings went to work bombing a problem in starch processing eight years ago, he has spent most of his time heightening the architecture of biopolymer science through analytical chemistry.

"I'm interested in understanding the properties of biopolymers," he says. "I'm attempting to meld what we know about polymer science and physical chemistry into an understanding of biopolymers."

Polymers are substances whose molecules are made up of chains of smaller component molecules. Biopolymers are simply polymers of biological origin. For example, polystyrene and polyvinyl chloride (PVC) are synthetic polymers derived from petrochemicals.

Starches, which occur abundantly in plants, are biopolymers comprising chains of simpler sugar molecules. Through hydrolysis, or breaking the hydrogen-oxygen bonds between sugar molecules, starches can be processed into their component sugars, or glucose, or modified to become other monosaccharides, like fructose.

"The typical example of starch hydrolysis occurs when you eat a cracker," Rollings explains. "If you chew on it long enough, the enzymes in your saliva break down the starch into sugars, and you actually get the sensation of sweetness." So, one application of Rollings' work with starches lies in the conversion of plentiful starches such as corn starch to liquid sweeteners such as fructose, which is a common ingredient in prepared foods.

A similar method of starch hydrolysis can be used to produce ethanol (grain alcohol), which many see as an alternative to non-renewable fossil fuels.

But starches are only one of many kinds of biopolymers. Others include proteins (polymers of amino acids) and polynucleic acids such as DNA. Although Rollings' work to date has focused on starch hydrolysis, he is really building a much broader body of knowledge about biopolymers and how they can be processed.

Biopolymer research has been a national priority only since 1973, when world cane sugar and petroleum prices shot up (quite independently of one another), according to Rollings. These events prompted research into two types of biopolymers belonging to the polysaccharides. Starches were seen as a source of sweeteners and fuel, and cellulose (present in all plants) was also seen as a source of grain alcohol.

"My initial approach to any problem is as a bomber, but I don't get very far before I start asking about what's going on architecturally."

Because the bulk of biopolymer research activity since the mid-1970s concentrated on trial-and-error methods of finding effective ways to use acids, bases or enzymes to break up polysaccharides, biopolymer science stayed far behind the science of neutral polymers. That's why Jim Rollings has been single-mindedly—but not single-handedly—building an understanding of the reactions involved in starch hydrolysis, including the interactions between biopolymers and water solutions.

Rollings explains his special interest in biopolymers: "We know a good deal about synthetic polymers, but the polyelectrolytic properties of biopolymers add another layer of complexity to this." Rollings' fascination with these polyelectrolytic properties is, in fact, what makes him sometimes seem more like a scientist than an engineer.

"Polyelectrolytic" refers to the fact that biopolymer molecules, which in nature are produced in water solutions within living cells, are peppered with minute electrical charges. It is the electrical interaction between biopolymers and the solution in which they are dissolved that makes them more complicated than synthetic polymers existing in electrically neutral organic solvents such as benzene.

How did Jim Rollings become so enthralled with the electrical properties of biopolymers? After finishing his B.S. in biochemistry at the University of Minnesota in 1972, Rollings began a two-and-a-half-year stint with the Peace Corps, teaching high school biology and chemistry in Mombasa, Kenya. There he met Mary Ann Garcia, a Peace Corps volunteer from Victoria, TX, who was teaching nursing.

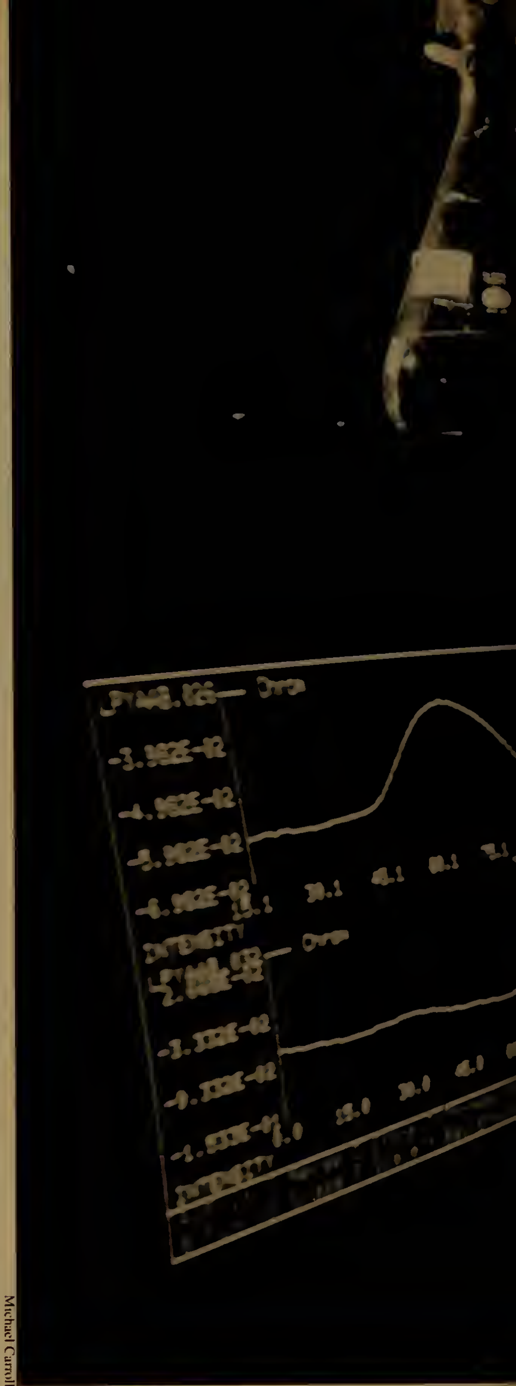
Jim's stay in Kenya convinced him that world hunger problems were not simply a matter of supply, but one of processing and distribution as well—of developing and implementing technologies that are *appropriate* for the social, political, economic and environmental conditions for which they are intended. As a scientist, Rollings felt ill-equipped to attack these problems, and thought about going into engineering. Married in Kenya, Jim and Mary Ann returned to the States in 1975, their plan being for Jim to earn an engineering degree and return to Kenya.

Then, two years later, having earned a bachelor's degree in chemical engineering at Purdue University, Rollings continued his training at Purdue in food engineering. Completing his master's work in starch processing in 1979, Jim felt that a purely engineering approach to food processing ("mish-mash some starch and some enzymes together and see what you get") was not for him. Entering a multidisciplinary program at Purdue in 1977, Rollings joined a team working on starch processing under a grant from the Department of Energy (DOE).

That was where the issue of applications started to surface.

One day I was working in my cubicle, and suddenly this bundle of paper came flying over my shoulder and landed on my desk. It was my quarterly report for the DOE project." One of the other team members had sent a symbolic protest: Rollings was not working toward the project's

Rollings confers here with Li-Ping Yu on the workings of a low-angle light scattering detector. Coupled to a size-exclusion chromatographic molecular weight separation device, this equipment analyzes starch hydrolysates (products of enzymatic chemical transformations). Developed by Professor Rollings and his research team, the scheme analyzes a critical, little understood element of the process for converting starch to sugars.



Michael Carroll

stated purpose, which was to study the production of alternative sweeteners from corn starch.

Rollings had taken exception to the standard practice of talking about the products of starch hydrolysis in terms of the *average size* of the molecules produced. Molecular size was supposed to indicate the composition of the sugars produced in the reaction, but Rollings felt that that approach did not reveal much about the reaction itself—the actual process of breaking starch polymers into sugars.

During his years of graduate study at Purdue, Rollings worked on an analytical technique called size exclusion chromatography (SEC), which analyzes a solution of sugars (or other substances) based on the time it takes for the sugar molecules to pass through a filter made of microscopic beads. The SEC technique depends on the relationship between the size of a molecule and its molecular weight (the mass of a molecule), the latter being a more accurate indication of its chemical structure, but not directly measurable.

Rollings and his coworkers found that changing the electrical properties of polyelectrolyte water solutions, such as by adding salts, affected the shape—and, as a result, the size—of water-soluble polymers by interacting with the electrical charges on the surface of the molecules.

Rollings' Ph.D. work dealt with what seemed less like a biochemical engineering problem than a chemistry topic: developing an analytical technique. Of course, the aim of Rollings' work was to better study the *process* of starch hydrolysis by improving on the available technique for analyzing the *products* of the process. Fortunately, despite the doubts of one team member, Rollings' thesis advisor had the foresight to let him follow his nose, and he produced some results with what Rolli..gs terms "broad implications for usefulness, despite the fact that some of them might be years off."

After earning his Ph.D. in biochemical/food engineering in 1981, Rollings was faced with the choice of entering the food processing industry or continuing his research. "I figured that if I was going to enter academe, it was now or never," Rollings explains, so he applied for academic positions in chemical engineering, chemistry, food science, and agricultural engineering. "It wasn't exactly clear where I belonged, since I had a very interdisciplinary background," he says.

"So I ended up here," he continues, surrounded by shelves laden with binders full of the thousands of articles he has read on polymer science and starch processing. "And I have been reasonably successful at teaching and getting grant money." Today, after four years with WPI's Chemical Engineering Department, Jim Rollings is the Institute's first Presidential Young Investigator.

A chat with Rollings reveals the conviction behind his pertinacious pursuit of "the truth about biopolymers." He starts off talking at a lecturer's pace. But when he gets going, forget the notebook and make sure the tape recorder is on. "He's very energetic," hints one department colleague with some degree of understatement.

When Jim Rollings is not teaching or working on his research, he is jogging "anywhere from zero to 60 miles per week," but it averages just under four miles a day. Or, he is spending time with Mary Ann and their six-year-old son, Ean, or doing home improvements. "Last year I remodeled the kitchen, and now I'm building a greenhouse over our garage." Someone with that kind of energy must be doing what he wants to do. So, during Jim's grad student days, he wasn't going to let someone tell him that his work was irrelevant.

The challenge that faces Jim Rollings now is to realize the "potential" for which he was recognized by obtaining funding from industrial sponsors interested in the same topics he is. That means thinking in terms of applications for his work.

But because of the basic nature of that work, many of its applications are indeed years down the road. After all, Jim Rollings is building a body of knowledge about biopolymers, which have enjoyed increased interest only since the mid-1970s. This is in contrast to synthetic polymers, which have been in the spotlight of chemical engineering since

World War II, when industry looked to petroleum as a raw material to provide substitutes for such natural polymers as rubber and silk.

Yet starches are only the beginning. Other types of biopolymers, including proteins and polynucleic acids such as DNA, are in line to be scrutinized. So far, Rollings has focused on starches and other polysaccharides because, for all their complexity compared to neutral polymers, polysaccharides are the simplest of biopolymers.

Although most of the benefits of Rollings' work are in the future, some applications can be readily identified. And Rollings is busy pursuing applications-oriented industry grants.

Novo Laboratories, for example, is interested in Rollings' work with SEC analytical techniques. Novo manufactures enzymes for use in the production of sugar substitutes from polysaccharides, and SEC can be used in the testing of these enzymes.

Another application of Rollings' work is in the design of chemical reactors that use enzymes to break up biopolymers. Currently, biopolymer hydrolysis processes use enzymes that float around in a liquid. When the liquid is removed from the reactor, the enzymes have to be separated out and returned to the reactor for reuse.

Some processes involving neutral polymers get around this separation problem by utilizing enzymes that are immobilized, or stuck to the surface of beads piled in a column. This way, as a polymer solution passes through the column, the immobilized enzymes act on the polymer molecules without actually entering the solution. Hence, there is no need to separate the enzymes from the product at the end of the process.

So far, the solution dimensions of many biopolymers have been an obstacle to using immobilized enzymes on

Li-Ping Yu (L.), who is originally from Taiwan, is a post-doctoral research associate in Rollings's laboratory.

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biopolymers. "There are two ways of avoiding (and exploiting) this physical constraint," Rollings explains. "You have the choice of making the pores where the enzyme is immobilized large enough to accommodate these large substrates. Or, if possible, you can adjust the bulk solution so that the biopolymers become more compact. In the case of neutral water-soluble polymers, you are constrained by only the first option."

Development of such reactors, he adds, would take cooperation of groups schooled in materials science. "There's a strong possibility that we will soon be working with corporate new product R&D people on this concept." One of Rollings' graduate students is working on this problem.

Rollings adds, "If we are dealing with a polyelectrolytic biomolecule, like pectin, then we can exploit not only the first situation, but also the bulk solution ionic strength, which will affect ion-containing polymers solution dimensions. So we have to consider interactions between all system components: the polyelectrolyte, the enzyme, the solution and the solid porous support where the enzyme is immobilized. Clearly, not an easy problem, but one that is theoretically tractable."

The common thread running through all of Rollings' work is the interaction between biopolymer molecules and their environment. So far, his work has focused on polysaccharides' responses to the electrical properties of the solutions in which they are dissolved.

When it comes to studying the interactions between polymers and their environment *in living cells*, Rollings is teaming up with David DiBiasio, a chemical engineering professor involved with fermentation research. Rollings and DiBiasio are planning to study the formation of a biopolymer in genetically engineered cells.

"Most biotechnology processes involve taking a gene from a nucleated cell (one with a nucleus) and implanting it in a non-nucleated cell (one without a nucleus) such as yeast or bacteria," the aim usually being to enable the yeast or bacteria to manufacture the protein described by the gene, Rollings explains. The problem is that nucleated and non-nucleated cells are fundamentally different forms of life, and they manufacture proteins in very different ways.

"Since the manufactured protein is a foreign material to the cell, it is secreted into an internal sac called an inclusion body. Which is great, because not only does the cell make the protein for you, it puts it in a neat little package," Rollings continues. He and DiBiasio hope to study how cells form these microscopic litter bags. The results could be of considerable benefit to pharmaceutical and other biotechnology companies, who want to find better ways of harvesting proteins from genetically engineered cells.

Rollings and DiBiasio are, in fact, the nucleus of their own biochemical engineering entity. Recognizing the potential for an interplay between WPI and research institutions such as the Massachusetts Biotechnology Park, to be located in Worcester, as well as hospitals and biotech firms in Central Massachusetts, Rollings and DiBiasio, along with Professor Judy Miller of the Biology and Biotechnology Department, have formed the New England Biotechnology Association. "There are only about a dozen academic institutions in the country with two or more biochemical engineers, and WPI is one of them," Rollings points out, "so we felt we had a critical mass."

"Biochemical engineering and biotechnology are two fields that necessitate bringing people together from different disciplines—microbiology, chemical engineering, genetic engineering, etc. So we formed NEBA to create a regional forum," according to Rollings. Thus far a rather modest organization, NEBA sponsors an annual speakers forum.

Rollings is not eager to see NEBA—or his own research program—experience phenomenal growth. He feels that, although the PYI program seems to implicitly expect recipients to start a big program with the help of matching industry grants, his mission is in education as much as in research. "Industry can call some of the shots if they want, but I don't want them running the entire program. I don't want to have to tell grad students to change their thesis topics to meet industry's needs, unless they want to."

At Purdue, Rollings stuck to his guns and resisted changing his thesis topic to make it more germane to the immediate needs of industry. He seems to want to preserve that same freedom for his graduate students. Rollings feels that such a strategy may have the greatest long-term benefits in terms of applications. "We expect that our students will be able to go out and do something more beneficial than we can do in the academic laboratory today," Rollings says.

Besides, academic freedom seems to hold more allure for Jim Rollings than heading a lofty research program. Whether his "bombing" initiatives or "architectural" tendencies have more influence on his work, Rollings states with certainty, "I'm not interested in being a prince."

Paul Susca is a freelance writer living in Norfolk, MA.

SPORTING STRIFE

By Marshall Ledger

An NCAA rule lets Division III colleges compete in a chosen sport on equal ground with the big-time powers of Division I. Changing that rule would hurt Johns Hopkins in lacrosse, RPI in ice hockey, Franklin and Marshall in wrestling, and Hartwick in soccer—but some say the change would help keep college sports in their proper place.

AP/Wide World Photos

An American University midfielder swiftly kicks a Hartwick College forward in the 1985 Division I soccer semifinals.

When Villanova University's basketball team won the NCAA Division I tournament last spring, it became the national champion, experiencing all the attention that goes along with winning a game seen by millions.

Philadelphia celebrated Villanova's victory with a parade down Broad Street—a special honor, previously reserved for the city's professional teams. Back on campus, the school received countless requests for pictures and autographs of the athletes and coach Rollie Massimino, while local stores experienced a run on Villanova Wildcat hats, T-shirts and the whole line of "Catwear."

Villanova got another bonus from the win—$751,889, a share of the NCAA's television and ticket sales revenues for the tournament.

When Rensselaer Polytechnic Institute (RPI) won the NCAA's Division I hockey title last year, its bonus was much smaller in terms of dollars ($37,427). But championship fever still caused a major commotion. About 3,000 RPI fans found their way to the championship game in Detroit, including a crowd-rousing group of student-musicians modestly deeming themselves "America's Pep Band." An estimated 500 people greeted the triumphant team when it arrived back at Albany, N.Y., airport; the next day, hundreds more stood in a drizzle at a rally outside the student union. Three students settled in as squatters on the porch of the building; they claimed, perhaps not altogether whimsically, to be waiting first in line for 1985-86 season tickets.

Hartwick College didn't win the Division I championship in soccer this year. But it won in 1977, and the team comes close almost every year, this year making it to the semifinals. Hartwick home games draw as many as 4,000 fans—about three times the population of the student body.

At Johns Hopkins University, Division I champion in lacrosse (worth $17,835), it's a similar story: 8,000 fans to a lacrosse game, newcomers often becom-

LACROSSE Magazine

Playing Division I is important to Johns Hopkins—one legacy of having won 41 national titles.

ing swept up in the frenzy. Hopkins has played in the national championship finals for eight years running, winning four times.

Division I sports are big time. They're where the excitement is.

Compare that Division I hoopla with the reception that greeted the women's cross-country team at Franklin and Marshall College, when it returned to Pennsylvania last fall after winning the Division III national championship—the first such championship ever won by an F&M team. There was no brass band at the airport, says William Marshall, the school's athletic director. But on hand were the college president, other officials, "and a few students and parents"—a coterie more in keeping with the restrained role of sports in colleges registered in Division III.

And, some would say, more in keeping with the role sports ought to play on the campuses of Hopkins, Hartwick, F&M, and RPI. Under NCAA classification, all four schools are registered in Division III, but they can "play up" in a sport of their choice because of an NCAA regulation allowing limited multi-level classification. About 20 schools take advantage of the rule to play up in a sport. That same regulation allows about 110 schools to "play down" in one sport—a big money-saver for schools that want to play Division I basketball, say, but who do not want to spend the money fielding a Division I football team. Villanova, which disbanded its football team several years ago, took advantage of the multi-level option when it re-established football this fall—but at a Division III level (eventually they will rebuild to Division I-AA).

The result of these multi-level programs, admits Tom Greene, athletic director at Hartwick, is "a little bit of apples and pears." Others put it more strongly. "Some of us find it difficult to imagine how you can have a Division I team in one sport and not let that influence the philosophy of your entire program," says Anthony Diekema, president of Calvin College in Grand Rapids, Michigan, and a member of the NCAA's Division III Council.

Division III purists have taken action. Through the Division III Council, they've submitted a proposal to the NCAA that multi-level classification be discontinued. Originally scheduled to be voted on by the 850-member NCAA in January 1986, the proposal has been tabled—in part because of an aggressive lobbying effort spearheaded by Hartwick's Greene. But the proposal will likely reappear, and some of the issues it raises, even multi-level partisans at F&M, Hopkins, Hartwick, and RPI agree, are important ones.

The NCAA exists, in a sense, to enforce consistency; it was founded in 1902 to help control violence in intercollegiate sports. Since the organization is made up of the schools themselves, they, in effect, agree to curb their own abuses to keep their peers from gaining untoward advantages. For more than 50 years, the NCAA has chiefly kept records, and, with better or worse success, policed violations. The latter activity has become acutely important in recent decades as astronomical TV revenues from the major sports—football and basketball—made winning more and more important.

In 1973, NCAA schools divided themselves into three divisions, according to their interest in gaining a share of the major sports revenue. To a large extent, the divisions simply separated the different-sized schools of the NCAA; schools of like sizes were determined to have like interests. That argument—"schools with like philosophies in like groups"—was repeated when Division I was restructured into I-A and I-AA five years later. Segmentation is determined by quantifiable criteria—in addition to the size of a school, the size of its stadium, spectator attendance and the number of other sports offered—rather than by formal statements of philosophy or principle.

Still, the leaders of Division III see themselves, by and large, as a principled bunch. "When you're a Division III school," says Anthony Diekema, "you have a certain philosophy about the place of athletics."

George Drake, a former Rhodes Scholar and now president of Grinnell College in Iowa, is a member of the NCAA's Presidents' Commission for Division III. Drake was also dean of Colorado College for four years. Colorado College plays in Division III—except for a Division I team in ice hockey.

"I enjoyed the hockey games immensely," Drake says, "but at the same time I was troubled by them." It was difficult to blend the hockey players into the rest of the student body; "they were definitely a class apart," he says, and were treated with different expectations academically. Drake sensed tension in the athletic department, jealousy, perhaps, over the money spent on hockey.

The hockey team did add something to the college life. "Division I sports are lots of fun to watch," Drake grants. But he questions "putting the interest of the

Marshall Ledger is associate editor of the Pennsylvania Gazette, *the alumni magazine of the University of Pennsylvania, which plays in Division I-AA.*

spectators ahead of the interests of the players." Priority should be put on what's best for the players, and he isn't sure that the pressures of high-powered sports are appropriate at an academically oriented college.

If a recent survey on pressures experienced by Division I players accurately reflects the experience of players in schools that play up, Drake's worry about the athlete's interests may be well-founded. Allen L. Sack, chairman and professor of sociology at the University of New Haven, and Robert Theil, professor of health sciences at Southern Connecticut State University, polled 644 student-athletes at 47 colleges and universities around the country. Sack and Theil asked the student-athletes whether they felt that demands put on them by coaches prevented them from becoming top students: 55 percent of the males in Division I said yes, as did 29 percent in Division III. Asked whether the student-athletes felt pressure to be "athletes first and students second," 41 percent of the males in Division I agreed, compared to 12.8 percent in Division III. Athletes on scholarship felt more of this pressure than walk-ons, as did athletes who practiced 30 hours or more a week.

Athletics should be just an extra dimension of a college education, Drake and Diekema argue. To those who believe most strongly in the Division III philosophy, citing examples of well-balanced Division I programs is beside the point. Villanova, for example, graduates virtually all of its players, giving them special tutoring, when necessary, to compensate for the pressures of playing Division I basketball. Still, the purists argue, the potential for abuse—admitting unqualified students, letting scholarship athletes use up their eligibility without ever graduating, alumni payoffs to star athletes—is always there in a Division I program, and many schools don't follow the Villanova example.

Division III is trying to hold the line. Its athletes are supposed to be treated like other students; there are no athletic scholarships.

All sports in a Division III program are to be treated equally, women's and men's, football and field hockey and cross country. It's hard keeping that in mind even without the influence of a Division I team, say Division III coaches and athletic directors. Carol Fritz, associate athletic director for women's sports at Western Maryland College (Division III across the board), points out that differentiating among sports can be a big problem because it inevitably leads to classification of "major" and "minor" sports, even though athletic directors "never like to admit that." It's an especially important issue as colleges try to establish equality between men's and women's sports. When a men's sport is established at a higher caliber of play, she says, "you highlight inequities."

Some Division III coaches and athletic directors feel the multi-level classification rule can also create inequities between schools that must compete together. Division III schools that play up in one sport may bring some unfair advantages to the other teams in their athletic programs. James Culpepper, athletic director at Worcester Polytechnic Institute, notes that institutions such as his (which plays solely in Division III) labor at a disadvantage to supposed peers when those Division III peers field a Division I team. Division I sports, even in Division III schools, have superior operations—they are "better funded and more appropriately staffed"—in areas ranging from public relations to business functions to training facilities. The crunch hits especially hard in recruiting: "There's a natural aura that goes with a successful sport that adds a luster to the other sports—and we can't add that."

Highlighting one sport may increase inequity between men's and women's sports, argues a Western Maryland coach.

George Wells

Fairness in competition is an issue. Still, the discussions in the NCAA have tended to focus on the bigger picture. As Judith Sweet, chair of the Division III Council and director of athletics at the University of California, San Diego, says, "It's a question of philosophy."

How do schools that play up accommodate the "apples and pears" programs they sponsor? A few case studies show a range of situations.

Franklin and Marshall College has been a national power in wrestling since the 1920s, says Bill Marshall, the school's athletic director, so when the NCAA went to divisions the school had to reconsider its program. As a school then of only about 2,100 students, it fell into Division III. But it wanted to continue scheduling the top-flight wrestling competition to which it was accustomed, and it enjoyed its membership in the Eastern Intercollegiate Wrestling Association, whose tournament automatically qualifies the winner for the NCAA Division I tournament.

F&M opted for Division I in wrestling, but on Division III terms. "Going in," Marshall says, "we decided that we wouldn't enlarge our coaching staff, and we weren't going to schedule anybody else that we weren't already scheduling. We weren't going to be giving grants-in-aid, and we weren't going to be giving anybody special admission consideration just because he happened to be a wrestler."

F&M recruits wrestlers—its academic departments are known in central and eastern Pennsylvania as assiduous recruiters, too—and some wrestlers receive financial aid. But, Marshall adds, "it is all given on a showing of need, based on the College Scholarship Service."

F&M generally ranks in the middle of the pack among the 16-member wrestling association. Some superior wrestlers are attracted by the Division I status in the otherwise less-pressured Division III atmosphere, Marshall says, and now and then a late bloomer arrives, overlooked by the grant-in-aid schools. Tryouts are open to all, and walk-ons (those who make the team without having been recruited) are not uncommon.

Marshall says that one of his sons volunteered for the team when, to avoid conceding points in every match, F&M needed a healthy entry in the 118-pound class. "He didn't tear the league up, but he felt good that he had tried, and his teammates accepted him," Marshall says. He doubts that such an occurrence could happen at a totally Division I school—or even in Hopkins lacrosse.

Robert Scott, the Hopkins athletic director, agrees—to a point. Lacrosse skills are so specialized, he says, "that it's almost a must today that a kid have high-school experience." Most start even younger. When Hopkins recruits, it goes out after the best players in the lacrosse hotbeds of upstate New York, Maryland and Long Island, where youth lacrosse can be as popular as baseball.

Aside from their lacrosse background, Scott says, Hopkins players look like other students on campus. The school offers them grants-in-aid, and some may score below the average admissions standards for the school, he acknowledges. But lacrosse players do not reside in athletic dormitories, or eat exclusively at training tables, or attend special courses, or drag their education out over five years—perks at many major-sports schools. "They don't stand out as a special group of roughnecks who are brought in to play lacrosse and win national championships," Scott says. "It's difficult to get through this place, but the kids make it, and they make it in normal time."

Can athletic scholarships lead to a "professionalism of spirit" out of keeping with Hopkins's academic orientation? "There's no professional lacrosse," says Hopkins President Steven Muller, "so a college lacrosse player is not on a farm club. I feel that athletic scholarships do not professionalize them and do not violate the spirit of the liberal arts education here." But if grants-in-aid were staples of the baseball and football programs, he points out, "I'd have to reassess them."

At Hartwick, athletic officials point with pride to the number of All-Americans the school's soccer program has produced, as well as the number of players who have gone on to play professionally. Jim Lennox, Hartwick's soccer coach, says that applicants with professional aspirations may choose Hartwick for that reason—and for a good education, too.

Is their budding professionalism out of proportion to the institution? "Why would it be?" he asks. "I don't think there's any difficulty as long as the soccer players are studying for a degree." He points out that last year, five players had 3.0 averages on a 4.0 scale, and the best player majored in physics. "It's fine as long as the emphasis is on the education," he maintains.

Hartwick takes pride, says Athletic Director Greene, in playing "purist" soccer, the sort seen in the more civilized arenas of Europe. The focus is on perfection of skills rather than brawn. "That's why everybody likes to play Hartwick," he says, "—it's a skilled game here."

Franklin and Marshall College fits neatly into Division III in terms of size and philosophy—and is Division I in wrestling.

One reason for Hartwick's European game, besides Lennox's coaching, is its continuing supply of English players—currently five of them, all on athletic scholarship, brought to the school's attention by an unofficial recruiting staff of former players.

"We don't ever talk about winning here, strange as that may seem," says Lennox. "What we talk about is playing the highest quality of soccer that we can. It works out that we win a lot of games because we play very high-quality soccer." And unlike most Division I coaches, he does not have to win to keep his job. "I'm a tenured professor of physical education," he says. "I could lose every game on the schedule and I wouldn't be fired. I would quit—but I wouldn't be fired."

RPI resumed playing hockey after a hiatus during World War II, when its president, a figure skater, bought a Navy warehouse and turned it into an ice rink, says Bob Ducatte, athletic director at the school. It played whoever would play, and the schedule that evolved was what RPI decided to stick with when the NCAA divisions were created—a Division I schedule.

Five years ago, the school approved grants-in-aid for hockey players. Ducatte had tried to have them approved twice previously but was turned down by the administration after the faculty objected. The third time, he says, he did "much better marketing" of the idea to the faculty, as well as to other groups. Most of the faculty remains "lukewarm," but other constituencies—alumni and student organizations—support the idea, he adds. Grants-in-aid, he says, "are part of our American heritage in college athletics."

Its hockey triumph last year presented RPI with a new problem. Six players received offers of multi-year professional hockey contracts—at sums ranging from the low six-figures to more than $1 million, according to Ducatte—and all seven signed. Four of the players were not seniors, and it is unlikely they will complete their degree work. "You can't blame the players," Ducatte says. "You'd have to work a lot of years as an engineer to make up that money."

Hopkins, RPI, F&M, and Hartwick willingly address the issues raised by their Division III colleagues about their high-powered sports. They say they steer clear

Being No. 1 in Division I basketball puts Villanova University in the national spotlight.

of feared abuses.

What about letting athletics take precedence over academics, for example?

The hockey players collectively "are not as qualified as the student body in general," RPI's Ducatte admits. But, closely monitored by the coaches, they probably have "much stricter" regulations about attending class and keeping academic pace than fellow students.

At Hartwick, senior Patrick Cruickshank, a midfielder on the soccer team, agrees that entering freshmen may feel heady about playing Division I soccer, but they are quickly brought to earth, like most freshmen, when their mid-term exam results roll in. As an upperclassman, Cruickshank takes his major courses in the spring, when he figures to have more time to devote to subjects important to him.

At Hopkins, Muller points out that no student studies all the time—and that athletes probably forego other sorts of activities in order to spend more of their non-academic time on sports. The lacrosse players "are not at a significant academic disadvantage because of the time spent on lacrosse," he says.

Faculty at the schools agree that academic abuses are few. At RPI, Annette Kolodny, professor of literature, says that she has heard "grumbling" over the fact that RPI gives hockey scholarships, but "only in passing—never with conviction or real concern."

Faculty members are proud of the team's success, she says. The players happen to be "rather sweet guys," she adds, illustrating her point with an anecdote that apparently is famous at the school: One of the players, faced with the assignment of an oral presentation in class, asked the professor if he could simply play a tape of his interview on a local television station, which was scheduled to be aired that night. "This story is told with enormous affection and good humor and with no sense that the player was trying to get away with something. He was just shy, personally," says Kolodny. She punctuates the story by observing that the professor denied the request.

Hartwick, RPI, F&M, and Hopkins deny that their Division I success gives their Division III teams unfair advantage—and they can point to the spotty success of their Division III teams as proof. On the other hand, having a Division I team doesn't necessarily mean Division III teams must do poorly. Hopkins has a powerful Division III swimming program, finishing in the top five nationally year in, year out.

All three schools feel that the Division I teams do bring their schools other kinds of advantages, however. There's national visibility. An occasional article in *The New York Times* or *Sports Illustrated*, says Lennox of Hartwick, "does create interest in the school."

Playing up also serves as a rallying point for alumni, although most schools feel that winning bears no direct relationship to fundraising. William McGoldrick, head of fundraising at RPI, suggests that the reward for development involves delayed gratification: "My suspicion is that, over time, we'll benefit from the hockey championship—it's a point of pride, a point of recognition, which will translate into more committed alumni and lead to success in fundraising down the line."

On campus, the effect of playing up can be almost therapeutic. Kolodny at RPI observes that many of the major academic subjects "are so narrowly focused that the hockey team becomes common parlance that all can share. Hockey is campus-wide permission for kids otherwise in a lab or at a computer workstation 24 hours a day to get excited and yell and scream."

How important is it, ultimately, to play in Division I? "To be honest," Hartwick's Greene says, "I don't think we could recruit the same kind of soccer team without giving scholarships." And so he perceives the proposal to eliminate the multi-level classification as a threat. "They're trying to take away something we treasure."

If the NCAA took away multi-level classifications, RPI would face a different kind of problem. The school recently invested an estimated $2.5 million in renovating its rink—the hangar is long since gone—to bring it up to Division I standards. For many years, a hefty chunk of every ticket (priced for students at $3.25; alumni, faculty and staff members, $6.25; and the general public, $6.75) will be helping to pay that off—revenue that might plummet if RPI had to play in Division III.

Playing Division I lacrosse is so important to Hopkins, says Athletic Director Scott, that if the NCAA actually forced each institution to choose a single division, Hopkins would have to think about moving up to Division I across the board, even though the move "would really almost destroy our athletic program." Keeping the sport at the level it has reached, it seems, is one of the legacies of having won 41 national championships in 102 years of college lacrosse.

Michael Carroll

At WPI, Division III sports are played across the board.

Scott suggests that lacrosse has found a justifiable niche in a school that does not sacrifice its academic integrity to it. His fellow athletic directors make similar statements about their colleges. Pointing to F&M, RPI, and Hartwick (and presumably Hopkins), Scott says, "They have that one little hoorah. If they're good enough to compete with the Division I teams, then more power to them!"

Whether working to uncover a forgery or to recover the original beauty of a piece of art, conservators are turning to materials science for help.

Science for Art's Sake

By Leslie Brunetta

Victorian men placed fig leaves over those parts of classical statues they didn't want their wives and children to see. Yet it's easy for someone looking at those statues today to assume that the leaves play some part in the Roman and Greek concepts of physical beauty.

A fig leaf may be the most blatant breach of an artist's original inspiration you'll encounter in a museum, but it's not likely to be the only one. Other more subtle transgressions are displayed in nearly every gallery and museum in the country—but unmasking them takes more than just a discerning eye. For instance, did the 17th-century painter see the world as quiet and subdued, or have his bright colors been muted by a 19th-century varnish? Did the classical sculptor intend his work to have an even, green patina, or has the Renaissance infatuation with antiquity allowed this corrosion to hide his varying shades of burnished bronze? Did Leonardo conceive the face of the Christ of "The Last Supper" as speaking, or silent, as his overpainters would have it?

"Modern conservators really make us think about objects," says Carol Faill, administrator of college collections at Franklin & Marshall College. "There's been a consciousness raising about objects' own integrity." Art and science are being used together as never before to gain an understanding of the physical and chemical properties of materials and their role in the fine arts. Whether an artist is creating a new work or a conservator is trying to restore and preserve a work hundreds of years old, the art community can use the knowledge and methods of materials science to make informed choices for the future.

"We don't at all profess to be artists," says Robert B. Pond, Sr., chairman of the Materials Science and Engineering Department at Johns Hopkins University. "But art," says Jerome Kruger of the same department, "is made of materials." Pond and Kruger, along with Robert E. Green, Jr., will offer "Materials Science of Art Objects" for the first time this spring. The course will cover nondestructive evaluation techniques, materials processing methods such as casting, and the characterization of materials properties (the nature of corrosives

and the microstructure of alloys, for example). The three expect the course's enrollment to include both engineers and artists, but think their main audience will be drawn from the local community of art curators and conservators.

"Conservators and artists need to know about materials," notes Kruger, "because they work with them every day." But for all their practical experience, many artists don't have a schematic understanding of why certain materials act the way they do—why, for instance, aluminum is softer than steel. "We'll be carrying out a dialogue between artists and materials people, trying to bridge two cultures that don't come together very often," Kruger says. "We see ourselves as offering a service for artists."

"There can be a symbiotic relationship between science, or scholarship, and art, or connoisseurship," says Arthur M. Feldman. Feldman, a 1964 graduate of Villanova University, has held positions at London's Victoria and Albert Museum, the Smithsonian, and the Spertus Museum of Judaica, and now has his own business specializing in antiques and Judaica. "Scholarship is very exacting and relies upon using known facts, whereas connoisseurship relies upon having a feel for something, upon experience of a type or a particular artist's work."

When a museum decides to have a piece authenticated, evaluated, and restored, science and art come together in a most obvious way. The process of authenticating, say, a painting is not a simple one and so will be performed only when a conservator has some reason to doubt the painting's supposed origin. This is where connoisseurship comes in: Are the colors and the brush strokes similar to those in the artist's other works? Does the signature look right? Does the varnish look original or restored? Is the composition characteristic of the artist's other work?

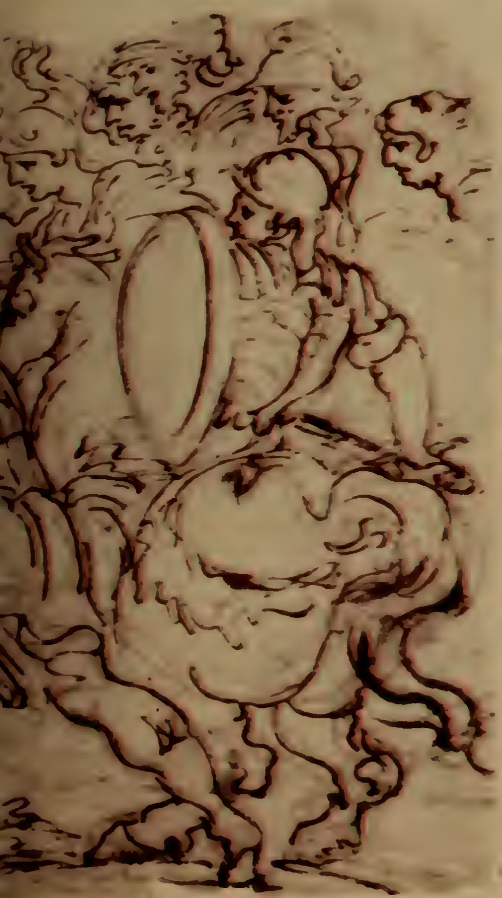
If the conservator gets the wrong feeling about the painting, it's time to turn to science. When Christine Flom, associate professor of art history and curator of the fine arts collection at Hartwick College, wants a piece authenticated and evaluated, she often sends it to the State University College at Buffalo Art Conservation Department (located in Cooperstown, NY). The Cooperstown staff and graduate students are trained in a scientific approach to art conservation.

"There comes a time when you have to rely on someone else's expertise," says Flom. Hartwick, for instance, was recently given a Baroque drawing: "We knew nothing about it," Flom remembers, "other than that it had a piece of tape attached to it naming Da Cortona as the artist. We had had a Baroque specialist look at it who said that it was very like a Foggini at the Metropolitan Museum of Art, and that it looked as though a signature had been scratched out.

"At Cooperstown, though, they were able to use microscopic and other techniques during the cleaning and restoration process. They discovered that the specialist had been right—the drawing had originally been signed by Foggini, and the signature had been scratched out. So we've gone from having a drawing that we really knew nothing about to knowing that we've got a quite valuable drawing similar to one held by the Met."

A signed drawing is usually considered to be more valuable than an unsigned one. But whoever covered up Foggini's signature had reason to believe that a drawing attributed to Da Cortona, even an unsigned one, would bring more money than a signed Foggini. Changing or obscuring a signature is probably the easiest form of forgery to perpetrate; however, it's also easily uncovered with a microscope. Unmasking more complex forgeries—works purposely made to deceive collectors—requires a greater knowledge of materials' properties.

Because some paints (for instance, lead and mercury based oil paints) block X-rays, they produce a definite contrast on X-ray film. So, by examining a painting with X-rays, a conservator can view underlayers of paint that are invisible to the naked eye. This can be an important step in authentication: a forger worthy of the name will always try to obtain materials that are contemporary with the artist whose work he is trying to fake. The best way to get a suitable canvas, then, is to paint over a painting from the period. Han van Meegeren, the infamous 1930s forger of Vermeers and de Hooghs, for instance, almost always painted on canvases dating from the 17th century. When a "lost" Vermeer showed up in Hermann Goering's collection, van Meegeren (who had sold the piece) was tried for collaborating with the Nazis in the plunder of Holland's great art treasures. When van Meegeren confessed



Some forgeries can be cracked with simple methods: A microscopic examination during cleaning of "The Rape of the Sabine Women" (left) revealed the scratched-out signature (above) of Giovanni Battista Foggini. The drawing had been attributed to Pietro Berrettini Da Cortona in hopes of gaining a better selling price.

Courtesy Hartwick College Fine Art Collection that the painting was a forgery, an X-ray examination of his "Vermeers" bore him out: underpaintings were revealed.

Even though forgers are well aware of X-ray authentication, the use of overpainting has by no means become a thing of the past. Dan Kushel, assistant professor at Cooperstown, says that every year one or two misattributed paintings (some deliberate forgeries, some with innocently mistaken identities) come through the Cooperstown center and are exposed by either X-ray, ultra-violet, or infra-red examination. (Ultra-violet and infra-red examinations work on the same principle as X-ray: the material properties of certain paints cause them to show up under either ultra-violet or infra-red light, thereby revealing underpainting.)

"For instance," Kushel says, "a painting came in recently that was supposed to be by a major 19th-century American landscape artist. With the microscope, we found some cracks that had been filled in, which made us suspicious, so we tried using infra-red light. What we found underneath was a rather insipid early 20th-century portrait."

It is in conserving art, not disproving it, that science can offer most benefits. Many of the techniques used to authenticate a piece of art are also used to evaluate its condition. X-rays can reveal cracks in stretchers, deterioration of nails, and tears in the canvas of paintings. In sculptures they can expose stress fractures, compression deformities, and the state of joints and welds. Other chemical and physical tests can also be helpful: emission spectroscopy, chromatography, and X-ray powder diffraction analysis can all help to identify the materials used in a piece and their current condition, thereby pointing the way to a conservation strategy.

Not all evaluation techniques depend on fancy instrumentation, though. "I'm a pewter biter," declares Robert Pond. Pewter is the name for any one of various alloys made up largely of tin. Tin is subject to an allotropic transformation at about 55°F—above this temperature it begins to develop tin disease, a blackish glaze which can be mistaken for other metals. But one thing about tin can't be mistaken: when tin is compressed between the teeth, it sends a squeak up through the jaw bones and into the ears. "That's tin noise," says Pond. "Then you know for sure you're dealing with pewter and what to do with it."

Knowing for sure what you're dealing with is a central tenet of the modern conservator's creed. Artists will be artists: like great chefs, they can't be counted on to stick to the recipe. "Albert Pinkham Rider, for instance," says Arthur Feldman of the 19th-century American landscape and figure painter, "made up all his own recipes for pigments. It would be crazy to treat his lead white paint like someone else's. You would certainly have to test each pigment before beginning to work on it."

And not just pigments have been fiddled with. Linda Cunningham, associate professor of art at Franklin & Marshall and a sculptor, has made use of the study of metallurgy in order to realize an artistic conception. "The image and the process are completely inseparable," she says of her semi-figurative bronze forms. "It meant a lot of research and experimenting with industrial processes before I discovered exactly which additives and how much of them would allow me to reheat the bronze and bend it the way I wanted to." The composition of Cunningham's bronze is unique. If the figures ever need to be restored, no conservator can rely upon experience with other bronzes; Cunningham's documentation of her processes as well as materials testing will be essential.

Conservators today have no desire to imitate the restorers of yesteryear, whose works include atrocious "restorative" overpaintings of Leonardo's "The Last Supper," overpaintings which are now taking years of painstaking work to remove. Restoring is no longer a process which aims to make a piece look new, but one which strives to reflect the artist's original intentions. "Modern conservators proceed very cautiously," says Christine Flom, "and anything they do to a work, they do so that it can be easily reversed." Reversing restoration means distinguishing between the original materials of a work and more recent restorative materials which have been added with the express intention that they will be visually indistinguishable from the originals. "These scientific tools enable us to weed out the truth from the fiction much more easily," says Dan Kushel.

At a conference on corrosion and metal artifacts, for instance, Jerome Kruger heard the story of a Roman bronze that was found in analysis to contain chromium. The problem is that chromium wasn't discovered until 1797—yet the piece really was Roman. It appears that at some point after 1797, the bronze had been dunked in an electrolytic bath using stainless steel electrodes. The chromium had been transferred from the steel to the bronze. The appearance of the bronze was largely unaffected, but a treatment aimed at conserving an artifact had instead added a foreign element that changed the artifact's physical character. Knowing that the chromium is there, however, conservators can now avoid treatments that might cause further damage.

A scientific understanding of chemical and physical reactions, then, can help the conservator appreciate not only which strategies to use, but also which not to use. No ideal solutions exist, but guesswork is reduced: This particular varnish will dry to a darker shade than the original on a painting; this process will convert a salmon-colored bronze patina to green; this solvent will react with original materials so as to leave behind unwanted foreign compounds.

Scientists cannot always tell what was, only what now is. Not that a simple scientific determination of what's original and what's not will suddenly determine the course of a restoration: a work of art, after all, is weighted with certain qualities that make it more than just an object. Art historians still tussle over whether the masters intended their varnishes to darken over time, over whether they knew certain paints faded over time and painted accordingly, over whether ancient sculptors intended their works to have reddish-brown or bluish-green patinas.

"There's some controversy that aesthetic judgment has been dominated by technology," says Dan Kushel. "I think that's a fake argument. Just because technology is talked about more at the moment it seems that aesthetics have dropped from the fore. But aesthetics are always the first priority for the conservator." So for conservation to be ideal, science must be tempered with connoisseurship. Writings by artists or their contemporaries can shed light on some problems; comparisons with an artist's other work may suggest solutions; knowing what it feels like to paint a picture or mold a sculpture may provoke intuitions that turn out to be right on the mark. "But science," says Dan Kushel, "can really clear up a lot of nebulous territory."

WHAT MAKES YOUR LIFE WORTHWHILE?!

In August, we invited readers to share with us their reasons for living. Some 200 readers submitted essays—thoughtful, humorous, personal, cosmic—and from those essays we had the difficult task of selecting a representative sampling. The 17 "winning" essays have one thing in common: they all make worthwhile reading.

Phil Holzinger
F&M '76
Bethlehem, Penn.

What makes life worthwhile? A weighty question, but I think I've come up with the answer. Follow these simple steps:

1. Mix together:
   —1 lb. hamburger
   —1 large Bermuda onion
   —1 teaspoon salt
   —1 teaspoon pepper
   —2 tablespoons chili powder
   —1 teaspoon cumin
   —1 teaspoon garlic powder
2. Cook above ingredients together until hamburger and onion are done.
3. Add 1 16-oz. can crushed tomatoes and 1 16-oz. can red kidney beans, then simmer for 1/2 hour.
4. Call up three friends, buy some beer, and have a party!

WHAT MAKES YOUR LIFE WORTHWHILE?!

The staff at the Beacham Adult Day Care Center, part of the Francis Scott Key Medical Center in Baltimore, asked its participants for their answers to the contest's questions. The ages of the group range from 54 to 92. Most have disabling medical problems that they have been dealing with for at least ten years. In answering, the group became an "I":

Beacham Adult Day Care Center
Baltimore, Md.

I think the most important thing is to have family and friends that I can reminisce with. So often no one wants to listen. Friends my own age can understand me. I need to feel that there is someone who really cares what is happening to me and with whom I can share my love. "No man is an island." You are my friends and my family sometimes.

Of course, when you think about quality of life, health is important, too. I try to appreciate what I have now—what I can do now. No, it doesn't always work. I wish that I could back up and start all over again. I mean appreciating things.

I can't get bogged down in self-pity. I know that other people get tired of listening to complaints. I need to be aware of the good as well as the bad—the dewdrops as well as the raindrops. That means living one day at a time and enjoying what is happening right now. This isn't easy because I often feel anxious and frightened.

When I think about appreciating what I have and can do, the things I think about may seem very small and insignificant to you. Anything in nature is exciting to me: a sunrise, a sunset, lightning during a storm, a newborn baby, the changing colors of the seasons. A loving pet would be nice. I have some happy memories. The past is important, too. Being able to paint a picture or something that someone else admires makes me feel so good. I like to laugh, to sing, to be with others, to be able to say Yes or No to something.

It worries me sometimes that I don't know whether I have enough money or even whether I have any money. Most of the time when I want something, I have to ask someone else about it. I'd like to think that I have enough for my basic needs. The nicest thing about having money is being able to say, "It's my treat!" once in a while.

"No man is an island." I like that; for me, having quality of life means not being an island. Does my answer differ from yours?

David Bailey
WPI '71
Santa Rosa, Cal.

On August 6, 1982, my wife and I were invited by our family physician to see a film called "The Last Epidemic." It was about the medical consequences of nuclear war. When it was over I thought, "My God, what have I been doing?"

As a child it was great fun to play in the attic with an old rifle and my father's World War II uniform with all the medals. As I grew older it was fun to play army and to build models of missiles and ships. In college, playing army meant learning how to polish my brass and spit-shine my shoes for Saturday ROTC drill and how to take an M1 rifle apart without catching my thumb.

My first job was more fun than building models. I was part of a team designing missile systems for the Navy. Electronic warfare was my next challenge. It required a constant effort to keep up with technology, and it was fun! But then watching that film changed my life. Preparing for war did not seem so very right, not so much fun any more. Watching that film made me realize that war today means the possible destruction of all life.

I had been living with the illusion that if there were a war between the super powers, it would happen somewhere else and my family and I would survive. I had also lived with the illusion that the leaders of the world would never use nuclear weapons even if there were a war. The third illusion was that, as only one in a population of millions, I don't make a difference. I have discovered that the individual does make a difference and that makes my life worthwhile.

The basis for hope is in changing the way we think about war. That same creative energy I used to design weapons I now use to work to end war. What makes my life worthwhile is working with thousands of others in the Beyond War Movement, educating others to the reality and challenging them to change the way they think about war. I have changed, and my life is now consistent with the truth that we are all one family.

Rita Schumann
Villanova
Warminster, Penn.

When I was a child in grade school, I thought I would make Joan of Arc look like a wimp. I would save the world. I started to mellow by high school and thought maybe I'd just work on my city. The years passed and I married and settled into my role as wife and mother. I would make my difference by raising a caring, productive family. Before I was ready, my children were grown, and a hollow, empty feeling set in. The children all chose professions to serve others and I was proud of them, but their achievements were theirs.

Now, I had to find a new challenge in my life. I saw an ad in the newspaper for volunteers. I called our local hospital and volunteered one day a week. Those days were so rewarding; the smallest kindness was so greatly appreciated. My friend asked me if I was paid for working there, and I told her truthfully, "many times each day." I then volunteered at our local prison. I was impressed by the caring staff and the rehabilitation opportunities. I was truly affected by the warmth and respect shown me by some inmates.

I learned that alcohol and drugs played a big part in their lives and took away their choice of living "the good life." I'm going to school now for dependency counseling. I won't save the world but—my world is getting better.

William H. Thornton

There is a fat, red book in the library listing the tribes that once peopled this continent. Some we massacred, like the Sauk and the Fox under Black Hawk. Most, however, perished with their habitat—human precursors of today's endangered species.

Natural habitat means more than virgin forests and unfenced prairies, and ecology means more than biological understanding. Fundamentally, it is an attitude toward our fellow occupants on a shrinking Earth. It first asks the question, "What makes life worthwhile for *them*?" and only then proceeds to "What makes life worthwhile for *me*?" The Indians who disappeared from North America forever, taking with them priceless cultures that are only dimly suggested by the artifacts my wife and I find along the Chesapeake shore, sometimes expired because life was made literally impossible for them. Far more commonly they simply lost the will to live. The great Christian hordes took away their human dignity as well as their habitat. We're left with little but the names of rivers, reaching across America like the outstretched fingers of a corpse: the Rappahannock, the Tensaw, the Chattahoochee, the Patapsco, the Kissimmee, the Monongahela, the Winooski, the Susquehanna, the Attawapiskat, the Chowan, the Patuxent, the Wissahickon, the Suwannee, the Potomac, the Apalachicola, the Umpqua, the Chicoutimi, the Ocmulgee, the Aroostook, the Wabash, the Saskatchewan, the Watauga, the Atchafalaya, the Withlacoochee, the Caloosahatchee, the Chippewa, the Owyhee, the Muskogee, the Hiwassee, the Tallapoosa . . . .

Not that long ago those names were part of the Indian Reason for Living. It got in our way, but we showed our magnanimity by keeping the names. What worthy Reason for Living replaced theirs?

The mere fact that I'm putting the question to the question indicates my status: I too am on the endangered list. Something that is natural to me, and irreplaceable, is being bulldozed. Hiking through a beautiful tract of woods marked "lots for sale," it occurs to me that I might be the last person to view and appreciate this habitat as the Piscataway and Yaocomaco knew it. Surely it was an integral part of their Reason for Living. In a way I feel blessed to have this privilege. Meanwhile, in my clumsiness, I disturb a great horned owl. It swoops just a few feet overhead. His Reason for Living, too, will have to move on, and there aren't many places left to move.

Having come to know a small part of what life means, or once meant, to the men and creatures of these woods, I'll venture just one Reason for Living that by historical accident is my own: there's a job that really must be done. Here among the lots for sale, someone has to look one last time. Someone has to give the last rites to a genuine Reason for Living.

WHAT MAKES YOUR LIFE WORTH-WHILE ?!

Ralph Allen
Villanova '83
Philadelphia, Penn.

The other night I called my prep school football coach to invite him to my class's 25th reunion. Feeling foolish, I blundered into the call. "Hello, Al Switzer? This is Bucky Allen. . . ."

"Bucky . . . Allen . . . Wait a minute . . . Bucky Allen. Hebron Academy, right?"

My ear quickened to the husky timbre of that voice. For four years it had been like grace, urging, teaching and, most importantly in my case, forgiving.

Now, as he sorted out who I was and what I wanted and answered questions about his family and his swim team, his voice set up resonances that had me all but tearful by the time I hung up.

"Okay, Buck," he said, "I'll give it my best shot."

When I entered Hebron Academy, I was badly in need of adults I could admire. Al Switzer was one of many who fulfilled this need so well during school and college that I became an English teacher. Talking with him, I discovered that what I'd thought was a dead relationship was not only alive but timeless, that if he were alive three million years from now, he'd still be willing to give it his best shot to help an old friend get a reunion off the ground. I'd do the same for many of my students. You can't be involved in teaching long without becoming aware of a mysterious sense of vocation which, borrowed from all your previous teachers and tailored for your own use, you pass on willy-nilly.

Mentors may carry you through the novitiate vows of honesty, unselfishness and restraint, but the best trials throw you back on your soul. Some years ago during a particularly demoralizing administrative shift, I had a dream: I was headed down a dirt road to go fishing in a pond a mile or so behind my grandmother's house. On the way I met the football coach from my present school with a string of fish like silver rainbows. He pointed off the road to a tree dazzling with fish among the leaves, each fish marked with a rainbow. It was a glorious, frightening image, at once threat and challenge, because I knew instinctively that, though every rainbow was a sacrifice, avoiding the tree was dangerous. I came to see the fish-filled tree of my dream as tree of knowledge, tree of life and cross, the fish as daily sacrifices stamped with the rainbow sign of Christ, the covenant fulfilled.

Intimations of the eternal have enriched my life, given it meaning, showed me the way. Al Switzer's care, the poets' vision, and all the untold influences of God's love have woven from things of this world an eternal realm that makes my life worthwhile.

Austin E. Gisriel
Western Maryland '79
Frederick, Md.

At first I was going to be a great athlete. The one drawback was that I had no talent. Then I chose to be a great philosopher and amaze people with my deep understanding of the human condition. Finally, I decided that I would become a great writer. I would get a job and write in my spare time, and eventually I would become great. This plan hit a snag. I now find that I don't have time to change the sheets, much less the world.

I began to realize that there are several practical impediments to achieving greatness: First, one must be well rested in order to pursue it—sleeping takes up one-third of my 24-hour day. One must also support oneself while waiting for greatness to descend, so there goes the second third of the day. Preparing, eating, and cleaning up after three meals per day takes another three hours. Thirty minutes per day to read the paper. Dressing and shaving and showering and brushing my teeth requires about an hour. A couple of hours out of the 24 interacting with my wife. Various tasks such as folding the laundry and taking out the trash and making the bed and balancing the checkbook require an average of 20 minutes per day. By the time I exercise a little and relax a little (you can't achieve greatness if you are tense), I'm left with about 10 minutes per day to devote to ensuring my immortality.

As I mulled over this daily schedule, I drew two inevitable conclusions. The first is the simple fact that 99 percent of one's life is taken up with the mundane. The second: Greatness is fleeting. These conclusions lead to one big conclusion. If life consists almost entirely of the mundane, and greatness is such a temporary condition, then pursuing greatness isn't such a great idea after all.

The real joy of life comes from the commonplace. A very wise philosopher (in fact, I think it was my father) once said that it's the little things in life that count. Little things, like watching the seasons come and go or listening to the ball game on a summer evening or sharing a laugh with my wife as we discuss some trivial matter at the dinner table, mean nothing to the world at large, but they mean everything to this one member of the world. I'm not always obnoxiously happy, and I don't go around telling folks to look on the bright side, because many times there isn't one. But I am content with life, and I suspect that's a claim not many people can make.

Wayne G. Hupfer
Villanova '66
Richmond, Va.

Until recently, I would have said that we should act in our own interest, toward the achievement of well-defined goals, and based upon a knowledge of ourselves. Two years ago, however, I married for the first time at the ripe old age of 39. Having been single all my life, I had let my lifestyle become extremely ordered, predictable, and, increasingly, unsatisfying. I had allowed myself to become bored, lonesome, and, like many single men, incredibly selfish. I had difficulty understanding the reasons for my dissatisfaction—I had, after all, gotten most of the "things" I thought I wanted in life. What was missing was simply a sense of belonging to something—and someone—beyond myself.

Ultimately, this is the most enduring achievement in my life, the gradual realization that all of our lives, particularly the lives of those closest to us, are inextricably bound together, and that each of us has the ability to contribute to and enrich the lives of others. It is as though the sum total of all of our lives represents one huge canvas, too vast for the human eye to see, too complex for the human mind to comprehend, yet capable of change through the positive acts of individuals. It is this understanding that for me makes life worthwhile.

A. Zoland Leishear
Hopkins '84
Lutherville, Md.

Unequivocally, the answer is blue shirts. What feels better than pima cotton? When it's blue, it picks up a luxuriousness and richness unparalleled in natural fabrics. Line dried and starched, what scent delights the senses more? And blue becomes most people: it enhances a tan and mitigates a winter pallor. It looks good, feels good, smells good; it is a little treasure.

But I think that the meaning comes as much from the blue as from the shirt.

As a small child, I was dedicated to the Blessed Mother. All it entailed was wearing blue and white until the age of seven. But those colors represented the possibilities of this life, of what a woman could be. Mary seemed to me a woman of wisdom, courage and strength. She took life head on and tempered it with gentleness and kindness. I should do so well.

When I was seven, my mother asked me what color coat I would like now that I was no longer required to wear blue. But it was too late. By then I was a hopeless academic and blue was the color of the September sky. It was the excitement of learning, the thrill of a challenge, the pleasure of a fresh start.

When I was 25, a friend gave me a blue ratcatcher upon which she had embroidered a small white fox. Many years later when my life had changed dramatically and was marked with financial reversals, serious illness and the loss of a loved one, I had occasion to have lunch with that friend. We brown-bagged it and sat on a bench unable to hide the sadness that had crept into both of our lives. That morning in a fit of disgust at not having anything new to wear, I had rummaged through my closets, discovered that old shirt and resurrected it with soap and starch. I saw my friend notice the shirt and break into a laugh that I should have that old relic. From there we went into a review of the 20 or so years we had known each other, all the stupid things we had done and all the fun we had had. We left each other feeling that as long as there were moments like this, we could survive anything.

I wore a blue shirt when I got my first car, signed my first contract, took my first and then my last exam at college. I wore them through my mother's operations (which she survived), and through IRS interviews (which I survived). The difficult times are behind me now but the blue shirts are not. A couple of months ago, my washing machine broke and I was too busy to get it fixed. A friend of mine, noticing my less than fresh appearance, suggested that I use hers. My clothes hung on the line to dry: "My God," she said, "don't you own anything but blue shirts?" I looked at the line and smiled. They moved in the breeze like the winged creatures of memory they are.

WHAT MAKES YOUR LIFE WORTHWHILE ?!

Christopher Beyers
Western Maryland '84
Washington, D.C.

There are two things which make life worth the trouble: wonder and possibility. Wonder comes from simply keeping my eyes open, experiencing the constant mix of the logical and irrational, the surprising and the mundane.

Since I see no certainty of events, there are always possibilities. Because of these possibilities, no matter how rotten things are right now, I can always imagine that soon things will be better. In fact, I can easily imagine that soon they will be great, even greater than I can imagine. Everybody knows some schlepp who, through sheer chance, is doing the very thing you think you should be doing. Furthermore, there is no reason that the same dumb luck that struck him shouldn't strike you.

Milton J. Dinhofer
RPI '45
Roslyn Heights, N.Y.

My goal is to maintain through the rest of my life the same physical, mental and social activity that I maintained when I was 30 years old. Now you can start laughing.

Twenty years ago, I was visiting a friend who had just put in a new swimming pool. He was a doctor and several of his doctor friends were there with their children. One of the sons dove in and started swimming laps. I dove in next to him and we stayed together for 50 laps at a fairly good pace. When I got out of the pool, the doctors pounced on me with ridicule: "Don't you know you are over 40? When you're over 40 you shouldn't even walk up a flight of stairs."

The pendulum has swung a long way since then, but I still get a lot of flak. I have been racing high performance catamarans for the past 10 years. When I attend the regattas and race there is always someone who will chirp, "Aren't you a little too old for that?" This year I finished seventh out of 60 entrants in my division for the northeastern championships. The competition ranged in age from 16 to 62.

If your body is sound your mind will have little trouble keeping up with it. I intend to maintain very close to the same working pace that I did 30 years ago with one exception. I will no longer worry about putting away for my old age.

Sondra Markim
F&M
Woodcliff Lake, N.J.

If onlys" postpone life. This—this very this—is all there is.

Yet most of us live for the future all the time, illustrated in so minor an example as what I call the five-pound syndrome. I know that I am not the only woman who has spent her life believing that, "If only I'd lose five pounds, I'd be happy." I am a reasonably intelligent, mature person, yet somewhere in the back of my brain exists this niggling certainty that once I achieve a weight goal, some vague, wonderful part of life will commence.

When I was a child, my grandmother kept all her furniture under plastic. When I asked her why, she replied that she was saving her furniture "for good." My grandmother was 76.

This is not to advocate a life of squandering or instant gratification. I adhere to policies of preparation and deliberate care. But I also maintain that we all overlook the "now." To embrace the gratifications inherent in the little everyday moments, be they walking in the brisk, fresh, autumn air, conversing with a friend, laughing with a child, solving a problem, doing a small job well, easing down into a soothing bath, laying your head on a pillow or reading this. Of course I still have dreams. I imagine cradling future grandchildren, traveling to Timbuktoo . . . but I know that it is this moment that is mine, writing this now, enjoying communicating.

There are no plastic covers on my furniture. And that's fine.

Tom Lashnits
F&M '71
Mt. Kisco, N.Y.

I get a rush of satisfaction when I realize I've accomplished something. And the sense of accomplishment is in direct proportion to my ownership of the project. Something I've done by myself, or with a small group of friends or colleagues, is much more soul-satisfying than any large project in which I've only played a bit part. The job can be as trivial as sweeping a floor or vacuuming a rug: before it was dirty, now it is clean. Very simple, very direct, very understandable.

When I see my name on top of an article I've written, I can say to myself: There's a piece of work I've done, and it is printed in a real newspaper or magazine for real people to see—to read, judge, admire or criticize. In a way it doesn't matter whether they like it or not. The important thing is that it exists as a unique entity. It's concrete, and I can point to it and say: "Look at that. There's something I alone made. Before, there was nothing; now there is something."

Another peak moment occurs when I hit a perfect golf shot. A "sweet" shot. After all the practice, all the bearing down, all the self-criticism, it's suddenly, magically, so effortless. There's a perfect sound to it, just a click, and the resistance of the ball is so negligible you can barely feel it. And you look up into the sky and the arc of the ball is a beautiful thing to behold, as the white dot heads exactly where you'd envisioned it would go. For as long as that ball is in the air—perhaps as long as five seconds—all is right with the world.

The question, "What makes your life worthwhile?" prompted The Rev. Stephen W. Tucker to preach the following sermon at the First Congregational Church of Otsego, Michigan:

Stephen W. Tucker
RPI '58
Otsego, Mich.

My answer has changed over the years. It perhaps changes every so often. When I graduated from college some 27 years ago, what made my life worthwhile was a whole exciting future—a new job, money coming in, dreams of marriage to Marie, traveling around the country—most of those dreams intensely personal. I believe that is probably true of most younger folks right out of college—"Watch out world, here I come."

In the 1960s we began to get extremely active in the First Congregational Church of Cheyenne, Wyoming. Teaching Sunday School, serving on the church boards, taking our turns in the nursery as parents with that age children. I don't know that I ever asked myself the direct question, "What makes my life worthwhile?" But, as the ripe old age of 30 crept closer I began to look at some of my fellow engineers. What made life worthwhile for them was the possession of things (bigger and better homes and cars). Or sports—one of my friends was in three or four bowling leagues each week—his wife was upset at his being gone all the time and she was stuck home alone at night with their children. (Come to think of it, maybe that was why he was bowling so much.) Most enjoyed partying and liquor and their idea of a good time was getting pie-eyed on weekends. Few attended church.

And perhaps subconsciously I began to think, "Is that where I am going?" "Is that all there is?"—as a popular song went a few years ago.

Then, the Lord tapped me. Goodbye engineering and Cheyenne. Hello seminary, study, work, Massachusetts. It amazed me that many of the younger students in seminary had no idea what they wanted to do when they graduated.

After seminary came the first church I served. Right here in Allegan County—The First Congregational Church of Saugatuck. "What made my life worthwhile?" My answer was changing. Oh, it was somewhat personal; could I hack it as a pastor? Put up with the church boards? But I began to see that people needed an anchor, something to hold onto in the everyday struggles of life. Was there any hope in this mad world's race—often ended by accidents with their sudden deaths, or bodies racked by disease? Was what made life worthwhile just looking out for No. 1?

My answer was changing. The scriptures became more and more real to me. "Hey folks"—I wanted to shake them—"Don't you see? Don't you hear? The stories of the Bible are true! The hymns we sing are the truth! Don't just mouth the words on Sunday and then go out and cheat in business. Don't give less than your best. God loves you! He has called you! Jesus really did live, suffer, die, rise again for you and me!"

And trying to tell and show the people of our Sister Church in Saugatuck made life worthwhile and challenging. The dear folks of Saugatuck responded—they chipped back at several of the rough edges I have. Some began to dream dreams they hadn't before. Some changed their lifestyles and felt also the pull of God on them. Those were, in some ways, frustrating years—hard years. But I am glad a tenth of my life or so was spent there in that effort.

What makes my life worthwhile

today? It is to give you hope that God loves you; that there is life after death; that God wants us to do our best; that we can lift our eyes higher and look outside of ourselves; that there is more to life than winning the Michigan Lotto, or booze, or self-gratification. To see you caring for one another, laughing, playing, crying, encouraging, comforting, hugging one another—makes life worthwhile for me! To be able to tell you, with absolute sincerity and no doubt of its truth, God's word from scripture and to see and hear you asking and searching and praying about the future and dreaming and hoping about what God wants you to do with your life—makes life worthwhile for me. To be an encourager—to be able to laugh with you and cry with you—to hug you in joy and sorrow—makes life worthwhile for me.

Morris Moshe Cotel
Peabody Conservatory
New York, N.Y.

Time is the commodity that musicians deal in. We also live in it, of course, like everyone else, and there never seems to be enough time available to accomplish all the things that cry out for our attention. Our activities push us onward and we find ourselves lunching on the run, glancing at watches, hurtling through time, racing from task to task, whirling from here to there, pushed, pulled, jolted, spun around and around by family, career, ego, muse, God.

Stop the clock!

Actually, I stop the clock every week. On Friday evening, in my mind's eye, I always see a silver fermata rising in the sky. It's Shabbat—the Sabbath—and for the next 24 hours the world is on hold while there is release from the prison-house of time. I do not perform on Friday nights. I am freed from the struggle for existence. Life becomes filled with the presence of wife and children and friends, prayer and meditation, walks in the park, and quiet listening to the inner sounds of living.

To those who say that a musician must be professionally available at all times, I can only respond that music is not a religion, and that for all that it enhances life it cannot teach one how to live. But music and religion *together*—these support a worthwhile human life.

Every day, in my central prayer—"Hear, O Israel . . ."—I strain to hear the Voice. Every day I listen for it in the words of the prophets. Every day I listen for it in the fugues of J.S. Bach. (He said, "The aim and final reason of all music should be nothing else but the glory of God and the refreshment of the spirit.") The sound waves are carrying the message right now that will open the doors of perception, that will lift up the gates of the world.

What, then, makes life worthwhile? Lots of things, but they all come from the same root: music, religion, self-knowledge, a devoted mate, precious children, true friends, good deeds, acts of kindness, justice/mercy/humility (the big three), hard work, good times, heartfelt performances, and also solitude, meditation, slow practice (it's good for you!), not giving up, and forbearance.

It seems strange that some or even much of this grows naturally out of the process of developing a well-trained and disciplined inner ear. But such an ear can pick up and lock in on that soundless sound. It can cause you to turn again and again in the direction of the Voice.

Edward S. Collins
Hartwick '70
Niskayuna, N.Y.

I cannot count the number of questions that I get every day from my 4-year-old daughter, Briana, and my 7-year-old daughter, Amanda. They are so very curious, as children should be. For them discovery is exciting.

We should all feel that way, but many of us forget how much the act of being curious adds to the quality of our lives. As adults we are supposed to have answers. We "advance" in our "careers" by virtue of our ability to "tackle" problems, to find "solutions" or "answers." No one gets "anywhere"—wherever it may be—by virtue of having a basket full of questions to distribute, like a little girl giving away a basket full of wild flowers. I've yet to hear anyone say, "Gosh, he's really brilliant. Listen to the questions he asks!" or "We've got to have her on board, J.P. That woman has all the right questions."

We have forgotten what it's like to see our own world—as different as it is for each of us—as a child sees it: with a hundred zillion things that are bigger than we are and every one of them uniquely amazing.

The quality of our lives can be measured every day by how we approach our lives: from a self-assured position of illusory omniscience or with a child-like posture of curiosity. After all, whatever we know at any given moment pales next to the secrets that life still holds.

Ann Weinstock Joseloff
Western Maryland '65
Silver Spring, Md.

Because of the intense work I do as a professional member of a hospice home care team, I find my view of the quality of life very different from when I was a college student. Then my reasons for living were being an "A" student, achieving, planning a future, succeeding, working for tomorrow.

Today, quality of life for me equals time. Whatever we possess can be taken from us—including our beloved family and friends. The one thing we can possess until death is the time allotted to us.

I value the time I spend watching my children smile and my husband sing. The precious time reading in the late night hours, after busy days of constant errands and demands. Time spent being with a treasured friend, hearing the tone of voice and watching the dancing hands as we share minutia of our lives. Time to smell the air, feel the sun, and watch the trees bend gently in a breeze. And laughter. When I laugh from inside out, I am refreshed, revitalized, and strong.

I value the time I spend with the hospice team. The terminally ill patients have taught me so much about time. They review their lives, sorting through, finding the valued, and completing the business of living. They have taught me never to forget to say, "I love you," "thank you," or "you are special." I do not waste time putting off telling people how important they are to me.

I do not leave parts of my life undone—I use my time to complete the areas of living I have begun. Life is fragile—I take no chances that I may not return to finish a task.

I think about tomorrow only in how my time can best be spent. Those who are dying do not worry about another day, and I have learned that we are all dying.

Time must be spent really living—tasting, feeling, smelling, seeing, hearing. The day does not have to hold a unique event to be special. It is special because I have the privilege of being here.

More than a little something for everyone!

Alfred Barry, Jr. '77 (far left), with son Matthew; melting into the crowd (center), President Jon C. and Jean Strauss could almost be seasoned WPI sports fans; Alumni Association Paul Bayliss '60 (below) and wife Joyce greet a friend at the Alumni Fund reception.

President Jon C. Strauss (R.) with Richard B. Kennedy '65 (L.), Citations Committee chairman, and Washburn Award winners Judy Nitsch '75 and Paul N. Varadian '75. The award is given for outstanding professional achievement by young alumni.

Nitsch is vice president of Allen & Demurjian, a Boston consulting civil and structural engineering firm. A registered Professional Engineer in 12 states, Judy is president of the Society of Women Engineers, Boston Section, the 1984 recipient of the ASCE Edmund Friedman Young Engineer Award, as well as vice chairman of WPI's Alumni Publications Committee.

Varadian is president of Trans-Continental Development Corp., a Boston real estate firm specializing in revitalization of historic properties and inner-city renovation projects. He is also founding director of both Summit Group, a Boston financial planning company, and RETEC Associates, a real estate consulting firm. Paul is past vice president of the Boston Alumni club.

HOMECOMING 1985

Photos by Michael Carroll

Homecoming '85 had its share of receptions. Above, C. John Lindegren, Jr. '39 (far right) offers congratulations and thanks at a reception for Alumni Fund volunteers, who helped push the Fund to an all-time record of $1,063,017. Below right: John Greenstreet '75.

At Alumni Field (above), Sterling Junction's (MA) Dan Coakley '85 tore up the Tufts line all day—with a little help from his friends. Below, help from some other friends: Class of 1975 families and President Jon C. Strauss (standing, left) gather for the camera during the presentation of the class gift to the college.

Above: Next year, victory at Institute Park might just turn to defeat for these eager freshmen.

A relaxed Bar-B-Que on the Quad. The weather couldn't have been better for this Homecoming event.

Inductees to the WPI Athletic Hall of Fame before a capacity Homecoming Day crowd on Alumni Field. (L. to R.) John J. Korzick '68, Charles F. Schmit '46, Richard D. Ferrari '51, Mrs. Percy Carpenter, widow of WPI's first athletic director, Fred I. Dipippo '60, and Victor A. Kolesh '41, who accepted the award posthumously for classmate Elmer T. Scott.

The inductees' scholastic credentials are remarkable, their naming to the Hall most deserved:

KORZICK. *Winner of seven varsity letters in three sports:*
- *Football, one of our greatest quarterbacks ever, earning three letters.*
- *Three-year letterman in lacrosse.*
- *Letter in wrestling.*
- *Lives in San Ramon, CA.*

SCHMIT. *Seven letters in three sports:*
- *Three in football as both an offensive and defensive back.*
- *Three in basketball, captain of the 1945 team.*
- *One in baseball.*
- *Member of Skull, Phi Gamma Delta, the Athletic Council.*
- *Lives in Westfield, NJ.*

FERRARI. *Eight letters in two sports:*
- *Running back in football, earned All-New England honors in 1950, co-captain as a junior.*
- *One of the best outfielders in New England.*
- *Class president as a junior and a senior.*
- *Member of Skull, Pi Delta Epsilon, the journalism honor society, sports editor of* Tech News.
- *Lives in Wilmington, DE.*

CARPENTER. *WPI's first athletic director, from 1916-52.*
- *Established physical education as a required course of study, a practice that exists to this day.*
- *Advocated the importance of team athletics as a means of developing sportsmanship, fostering college spirit, and nurturing the competitive drive.*
- *Died in 1960.*

DIPIPPO. *Winner of four varsity letters in basketball.*
- *First WPI player to reach the 1,000 point plateau.*
- *Co-captain in the 1959-60 season.*
- *Infielder on the baseball diamond.*
- *Member of Skull, Athletic Council, Varsity Club.*
- *Class president for three years.*
- *Lives in Enfield, CT.*

SCOTT. *Eight letters in football and baseball.*
- *Center and linebacker in football, played a vital role in the undefeated 1938 season.*
- *Four letters in baseball.*
- *Member of Skull, Athletic Council.*
- *Senior class vice president.*
- *Died in 1966.*

WPI Alumni Association
President, Paul W. Bayliss '60
Senior Vice President,
Richard B. Kennedy '65
Vice President, Alex C. Papianou '57

Past President, Harry W. Tenney, Jr. '56
Executive Committee
Members-at-Large
Henry P. Allessio, '61
Walter J. Bank, '46
William J. Firla, Jr., '60
Patricia A. Graham Flaherty, '75

Alumni Fund Board
Allen H. Levesque, '59, Chairman
Edwin B. Coghlin, Jr., '56
David B. Denniston '58
Michael A. DiPierro, '68
William A. Kerr '60
Bruce A. MacPhetres '60
Francis W. Madigan, Jr., '53
Stanley P. Negus, Jr. '54

1914

Arthur Torrey writes that he is 94, a Mason, and a World War I veteran. Currently, he resides at Elim Covenant Home in La Crescenta, CA.

1926

Reunion **June 5–8, 1986**

1929

Hal Pierce may be officially retired, but unofficially, he's more active than ever. For instance, he is vice president of a family-help group called Adopt-a-Family of Manatee County, FL, president of the Florida Fellowship of Community Churches, budget manager of his Anna Maria church, and a member of the board of directors for Manatee Religious Services. He is also on the missions commission of the International Council of Community Churches and a four-year member of the Anna Maria planning commission. Previously he was involved in the mission activities of Roser Memorial Community Church.

During his professional career, Pierce was responsible for creating planning systems at New England Electric System that will be in use through the year 2000. After retirement in 1972, he continued to do consulting work for New England Electric for five years.

1931

Reunion **June 5–8, 1986**

1933

Barbara and **Allen Brownlee** left the experience of October's Hurricane Gloria, which felled several large trees on their property, barely missing the house, only to feel the results of another one, Waldo, off the Mexican coast during a cruise from Acapulco to San Francisco. Waves up to 30 feet high caused more than a few people, including Barbara, to miss dinner that night. The weather was better during their exciting stay in Frisco, where it was "Fleet Weekend" with the Blue Angels doing their stuff over the Golden Gate Bridge.

Those who go back to WPI for Old-Timers' meetings often see **John Dwyer,** who as committeeman for our 50th reunion did such a good job with refreshments at our hospitality suite. Some may not know that John worked for the Worcester School Department for many years, and that he was director of Vocational Tech High when he retired. He and his wife, Grace, live in Shrewsbury, where John helps Grace with her antiques business, which she has run for many years.

Since **Robert Fulton**'s wife, the former Ruth Coan, published a book on her family genealogy, she has been besieged with letters and calls from other descendants of ancestors bearing the Coan name. Consequently she is writing a supplement. She is also researching her husband's ancestry. We hope your namesake, the inventor of the steamboat, is among them, Bob!

Gil Gustafson, who is confined to the Brookfield Health Care Facility in West Hartford, CT, is visited regularly by his fraternity brother and former roommate, **Ed Johnson. Al Brownlee,** a close friend of both from Sanford Riley days, recently visited him with Ed and is happy to report that Gil is physically in good health and thoroughly enjoyed talking about the good times they had at WPI.

After the Blue Jays were defeated in the American League Playoffs, it seemed an appropriate time to contact and console **Ed Perry**, who lives with his wife, Jean, near Toronto. Many Blue Jays rooters were disappointed, but Ed said their fans would remain loyal even though he knew of no genuine Canadians on the team. Ed received his postgraduate degree from the University of Toronto, and recently was on the committee for his 50th reunion there. In 1962 he left as manager of a gold mining company in Timmins to become managing director of the Ontario Mining Engineers' Association. He finally retired in 1972.

We have learned that Bob Saltmarsh, who is the son of our classmate, **Warren Saltmarsh,** has been named treasurer of Apple Computer. Warren and his wife, Gail, live in Avon, CT, but spend most of their summers at their place in New Hampshire.

Bill Slagle and his wife, Harriet, have returned from a two-week tour of the West Coast, including San Francisco, Yosemite, the Hearst Castle, Hollywood, San Diego, Las Vegas, the Grand Canyon and Boulder Dam.

Bill says he's still enjoying retirement, but agrees with a number of his classmates who feel that they're busier now than when they were working for a living!

Chester Spielvogel, superintendent and treasurer for the Southbridge (MA) Water Supply Co., says he's getting a lot of razzing these days. He can't find water on the lot where he plans to build a new home, not even after burrowing 865 feet into the ground and using 21 sticks of dynamite. He laughs, "Here I've been in the water business for 50 years and I can't get water for myself." He's decided the best solution may be to hook up with the town water system!

Gene Teir continues as engineer for Athol and Gardner, MA, a post he has held for 32 years. He makes use of his experience by taking on design jobs related to town services and regulations for housing projects, shopping malls, etc. Gene would like to hear from **Art Glow** and **Jack Keefe.**

Ralph Voigt and his wife, Jan, report they are in good health, and were happily involved in the recent marriage of their only daughter. Her wedding and honeymoon were in New England, but a second ceremony was performed in Hawaii, where she resides. The second ceremony was attended by her parents—their fifth visit to that beautiful state! The Voigts have two married sons and one grandchild.

The **Gordon "Buck" Whittums** were profiled in a recent issue of their church bulletin, "The Parish Visitor," in Orleans, MA. It notes that Buck's first job was with the New Hampshire Highway Department, working on the design and construction of bridges. Later, at American Steel and Wire Company, among other things, he was involved with the construction of the famous passenger tramway at Cannon Mountain in Franconia Notch, NH. During World War II, he was transferred to the company plant in Trenton, NJ, which made steel and steel products, including arresting gear cable for aircraft carriers. In 1971 he retired as chief engineer from U.S. Steel Corporation (formerly American Steel and Wire) in Worcester. Both Buck and his wife, Kay, are active in community affairs. For the past ten years Kay has been a volunteer worker with the Association for the Preservation of Cape Cod.

Al Brownlee, Class Secretary

1935

Harold Vickery of Gloucester, MA, has been director and vice president of Winning Hoff Boats Inc. since 1976. For 36 years he was an industrial engineer with Norton Co., Worcester, from which he is retired. He has been a local selectman, fire engineer, planning board member and personnel board member. He has also served as an officer in the Worcester Engineering Society and the Worcester chapter of the American Institute of Industrial Engineers. Interests include boating, rock hunting and bird watching.

Max Voigt underwent open heart surgery for aortic valve replacement and a by-pass in 1983. He was a senior engineer for American Bosch Corp. prior to his retirement. His hobby is amateur radio.

Douglas Watkins's main hobby is painting watercolor landscapes. He belongs to the Northern Vermont Artist Association. In 1936 he joined U.S. Steel in the Electrical Cable Works Engineering Department. In 1972 he retired as chief cable engineer. During his career, he was a registered professional engineer, a member of the IEEE, a vice president of the Insulated Power Cable Engineers' Association, a member of the American Iron and Steel Institute's Committee on Steel Electrical Raceways, a member of the American Society for Testing Materials' Committee on Electrical Insulating Materials and a member of The Engineers' Club of New York City.

Harvey White of Charlotte, NC, is a former city councilman, past president of the Charlotte Sales Executives' Club, church deacon and Boy Scout commissioner. He continues to be active in church and community work, as well as consulting work. During his career he has been a risk consultant and risk manager in the fire insurance industry. Employers have included Kemper Insurance and Factory Insurance Association.

Surprise Knowlton Memorial Gift to Fund Scholarships

Bernard Knowlton never attended college, but when he died last February, his widow, Mrs. Marie Knowlton of Worcester, gave WPI a $10,000 gift as a memorial.

"My brother, Ernest Bloss [deceased], was an electrical engineering graduate with the Class of 1918," says Mrs. Knowlton. "He was our closest connection with WPI, and he always spoke highly of the college. My husband also held the school in high regard. It was his intention to remember WPI in his will."

In accordance with Mrs. Knowlton's wishes, the $10,000 gift will be used for scholarships (The Bernard N. Knowlton and Marie Bloss Knowlton Scholarship Fund). "Bernard liked young people," she reports. "He spent many years lecturing to school groups."

Roger N. Perry, Jr., '45, director of public relations at WPI, recalls that when he was a high school participant in a youth news radio program, he interviewed Bernard Knowlton, who at the time was an inspector for the State Registry of Motor Vehicles. "He was very knowledgeable about highway safety," says Roger. "And he had a fine rapport with students."

When Mr. Knowlton retired from teaching highway safety in 1955, he and Mrs. Knowlton traveled and remained active with a number of clubs, including the AARP and the Grange. They also enjoyed their big old house on Brattle St., where Mrs. Knowlton had lived for nearly 80 years.

"We planted evergreens and tended the vegetable garden," she says. "In the summer we'd sit out front under the maple tree."


Worcester Telegram & Gazette, Inc.

Marie Bloss Knowlton

Roger Perry reports that in later years when he was a guest speaker at various local clubs, he'd occasionally run into Bernard Knowlton. "He was interested that I worked at WPI and mentioned that he thought it was a fine college. I had no idea that he might one day fund a scholarship."

Last winter, carrying out her husband's long-standing wishes, Marie Knowlton established the scholarship memorial. "Bernard would be pleased to know that his money was helping to further the education of young people," she says.

In 1980 WPI gave **"Plum" Wiley** the Herbert F. Taylor Award for distinguished service to the college. For many years he was involved with Alumni Fund drives, student recruiting, the Alumni Council, and local alumni chapter activities (officer). He and his wife, Jean, travel extensively, then give travel talks illustrated with their professional-type slides. They collect American Indian artifacts, automobile license plates, coins and stamps. For nearly 40 years Plum was with the Chesapeake and Potomac Telephone Company in Baltimore, MD. In 1975 he retired as traffic engineer of Central Office Equipment.

William Wyman retired as a general report writer with the Office of the Secretary of Defense in 1973. Earlier posts had been technical report writer in the same office, civilian engineer with the Navy Bureau of Ordnance, and claims adjuster for Fidelity & Casualty Co. He received the Secretary of Defense Meritorious Civilian Service Award. For many years he was active with organizations in the Washington, DC, area, including the WPI alumni chapter (officer). Other interests were Scouting, Red Cross and the United Fund. "Have served as a guinea pig for the Gerontology Research Center, National Institutes of Health, Baltimore, for 20 years." He recently "unloaded" most of the coins he's collected since he was a child, but still has about 10,000 old postcards on hand.

1936

Reunion **June 5–8, 1986**

The **Jack Brands** recently moved from Wilmington to Hockessin, DE.

1939

Leo Douville, who retired three years ago from Du Pont, says that during the winter he still works for the firm on a part-time basis. "In the summer we have our home at the seashore." His wife is active with senior citizen programs.

Warren Hardy, now retired as the owner of Hardy Home Engineering, Scituate, MA, currently resides in Tucson, AZ.

1940

Rolfe Johnson is an engineer-at-large in Jamaica, VT.

P. Warren Keating has been named chairman of the board of directors of Safety Fund Bank, Fitchburg, MA. He is chairman of the board of P.J. Keating Co., Lunenburg, and is a member of the board of Fitchburg State College, the Fitchburg Public Library, Fitchburg Mutual Fire Insurance Co. Inc., Burbank Hospital and Catholic Social Services.

1941

Reunion June 5–8, 1986

1942

James Sheehy of Rutland, VT, is a consultant in the field of statistical process control.

1944

Newt Burr continues as a management consultant with Profit Management Development Inc., Barrington, IL.

Douglas Noiles has been presented with the Eli Whitney Award for 1985 by the Connecticut Patent Law Association. The award is presented annually to a person having an association with Connecticut who has made a significant contribution to law or science. Noiles is co-founder of Joint Medical Products Inc. of Stamford, CT, where he is vice president for technology. The former vice president of engineering at United States Surgical Corp., Norwalk, he was instrumental in that firm's development and marketing of surgical staplers. He has been issued 45 U.S. patents in such diverse fields as medical products, automatic production equipment and electronics, more than half of which have been developed commercially.

1945

Philip Tarr, general manager of Thermet Inc., Rockport, MA, recently received the Distinguished Service to Powder Metallurgy Award from the Metal Powder Industries Federation during the 1985 Annual Powder Metallurgy Conference & Exhibition in San Francisco, CA. The award is presented to individuals who have devoted more than 25 years of their careers to powder metallurgy. Before joining Thermet in 1981, Tarr had been associated with the PresMet Corporation and Kwikset Powder Metallurgy Products. He was a founder of Midwest Sintered Products. He is a former president of the Chicago section of the American Powder Metallurgy Institute, the Powder Metallurgy Parts Association and the Metal Powder Industries Federation. In addition, he is a member of the American Powder Metallurgy Institute and the American Society for Testing and Materials.

1946

Reunion June 5–8, 1986

1949

Sidney Madwed has begun a new career as a public speaker and a seminar leader. He speaks nationally conducting seminars on self esteem, stress control and getting what you want out of life by using universal principles.

1950

Carl Ackerman, polymer composites product specialist at Rogers Corporation, Rogers, CT, has been named the recipient of the annual Arnold H. Scott Award by the American Society for Testing and Materials. He was honored for outstanding achievement in the science of electrical insulation by the ASTM Committee on Electrical Insulating Materials at ceremonies held in Norfolk, VA. Prior to joining the Rogers Corporation in 1980, he worked for the Keene Corporation and Superior Polymers Company. His career in dielectric materials has emphasized paper, mica, resins and laminates for power apparatus, including wire, cable, generators and transformers. Ackerman is a member of the IEEE and the Technical Association of the Pulp Paper Industry.

John Converse is a professional engineer with the Florida Department of Health and

R. J. Ventres Named President of Borden

Romeo Ventres '48 CHE has been named president and a director of Borden Inc., a consumer products and chemical company with annual sales of $4.6 billion. He was also elected chief operating officer of the firm, which has had no COO since 1979.

Ventres joined Borden's chemical division in 1957 as assistant chief engineer at its PVC operation in Leominster, MA. The next year he was promoted to chief engineer. In 1966 he became general manager, and in 1968 he was appointed vice president in charge of the division's PVC operations. He was made a division group vice president with additional responsibility for petrochemicals in 1972.

In 1974 Ventres left Borden to become executive vice president of Haven Industries, a specialty chemicals company located in Philadelphia. When the company was sold in 1979, he returned to Borden as a group vice president of the chemical division in charge of adhesives, energy resources and Canadian operations. He was named president of the division and elected a corporate executive vice president in July 1983.

For six years Ventres was based in Borden's administrative offices in Columbus, OH. He transferred to the firm's executive offices in New York City last summer.

Borden plants in Massachusetts include, in addition to the Leominster plant, an ice cream branch in Worcester, a plastic packaging film operation in North Andover, a vinyl fabric operation in Haverford and Deran Confectionery Co., a unit of the Consumer Products Division, in Cambridge.

During his sophomore year at WPI, Ventre's education was interrupted when he served two years as an aviation electronic technician's mate in the U.S. Navy. After graduating in 1948, he worked as a petroleum engineer for Atlantic Richfield Co. in Philadelphia until 1955.

Before joining Borden he spent two years in Baghdad, Iraq, as one of 50 temporary U.S. employees assigned to train Iraqis to operate their oil refineries.

Rehabilitation in Jacksonville.

Donald Giles continues as a township planner in Wayne, NJ, where he has been employed since 1961. Earlier he had been a private consultant with a leading New York firm for ten years while the field of planning was still new.

1951

Reunion June 5–8, 1986

Bill Baker serves as an intermediary with Geneva Business Services in Santa Ana, CA.

1952

Leo Lutz continues as a group leader at Nashua Corp., Nashua, NH.

Warren Palmer, Jr., was recently transferred as a senior staff engineer from San Diego, CA, to Raleigh, NC, by Millidyne Inc., a data communications company. The firm's principal product is an alphanumeric display pager.

George Randig has been named head of the Strategic Surveillance Systems Department at the MITRE Corp., Bedford, MA. He provides technical support to the U.S. Air Force on the North Warning System, a replacement for the Distant Early Warning Line to detect aircaft and cruise missiles threatening the U.S. from the north. In addition, he is responsible for the upgrade to the Ballistic Missile Early Warning System (BMEWS), the PAVE PAWS system for detection of submarine-launched ballistic missiles, and other space surveillance projects.

He went to MITRE in 1974 as a member of the technical staff. Later he was promoted to group leader, division staff member and an associate department head. Before joining MITRE, he was with Raytheon for 15 years. One of his Raytheon projects was providing the basic system architecture for Cobra Dane, a phased-array radar for intelligence-data gathering located in the Aleutian Islands. He holds an MSEE from Northeastern.

1954

Walter Reibling has been named general manager of the Louisville (KY) manufacturing facility of Corhart Refractories Corporation, a division of Corning Glass Works. Formerly he was Louisville plant manager. He has been affiliated with Corning since 1964 in various posts, including chief engineer of equipment (process and industrial), production superintendent, and plant manager of the general machine shop.

1956

Reunion June 5–8, 1986

Homecoming '85 (clockwise from top left): A post-game get-together at Higgins House; Bette and Ted Cole '35; Julius A. Palley and August C. Kellermann, '46 classmates; William F. Trask, Director of Graduate and Career Planning, with Joseph Slocik '67 and son Michael; Joseph Coghill '30 and wife Edith on a sunny football afternoon; Albert B. Glenn, '33, a familiar face on campus, fills in an alumni family on recent changes on the Hill.

1957

John Daly has been appointed head of Columbia Gas System's pipeline subsidiary in Charleston, WV. He joined the firm in 1957 as a junior engineer at the Marble Cliff subsidiary. In 1960 he was promoted to engineer and the following year became assistant supervisory engineer at system headquarters, then located in New York. He received his JD from Seton Hall University in 1967. In 1971 he was named a senior attorney for Columbia Gas Transmission at new headquarters in Wilmington, DE. He was transferred to Charleston in 1973 and in 1976 became general counsel and secretary. In 1979 he was elected president and chief administrative officer of Columbia Gas Distribution Companies in Columbus, WV.

James Duff continues as a manager with Lever Bros., New York City.

1958

William Zavatkay has been promoted to senior project engineer for the PW1120 engine program by Pratt & Whitney Aircraft Co., Palm Beach Gardens, FL. He joined Pratt & Whitney in 1959, and holds an advanced degree from RPI.

1959

Robert Berg holds the post of president and chief executive officer of Wesley Corporation in Scottdale, GA. He is also active with the Private Industry Council, Atlanta Export Council, the Chamber of Commerce and Rotary.

William Hees recently started his own manufacturers' representative company.

1961

Reunion June 5–8, 1986

Paul Nordborg has been promoted to systems development officer at Conifer Computer Services Inc., a subsidiary of The Conifer Group of Worcester. He has two master's degrees from Northeastern.

Wayne Taylor recently left Ford Aerospace to become product development manager with Olin Corporation's ball powder propellant facility in Florida. Even though he has worked in the ordnance, ammunition and ballistics field with both industry and the government, this is his first direct exposure to actual propellant manufacturing. "The cultural shock when first leaving fast-paced California and moving to the northern Florida very slow lifestyle took some getting used to, however, my wife and I, along with our three Lhasa Apsos, are quickly becoming acclimated." Their children are living on the West Coast.

1962

John Lukens is an associate professor at the Asian Institute of Technology in Bangkok, Thailand. He holds a PhD from Cornell University.

Frank Maher, a senior planning engineer of generation for the United Illuminating Co., spoke about generation and distribution of electricity at a recent meeting held at the Museum of Art, Science and Industry in Bridgeport, CT. He belongs to the IEEE and serves on the Load Management Committee of the Electrical Council of New England and the New England Power Pool Generation Task Force.

Richard Sharkansky has been promoted to patent counsel for Raytheon Company. He will be responsible for protecting the diversified electronics company's intellectual property through patent and trademark registration and enforcement. He will also direct licensing of products and processes to other manufacturers. He holds a BSEE from Southeastern Massachusetts University, an MSEE from WPI and a law degree from Suffolk University. Following graduation from WPI, he joined Raytheon as an engineer in the Missile Systems Division. In 1969 he was named division patent engineer. He became a member of the corporate patent staff in 1970. Since 1979 he has served as managing patent attorney. A member of the IEEE and the Boston Patent Law Association, he is admitted to the Massachusetts Bar and is registered to practice before the U.S. Patent and Trademark Office.

David Smith serves as project manager for Montgomery Engineers in Pasadena, CA.

1963

Ken Backer holds the post of vice president of marketing and sales at Dorman Bogdonoff, Andover, MA.

Robert Behn has joined The Center for Excellence in Government in Washington, DC, where he is a scholar in residence. He continues as the director of the Governors' Center at Duke University.

Homecoming '85: President Jon C. Strauss and wife Jean with Gertrude Carpenter, whose late husband, Percy, was that day honored with induction to the WPI Hall of Fame. Top left: John Korzick '68, Cary Palulis '68 and William Shields '65; bottom left: Sam Mencow '37, William J. Firla, Jr. '60 and Francis S. Harvey '37.

1965

MARRIED: Roy Cornelius, Jr., and Sharon Craig in New York on May 4, 1985. Sharon, the food service director for Dennis-Yarmouth (MA) schools, holds a BS from Cornell and an MS from Simmons College. Roy has an MBA from BU and is employed by the Newton Public School System.

Nicholas Gallinaro has been elected vice president of operations at Badger Engineers Inc., a subsidiary of Raytheon Company in Andover, MA. He will be responsible for overall engineering, procurement, project administration and client liaison on Badger projects in petroleum, petrochemical and related fields. Since starting with Badger in 1969, he has held several engineering management posts, including three years as project engineer at Badger B.V. in The Hague. Before joining Badger, he was with Esso Research & Engineering Company. He has a BSME from Tufts and an MSME from WPI.

Richard Rice is a research scientist at Holcomb Research Institute, Butler University, Indianapolis, IN. He has a PhD from Michigan State University.

Philip Ryan of Bow, NH, a partner in the management-consulting firm of Bigelow Company Inc., of Manchester, Boston and Philadelphia, was recently elected to the board of trustees of The Derryfield School. He has served as chairman of the board of trustees of Elliot Hospital and is a past vice president and board member of the Greater Manchester United Way.

1966

Reunion **June 5–8, 1986**

Ahmet Atakan is a physics professor at Knoxville (TN) College. He has a PhD from the University of Tennessee.

Tod Wicker serves as manager of financial projects at Public Service Co. of New Hampshire in Manchester.

1967

Ron Gordon, now home after a three-year overseas assignment, is currently manager of office systems planning for IBM in Irving, TX.

Wayne Miller serves as manager of products research at Unocal Corp., Brea, CA. He has a PhD from Caltech.

James O'Rourke continues as a consultant in electronic engineering at WPI.

Bob Shen is network design manager for Burroughs Corp., San Diego, CA.

1968

William McCarthy has been elected assistant vice president, portfolio management, at State Mutual in Worcester. He received his master's in actuarial science from Northeastern and holds the fellow, Society of Actuaries (FSA) professional designation. In 1971 he joined State Mutual as actuarial associate. In 1973 he was promoted to senior actuarial associate. He was named assistant actuary in 1974 and associate actuary in 1978.

Stephen Pytka, vice president of C.A. Pesko Associates Inc., has been listed in *Who's Who in Finance and Industry*. He has a broad background in the information processing and automation industry and has had experience in corporate strategic planning, all aspects of product development and product marketing. Pesko Associates is a market research and consulting firm located in Marshfield, MA. It specializes in the information processing and graphic arts markets and services the major participants in the information processing industry worldwide. Pytka is also director of the company's Intelligent Copier/Printer Market Requirements

Visage Vice President Is Active Volunteer

"When you want something done and done right," the old saying goes, "give it to the busiest person you know." Marvin Berger '65 EE, the busy, recently elected vice president for sales at Visage Inc., Natick, MA, still finds time to participate in a number of volunteer activities.

For example, he has served as director of the Manchester, NH, Chamber of Commerce, and as state chairman of the New Hampshire Muscular Dystrophy Association. "Currently, I'm consultant for the Active Corps of Executives Organization for the Small Business Administration," he says. At one time, he wrote a monthly column on business management for the *New Hampshire Business Review*.

In his newly created post at Visage, a developer and marketer of interactive video disc systems, Berger is responsible for the company's sales in its major markets, including industrial training, point-of-purchase advertising, video archiving and government.

Prior to joining the firm, Berger served as branch sales manager for Data General's Northeast region. He had charge of sales for the complete minicomputer and microcomputer software and hardware lines used in industrial automation and office automation. During his tenure, he raised the branch from 49th to 10th in sales.

Until 1983, Berger was president of Adelphi Management Group, which he founded in 1981, a management consulting firm specializing in industrial marketing and sales. He was with Chancellor Corporation from 1979 to 1981, where he was vice president of sales and managed the Chancellor Equipment Company.

Berger, who holds an MBA from Amos Tuck School at Dartmouth College, received the Edward Tuck Scholar Award for scholastic achievement in 1970. He and his wife, Dina, reside in Bedford, NH, with their sons Jonathan and Daniel.

Service, which analyzes all aspects of the on-impact printer marketplace. He was previously with Xerox Corporation and Wang Laboratories. He has an MBA from Amos Tuck School of Business at Dartmouth College.

Terry Sullivan continues with Boston Bay Capital Inc., Boston.

John Trudeau is now with Industrial Networking Inc., Santa Clara, CA.

Mario Zampieri holds the post of project engineer at Stone & Webster in Denver, CO.

1969

David Lieberman is regional sales manager for Syntactics Corp., Santa Clara, CA.

Bob Seldon is a partner in the Los Angeles law firm of Romney Golant Martin Seldon & Ashen, which specializes in patents, trademarks, copyrights and unfair-competition matters.

David Zlotek is the owner-president of Cirrus Technology Inc., Nashua, NH.

1970

Richard Abrams is manager of engineering and development for Koch Process Systems Inc., Westboro, MA. He manages a group of chemical, mechanical and electrical engineers and drafting personnel in the sales, design and manufacture of radioactive-waste treatment systems and solid-fuel combustion systems. Previously he had been with Artisan Industries and W.R. Grace.

Paul Akscyn has been appointed district sales manager of the Houston office for process systems sales covering the Gulf Coast and Central Southwest Region for Forney Engineering Company, Addison, TX. With the firm since May, his district includes Texas, Colorado and New Mexico. He is a member of the Houston chapter of the Instrumentation Society of America (ISA). In 1975 he presented a technical paper for the ISA at San Jacinto College. In 1982 he delivered a technical paper in Midland/Odessa at a regional meeting of the Gas Processors' Association. Prior to joining Forney Engineering, Akscyn was an advanced control systems specialist with Crawford & Russell/John Brown of Houston and the Netherlands. Forney products include the AFS-1000(TM) analog and digital microprocessor-based logic control system and the Mini AFS-1000 control system, to name a few. It also supplies burners, flame detectors and other boiler-related hardware.

Richard Bergeron continues as vice president of sales and marketing at Industrial Systems Design Inc., Exton, PA. He is responsible for all sales and marketing, including the opening of new sales offices every year. Before joining his present firm in 1974, he had served with the U.S. Navy and had been employed at a nuclear power plant. He belongs to ISA and IEEE, and he enjoys golf, baseball and swimming.

Stephen Bernacki continues as principal engineer at Raytheon in Sudbury, MA, where he is concerned with semiconductor fabrication. He holds a PhD from Harvard and has done research at MIT Lincoln Labs and

Homecoming '85 was enjoyed by one and all. Faces in the crowd at the game against Tufts; father and son face the camera (above left); at the Alumni Fund reception, Bob Hart (L) and Jon Anderson, '75 classmates, catch up on the news; mother and child enjoy the fine weather (left); Bob Morin '75, latest in a long line of Morins to attend WPI, with son Kyle.

Sperry Research Center. A Youth Soccer coach, he also jogs about 20 miles a week.

Bradford Bjorklund is manager of engineering at UOP Inc., Riverside, IL. In addition, he is administrative assistant for UOP's experimental development department. He joined the company in 1970, and previously served as development engineer, technical service engineer, senior design engineer, marketing liaison engineer in Europe, and engineering process manager.

Peter Blackford holds the position of chief engineer for Astro Wire & Cable Company in Worcester. He is involved with product design and development, technical resources and systems management. A member of the Wire Association, he is also active with the International Municipal Signal Association, the Worcester Engineering Society and the IEEE.

Henry Block serves as broker, office manager and property manager at Jack Thomas Inc., Realtors, in Miami, FL. Part of his responsibility is the management of investor-owned commercial real estate in Dade and Monroe Counties. Previously he was with the Susquehanna Steam Electric Station project team, and a student in the master's program (nuclear engineering) at Penn State. He is a member of the Miami Board of Realtors and enjoys sailing and fishing.

John Boyd is a financial planner with Boyd Financial Strategies, Worcester. He provides individual analysis and planning services in financial matters and brokers various financial products to assist in implementing financial goals. Previously he was a product manager for Hewlett-Packard, Waltham, MA, and a biomedical engineer at St. Vincent Hospital, Worcester.

Daniel Breen holds the post of sales engineer at Thorson Company Northwest in Beaverton, OR. He sells electronic and electro-mechanical products to original equipment manufacturers in Oregon and southwestern Washington. He writes that he likes to hike and "follow the Red Sox and the Celtics."

Alan Breitman is the principal at William M. Mercer-Meidinger Inc., Boston, which he serves as employee benefits and compensation consultant. His previous employers include Boston Mutual, State Mutual and John Hancock. He is a member of the Town of Sharon (MA) Personnel Board.

Oliver Briggs, Jr., is manager of special facilities and technical services at Riley-Stoker (Research) in Worcester. He is responsible for construction of R&D projects, testing, physical facilities and Riley Laboratories. During his spare time he enjoys fishing, golf and old car restoration. He belongs to the ASME and the Campfire organization.

Dave Brown is now manager of the value improvement program at AVCO Systems Division-Textron in Wilmington, MA. Besides his BSME, he holds a master's from WPI and an AS from Wentworth Institute. He has been in charge of managing manufacturing engineering departments, but is currently managing division-wide cost reduction and productivity programs (4000 employees—$260 million sales). He is vice president of the Worcester Fresh Air Fund, which operates Camp Putnam for underprivileged children.

Larry Cohen holds the post of technical vice president at Cavedon Chemical Co. Inc., Woonsocket, RI. He is involved with the planning and execution of internal R&D efforts. Previously he was with Kendall Co. and Union Carbide. From 1973 to 1976 he was a faculty member in general chemistry instruction at BU. He belongs to several professional societies and likes reading history, bicycling and travel.

Donald Colangelo is an account executive (investment broker) with Janney Montgomery Scott in Brooklyn, NY. Previously he was a stockbroker, manager/business consultant, and transportation planner. He and his wife, Sarah, have three children and reside in Brooklyn.

Robert Cournoyer continues as associate professor of mathematics at Wentworth Institute of Technology in Boston. He is active with the local softball league.

Kenneth Cram holds the post of support program manager at GE in Lynn, MA, providing prime interface between GE and customers in support of the TF34 jet engine. He identifies problems encountered in the field and helps assure resolution within GE. For seven years he was a test engineer for Pratt & Whitney Aircraft.

Douglas Dayton works as a sales engineer for GE at Thompson's Point in Portland, ME.

Dwight Dickerman serves as product manager for Cryogenic Associates/Sybron Corp. He is located in Brownsburg, IN.

Ralph Di Iorio is director of operations for Contel Service Corporation-Data, in Atlanta, GA. In his headquarters staff position, he provides computer operations support to regional and local data centers. Before joining Contel, he had been with AMS, Digital, New England Telephone Co. and AT&T.

John Ducimo is a full-time dental student at Boston University. He plans to open up general dental practice with a special interest in children. The president of his local PTA, he is also eucharistic minister of St. Margaret Mary Parish in Worcester.

Jack Gale continues as a golf professional at Tatnuck Country Club in Worcester, where he also owns and operates a pro shop. Previously he was head golf pro at Rochester (NH) Country Club. Others posts have been with Holden Hills and Green Hill (Worcester). He is a member of the executive committee of the New England PGA and former president of the New Hampshire PGA.

Francis Gardner is a project engineer for Duquesne Light Company, Pittsburgh, PA. Involved with nuclear engineering design and procurement, since 1973 he's worked in nuclear-related fields. He is active as a hospital volunteer (youth care) and is concerned with political action.

Mark Gemborys serves as a research chemist with McNeil Consumer Products in Ft. Washington, PA. He is involved with R&D and analytical organic chemistry. Activities include the North Penn Beagle Club and the BSA (cubmaster), as well as woodworking, gardening and hunting.

Richard Goff is a staff computer systems engineer for IBM in Cambridge, VT. He and his wife, Marilyn, have two daughters, Mary, 4, and Emily, 1.

Dr. **Frederick Golec, Jr.,** continues as section head/process chemistry R&D at Revlon Inc./Revlon Health Care in Tuckahoe, NY. He heads scientific management in the area of pharmaceutical chemical research and development. Previously he was a group leader and senior chemist.

Bob Goodness holds the post of project engineer in endoscopic product development at Codman & Shurtleff/Johnson & Johnson in Southbridge, MA. He is helping to develop a line of endoscopes to enable Johnson & Johnson to enter the least invasive surgery market. Previously he had been a manufacturing engineer in the fiber optics industry, a tool manufacturing engineer, and a self-employed manufacturer and marketer of hang gliders. He is vice president of the Lake Quinsigamond Watershed Association, has made short films which have won international honors and been aired on national TV, and has raced catamarans. Currently he's building a passive solar house designed with the aid of IQPs from nine WPI students.

Robert Grillo serves as assistant city engineer for the City of Nashua, NH. He is in charge of site approval for a rapidly growing city of 75,000. Earlier he had been with the Willimantic, CT, engineering office and the Nashua Regional Planning Commission, as well as a participant in the Federal Transportation Agency training program.

Bill Hakkinen serves as assistant department manager at Pfizer Inc., Groton, CT, where he is concerned with the manufacture of citric acid. With Pfizer since graduation, he has held progressively responsible posts. He is president of his local homeowners' assocation and is a member of the WPI Athletic Hall of Fame Committee.

Dr. **James Hannoosh** holds the post of director of new business development at Norton Co., Worcester. He creates new businesses in the area of advanced ceramic materials, (for example, silicon nitride bearings). He holds an MSME and a PhD from MIT. Besides serving as a planning board member in Sudbury, MA, he enjoys furniture making, cars and photography.

William Heald is a self-employed realtor in Phoenix, AZ.

Thomas Heinold serves as manager of manufacturing engineering at Morgan Construction Co., Worcester. He is responsible for processes, standards, numerial control, CAD/CAM systems, computer integrated manufacturing projects, capital procurements and tool design. A member of the Holden (MA) finance committee, he has also coached the Youth Soccer League. He belongs to the Chaffins Recreation Association and the Holden Historical Society.

Roger Henze is senior planner for transportation services at Chatham-Savannah Metropolitan Planning Commission, Savannah, GA. He is concerned with highway and transit planning in the Savannah urbanized area. Previously he was transportation planner in Albany, NY, a VISTA volunteer, and a planner with CE Maguire Inc., Wethersfield, CT. Currently he belongs to the Georgia Planning Association board of directors and the Baldwin Park Neighborhood Association. He is a head agent for the WPI Alumni Fund drive.

Neil Hodes holds the post of senior associate for Heery Program Management in Bala Cynwyd, PA. He writes, "I am the Philadelphia area manager for Heery. We are a construction program management company which manages large construction programs for those who do not have the proper expertise on their own staffs." He has been attending law school at night.

Stuart Hurd works as assistant town manager for the Town of Bennington, VT. He is project manager for wastewater facilities, upgrade purchasing agent, business manager for town liaison and supervisor for six town departments. Outside interests include basketball (year-round industrial leagues), watercolor painting, physical fitness and politics.

Raymond Janus is a staff manager for NYNEX Service Co., White Plains, NY. He is concerned with the analysis and resolution of regulatory/political issues relating to telecommunications services and general staff duties. Earlier he was involved with long-range telecommunications planning and telecommunications equipment engineering.

Philip Johnson is president of Transept Inc., Lebanon, NH. The company supplies computer software systems for the transportation industry throughout the U.S. and Canada.

Stephen Johnson serves as manager of coal technology for Physical Sciences Inc. in Andover, MA. He leads contract research in the areas of coal combustion, coal gasification and air pollution control. Before joining Physical Sciences in 1983, he had been with Science Applications Inc., Babcock and Wilcox Co., Riley Stoker, and E.F. Laurence Mfg. Co. He belongs to the A.I.Ch.E. and the Combustion Institute. Interests include tennis, gardening and camping.

Stephen Joyce holds the position of branch manager for Peerless Pumps Co., Norwalk, CT, where he manages direct and distributor sales of centrifugal pumps and pump systems for the New England territory.

Jack Kaferle, Jr., process manager for John Brown Engineers & Constructors in The Netherlands, is responsible for preparation of design for chemical plants, including heat and material balances and equipment specifications. He writes, "Newly relocated to The Netherlands for design and construction of a major grass-roots facility for a large U.S.-based chemical company." While in the U.S. he was active with the Appalachian Mountain Club. He and his wife, Marcia, have climbed 46 White Mountain peaks exceeding 4000 feet.

Robert Kelley is corporate vice president of Ducci Electrical Contractors, Torrington, CT.

Robert Killion, Jr., holds the post of chief executive officer at Applied Molding in Leominster, MA. He oversees all functions at the company, but focuses mainly on financial matters. He also directs daily operations through the company president. A member of the East Princeton (MA) Improvement Society, he also likes skiing, carpentry and basketball.

Lothar Kleiner serves as a senior development engineer for Raychem in Menlo Park, CA. He is involved with the formulation and compounding of conductive polymers. The conductive compounds are fabricated into devices which provide circuit protection for the telecommunications and battery market. Kleiner has a PhD in polymer science and engineering from UMass. Before joining Raychem, he spent six years at Diamond Shamrock, where he invented polymer formulations for electromagnetic interference shielding and electrostatic dissipation resulting in four patents and acceptance in the electronics marketplace. At Raychem he recently invented a compound which yields high-voltage circuit protections in telecommunications. He is active with SPE and ACS, and he has taught polymer science and rheology at a local community college. His wife, Donna, is a senior information specialist for SRI International in Menlo Park.

Donald Kremer is manufacturing manager at Merck & Co. Inc., Danville, PA. He is responsible for the manufacturing function at a company mid-size bulk pharmaceutical production plant. With the company since 1970, he has worked in the technical services department and has held increasingly responsible posts in the manufacturing department since 1972. He belongs to the A.I.Ch.E., the Danville Chamber of Commerce and the United Way Board of Directors. Hobbies include golf, Youth Soccer (coach) and racquet sports.

Kent Lawson, who has been 15 years with Polaroid, serves as principal manufacturing engineer for the corporation in Norwood, MA. He is the lead technical support engineer for all hardbody, amateur camera products, overseeing five engineers and three technicians. He is responsible for the product, process and equipment, including design changes, cost reductions and quality and product improvements. Currently he is working with a group to computerize the engineering group and process. An incorporator of his local housing association, he is also active with the American Society for Quality Control, the ASME, the Federation of New England Housing Cooperatives (director) and the Polaroid golf and bowling leagues.

Jonathan Leavitt holds the post of supervisor of pump testing at Combustion Engineering in Newington, NH. He is trustee of the Exeter (NH) Public Library and an officer in the local chapter of the ASME. He enjoys genealogical research and collecting old books. He and his wife, Fran, have two children, Julie, 13, and Jonathan, 10.

Thaddeus Lelek is business manager for Steuber Co. Inc., Greenwich, CT, a chemical distribution business. Formerly he was with Gill & Duffus Chemicals and Gulf Oil Chemicals.

James Lockwood serves as director of marketing at Petrolite-Specialty Polymers Group in Tulsa, OK. He is responsible for marketing worldwide for the firm, and is involved with business analysis, new product development, pricing, market research, preparation of promotional material, literature and advertising.

Robert Mulcahy serves as director of MIS and office systems at NYNEX in Burlington, MA. He is responsible for data processing systems development, operations, and product planning and development. His outside interests include skiing, tennis, golf and running.

David Rockwell owns 11 businesses (insurance, pizza, jewelry, etc.), which he serves as buyer and manager. Residing in West Springfield, MA, he has served as president of the local Kiwanis Club and of the Western Massachusetts Muscular Dystrophy Society, as well as district director for the Boy Scouts.

E. Richard Scholz serves as manager of technical planning for NYNEX Service Company in Boston. He does strategic network planning for the New England and New York Telephone Companies—interoffice transmission facilities and digital services.

Wine-making is a hobby. He is a charter member of the Medway (MA) Lions Club and a local cubmaster for the Boy Scouts.

Richard Schwartz, a contract negotiator for major accounts at Data General, Westboro, MA, also invests in real estate in the Boston area. He owns condominiums in the Back Bay, Brighton and Allston. He and his wife, Jean, have two children, Michael and Jared.

Leon Scruton is owner and president of Professional Service Packaging, Los Angeles, CA, a firm which packages vitamins and nutritional products. Previously he worked for Clairol for 11 years. In 1981 he started his own company. He has been involved with the local United Way and the WPI Alumni Fund.

Joseph Toce holds the post of director of research and development at Reliable Chemical Co., St. Louis, MO. He has a PhD from the University of Wisconsin.

Dr. **Paul Wilson**, general manager of Arwood Corp., Tilton, NH, manages two manufacturing plants. He has an MS from WPI and a PhD from UConn, and he has seen service with the local school board.

Frank Zone, Jr., works as a staff engineer at Riley-Stoker in Worcester. He is concerned with heat transfer analysis related to the development of standards for mass-fired municipal refuse incinerators and boilers. With Riley-Stoker since 1971, he holds a BSME from Rose Polytechnic Institute, and an MSME and MSCE from WPI. From 1962 to 1967 he was a navigator and captain with the U.S. Air Force (SAC).

1971

Reunion September 20, 1986

Frederic Mulligan has been named president of Cutler Associates Inc., an engineering and contracting firm in Worcester. He will supervise all engineering and construction operations as well as a staff of 150. He was the company's first employee when it opened in Worcester in 1973. Besides Massachusetts, the firm has projects in Texas, Florida, Georgia and Maine. In 1979 Mulligan was promoted to vice president. He holds an MBA from WPI, where he lectures part time. A member of the ASCE, he belongs to the Massachusetts Society of Professional Engineers and the Business and Education Committee of the Worcester Chamber of Commerce.

Robert Wright, who has an MBA and a DBA from BU, is an assistant professor at Boston College, Chestnut Hill, MA.

Tony Yankauskas has a new post within Continental Can (Hong Kong Ltd.) heading up their Hong Kong operations, as well as their activities in China.

Homecoming '85: Skull freshman service award recipient Susan Morena '88 (2nd from R.) gets a pat on the back from the Homecoming crowd and senior Skull members. Top right: Alumni and faculty at the Mechanical Engineering Department continental breakfast, one of four such departmental events. The Parade of Floats featured WPI traditions, such as the freshman-sophomore Rope Pull and the Two Towers.

1972

BORN: to Lorraine and **Richard Logan** a son, James Maxfield, on August 12, 1985.

Bill O'Rourke continues as president with James J. O'Rourke Inc., Warwick, RI.

LCDR **Marce Ranalli**, USN, is currently stationed at Kings Bay, GA.

Thomas Reynolds is concerned with corporate internal audit at Occidental Petroleum Corporation, Tulsa, OK.

1973

MARRIED: Russell Smith, Jr., and June Borth on July 6, 1985, in Holyoke, MA. June graduated from Springfield College and teaches at Sullivan School in Holyoke. Russell is a chemical engineer.

Steve Baum has been promoted to supervisor of engineering for Computer Methods Development at General Dynamics-Electric Boat Division in Groton, CT. Steve also serves as WPI's corporate contacts chairman for the company and team captain for college recruiting at WPI. Steve and his wife, **Liz Keegan Baum '75,** who reside in Waterford, CT, are both registered professional engineers and run Select Systems Engineering, a microcomputer consulting business. They have three children: Michael, 6, Colleen, 3, and Caitlin, 1. Steve is an officer of his local PTA and serves on the Superintendent's Liaison Council. Liz is an appointed member of the Waterford Energy Conservation Commission. The Baums recently renovated a 200-year-old house over an eight-year period.

Diane Drew holds the post of senior design engineer at Hamilton Standard in Windsor Locks, CT. She has a six-year-old son, Michael, and a three-year-old daughter, Jessica.

Brian Guptill serves as a program manager for Raytheon in Bristol, TN. He holds an MBA from BU.

Stephen Martin, M.D., is a retina fellow at Hagler Jarrett in Atlanta, GA.

Bruce Olsen holds the post of president at Aaron Scott Corporation in San Mateo, CA.

Having sold Pizza Transit Authority, **Mark Richards** is currently a cycle count analyst at Allied Corp., Amphenol Products Division, Durham, NC. He writes, "Am gearing up to pursue my ambition of becoming a photographer." His wife, Chris, works with a local commercial property developer.

Thomas Savage is a field market development manager for GE in Selkirk, NY. He has an MBA from the University of New Haven.

Doug Tarble is now a plant manager for Nabisco in Mansfield, MA.

James Viveiros continues as product marketing engineer with Logic Systems Divisions, Colorado Springs, CO.

Kathryn Zawislak now works as a software engineer and project leader at Northwest Instrument Systems Inc., a maker of logic analysis and software performance analysis plug-ins for IBM PC ATs. She is located in Aloha, OR.

1974

John Chipman has been appointed vice president of marketing and sales at Intelco, a new West Acton, MA, company in the fiber optic and digital telecommunications field. Previously he had been with Tautron Inc., (product manager of fiber optic instrumentation) Westford, and GTE Sylvania, Needham (business development manager for fiber optic systems.) He has an MS in engineering management from Northeastern and has written seven technical papers on fiber optics and articles on personal computing. He belongs to the Optical Society of America and SPIE, the International Society for Optical Engineering.

Last May **Edward Dlugosz** resigned as waste management engineer with the State of California Department of Health Services, Toxic Substances Division. Currently he is chief of the Office of Environmental Engineering and Energy for the Goppingen military community in the Schwabisch Alb section of Bundesrepublik, Deutschland. He is responsible for the planning, design-review and construction management of utility projects for the military in southern Germany. He monitors all military construction projects, while maintaining liaison with German governmental offices.

Air Force Capt. **Richard Dykas** has been assigned to the Space and Missile Test Center at Vandenberg AFB, CA. Previously he was stationed at Loring AFB in Maine.

Ronald Fargnoli has been promoted to the post of estimating executive in Gilbane Building Company's New England regional office in Providence, RI. With the firm since 1977, he has served as project superintendent, project engineer and project manager. Before his latest promotion, he was a design phase manager for several New England projects, including the St. Joseph Hospital boiler plant in Lowell, MA, and the Rhode Island School of Design in Providence.

Suresh Masand is a senior engineering manager with DEC, Merrimack, NH.

Roy Pelletier has been named district manager for 55 7-Eleven stores in Connecticut. With the firm since 1978, he has served as a field representative, area training manager and franchise coordinator. Earlier he was a district manager for House of Fabrics. Besides WPI, he attended the University of Southern Maine in Portland.

Rick Peterson's work at RCA Labs, Princeton, NJ, currently involves artificial intelligence and human-computer interfaces. He writes, "My boss's boss is **Curt Carlson** '67."

Ron Sarver continues as president of corporate food service at New England Party Supply Inc., Randolph, MA. He operates cafeterias and vending machines for high-tech companies and is involved with professional meeting planning. He and his wife, Rhoda, have a daughter, Lauren, 3.

1975

Robert Byron serves as superintendent of chemicals for UOP in McCook, IL.

Paula Delaney has been named registrar at Nichols College, Dudley, MA. She had been director of advising services at the college since 1981. Earlier she was the registrar at Daniel Webster College, Nashua, NH. In her new post she will be responsible for the records of all of the students at Nichols. Currently she is studying for her master of education degree at Worcester State College where she is specializing in leadership and educational administration.

Bob Fried was recently promoted to product engineering manager in the Discrete Semiconductor Division of General Instrument Corp., Hicksville, NY.

Kevin Kelly now works as a software engineer for Norden Systems/United Technologies in Norwalk, CT. He is concerned with the field of avionics, real-time software involving signal processing for advanced radar systems. Previously he was with Project Software & Development Inc., Cambridge, MA.

Alan Madden was recently promoted to systems officer in the planning and development department of the Correspondent Services Division at State Street Bank and Trust Co., Boston. He has a bachelor's degree from Hiram College and a master's from WPI. In 1983 he joined the bank as senior systems analyst. Earlier he was with Shawmut Bank and the Investment Companies Services Corp.

Penn Pixley has joined Garden State Paper Company Inc., Garfield, NJ, as a project engineer. Previously he was an assistant superintendent at Jefferson Smurfit in Cincinnati, plant engineer at Celotix Corp., Quincy, IL, and project engineer at the U.S. Gypsum Co., Oakfield, NY. Garden State is the world's largest manufacturer of newsprint made entirely from recycled newspapers.

1976

Reunion September 20, 1986

MARRIED: **Joseph Lucchesi** to Lorraine Francoeur in Holyoke, MA, on August 3, 1985. Lorraine graduated from Berkshire Community College and Westfield State. She is a variable annuities technician at the Massachusetts Mutual Life Insurance Co. in Springfield. He is a senior chemist at Fisons Corp. in Bedford, MA.

Jeremy Brown has been elected second vice president of group pension product development at State Mutual in Worcester. In 1980 he received the fellow Society of Actuaries (FSA) designation. He joined State Mutual in 1976. After several earlier promotions, he was elected assistant vice president, pension product development, in 1984. The Browns reside in Paxton, MA, and are the parents of Scott, 1, Emily, 7, and twin daughters, Melissa and Glenna, 5.

Industrial Risk Insurers, Hartford, CT, has appointed **Peter DiPietro** as district manager of the Seattle office. Since joining IRI in 1976, he has received several promotions. In 1979 he was named special agent and in 1981, special representative.

Walter Hoskins was recently promoted to senior planning and research associate, individual operational planning, at State Mutual in Worcester. While still a student at WPI, he started work at State Mutual. In 1975 he was named actuarial assistant, actuarial research. In 1978 he was promoted to actuarial associate and earned the Associate, Society of Actuaries (ASA) professional designation. In 1984 he was named planning and research associate, individual operational planning.

Duncan MacIntosh has been promoted to supervisor of secondary operations at Beswick Engineering in Ipswich, MA. He joined Beswick last January as a production engineer.

Thomas Pelis, with O'Brien & Gere Engineers, Syracuse, NY, since 1976, has been advanced to managing engineer in the Systems Engineering Division. Previously he had worked on design and construction management projects, including combined sewer overflow studies and design for the cities of Utica and Schenectady, NY, and Washington, DC. In his new post, he will primarily oversee industrial facilities engineering and environmental projects.

Karen Swanson serves as a senior geologist for the New Jersey Department of Environmental Protection in Trenton.

Pete Tordo is a senior loss prevention consultant for Liberty Mutual Insurance, Roseland, NJ.

David Vogt has been promoted to director

Father and Son Guide A.D. Technologies

of reserves and special studies in the actuarial department at American Universal Insurance Group (AUI Group), Providence, RI. A fellow of the Casualty Actuarial Society, he joined the company two years ago.

Tom Zarrilli holds the post of vice president at Sonnenblick Goldman in New York City.

1977

MARRIED: Mark Kerrigan to Joanne Henrickson in Worcester on June 2, 1985. Joanne graduated from Westfield State College, is studying for her master's degree at Anna Maria College and is employed by the State of Massachusetts. Mark serves as a senior marketing specialist at Prime Computer, Natick, MA. . . . **Kathy Molony** and Kim Shea in Orleans, MA, on August 31, 1985. Kathy is manager of industrial engineering at Clairol Inc., Stamford, CT. Kim graduated from Westfield State College and is a special needs teacher at Masuk High School in Monroe, CT.

BORN: to Evelyne and **Hanspeter Ruefenacht** a daughter, Magali, on July 4, 1985. Hanspeter is a project manager for SGL Consulting Engineers in Switzerland. . . . to Tae-Hyun Moon and **Gregory Tietbohl** their first child, a daughter, Stephanie Kim, on June 15, 1985. Gregory is employed as a laser fusion engineer at Lawrence Livermore National Laboratory in Livermore, CA.

Gary Babin, former acting superintendent of the Electric Division (Wellesley, MA), has been named superintendent. Previously he was assistant superintendent. Earlier he was with the United Illuminating Co., New Haven, CT, and the Office of Facilities at the University of Connecticut. He holds an MBA from the University of New Haven.

Robert Cundall was recently promoted to administrative and controls manager at Mobil Oil Corporation's U.S. Marine Sales Division in Scarsdale, NY.

Asta Dabrila continues as a naval architect at Portsmouth (NH) Naval Shipyard.

Terry Heinold, who holds an MBA from Anna Maria College, is with Ground Control Corporation, Sterling, MA.

Dennis Metrick serves as a research engineer at Kendall Co. in Rhode Island. He writes, "I recently received my MS in chemical engineering from Northeastern University and my first patent for a scrub wipe fabric."

Marc Meunier holds the post of manager of district loss prevention at Industrial Risk Insurers in West Hartford, CT.

Donald Statile is currently studying for his MS at the Graduate School of Industrial Administration at Carnegie-Mellon University, Pittsburgh.

Christopher Thomas has received his MBA from the University of Michigan. He works as an account manager with The Torrington Bearing Co., Detroit.

1978

MARRIED: Richard Bielen to Laura Cogan in Maynard, MA, on May 25, 1985. A graduate of St. Vincent's Hospital School of Nursing in Worcester, Laura is currently employed at Children's Hospital in Boston. Richard is with the National Fire Protection Association in Quincy, MA. . . . **Jerry Marcotte** and Kathy Papalia recently in San Francisco, CA. Kathy attended the University of California at Berkeley and works for the EPA as an environmental specialist in the Pesticide Enforcement Unit. Jerry currently serves as an environmental engineer and team leader managing four environmental scientists for California's Hazardous Waste Superfund Program.

BORN: to Donna and **Ronald Fish** a son, Nathaniel Phillip, on May 4, 1985. . . . to Kathy and **Bob Lavieri** a son, Robert Raymond, on April 5, 1985.

Anthony Allis continues as president of Microwave Systems Inc. in Woodside, NY.

Dean Giacopassi works for Newport News Shipbuilding in Virginia.

Rick Schonning is now an engineer for the City of Worcester.

1979

MARRIED: Robert DeMarco to Leslie Harris on June 15, 1985, in Worcester. Leslie, a flight attendant with U.S. Airlines, Boston, attended San Antonio Community College and Onondaga Community College, Syracuse, NY. Robert attended the master's program at Syracuse University and is a sales engineer at Marconi Instruments/Automatic Test Equipment Division, Marlboro, MA. . . . **David Gardiner** to Cheryl Ripsom in Chelmsford, MA. She received her bachelor's and master's degrees from the University of Maine at Orono. An engineer for Support Systems Inc., Lexington, MA, she is currently working for her second master's degree at the University of Southern California. He is an engineer for Horizons Technology Inc., Lexington, MA. . . . **John Morrison** and Deborah Martin in Manchester, CT, on July 13, 1985. She graduated from Central Connecticut State University and was formerly employed by Viola, Chrabascz and Reynolds, Enfield, CT. He is with Norton Co. of Jacksonville, FL.

John Hopkins, Jr. holds the post of vice president at Alger Corporation in Abington, MA.

Since 1983, **James Miller** has been pursuing a PhD in ocean engineering at MIT and Woods Hole Oceanographic Institution. His wife, Linda, graduated from Worcester State with a BS in health education and teaches in Cambridge, MA.

David Peterson serves as a research scien-

Gordon "Bucky" Walters '54 and his son, Glenn Walters '76, have a good thing going—their own firm, Advanced Dielectric Technologies Inc., an up-and-coming, micro-thin metalized film manufacturing business located in a new plant in the Miles Standish Industrial Park in Taunton, MA.

While some big-name (Route 128), high-tech firms are in a slump, A.D. TECH is currently one of several start-up companies emerging successfully in southeastern Massachusetts. Part of the reason for the company's success is that father and son have 40 years of combined electronics experience between them.

"We will be vacuum metalizing thin films used in capacitors, computers, liquid crystal displays, flexible circuits, and audio and video tapes," says Glenn, founder and company president. "The film is used by telecommunications, industrial, consumer and defense-related firms. Customers include GE, Westinghouse, TRW, Union Carbide, Western Electric and Sprague Electric."

Advanced Dielectric Technologies is part of an $800 million-a-year industry in the U.S. using thin dielectric films which are metalized using custom-built vacuum evaporation equipment. (A common example would be the metallic coating applied to Christmas tree tinsel.) At A.D. TECH similar processes are used for applying metallic coatings to ultra-thin dielectric films, which are wound onto reels and packaged.

Glenn and Gordon Walters are both natives of Newburyport, MA, reside in Duxbury, MA, and have ME degrees from WPI. Glenn has also had training in management engineering. In spite of their shared interests, Glenn says his father never pushed him into attending WPI or into the high-tech business.

"Dad worked nine years each for Du Pont and Sprague, then set up a U.S. distributorship to sell capacitor films made in West Germany and Ireland," he says. "I had intended to be an oceanographer, but I found the family business challenging." After graduating from WPI, he marketed the film on the West Coast and later traveled to West Germany to study vacuum metalizing.

In 1971 Gordon Walters founded Steinerfilm, and in 1978 son Glenn set up the manufacturing process in the U.S. In 1983 Gordon sold his interest in Steinerfilm. The following year he assisted Glenn in establishing A.D. TECH.

Now the CEO of A.D. TECH, Gordon will focus his primary efforts towards technical marketing, while Glenn will be responsible for manufacturing.

tist at Eastman Kodak Research Labs in Rochester. NY. He has an MS and a PhD from Purdue University.

Michael Rafa has been promoted to senior design engineer in GE's Aircraft Instrumentation Department in Wilmington, MA. Prior to joining GE in 1982, Michael, who holds an MSME from Northeastern, was a design and application engineer with Westinghouse.

Lt. **Robert Sachuk**, USN, is a resident construction officer in Coleville, CA.

E. Charles Tidman III has been promoted to assistant vice president at Mechanics Bank, Worcester. He joined the bank in 1981 as a management trainee and was promoted to assistant loan officer in 1982. In 1983 he was named loan officer. He holds an MBA from Babson College.

Paul Wrabel is a project engineer for Babcock & Wilcox, Barberton, OH.

1980

MARRIED: **Richard Forand** and Stacey McMurphy in Keene, NH, on June 22, 1985. Stacey, who works for the American Red Cross in the public education department, graduated from UNH. Richard, a special representative with Industrial Risk Insurers, is an MBA student at Temple University, Philadelphia. . . . **Gary Holland** and Jacqueline McGourty in Tacoma, WA, on June 15, 1985. Jacqueline graduated from the University of Puget Sound with a BS in chemistry and holds a master's and a doctorate in biochemistry from Northwestern University. Gary has a master's and a doctorate in chemistry from Northwestern. Both are doing post-graduate research at the University of California. . . . **Joseph LeBlanc, Jr.**, and Penny Holmes in Natick, MA, on June 15, 1985. Penny has a BA in interior design from UMass, Amherst. Joseph, who has completed a doctorate in chemical engineering at UMass, is a scientist at Union Camp of New Jersey.

BORN: to Francie and **Brownell Bailey** twin sons, Spencer and Trent, on August 18, 1985. The twins have an older brother, Brandy, age 3. . . . Patricia and **Charles Dyke** a son, Christopher Alan, on May 29, 1985. Charles is responsible for scale-up and downstream processing of new biological products developed at Texaco's Beacon, NY, research center. . . . Liz and **Robert Yule** a son, Brandon Robert, on September 12, 1985. Robert was recently transferred from Belle, WV, and is now a senior works supervisor at the Du Pont Experimental Station in Delaware.

Mark Andrews is a software applications management manager at Waters Associates in Milford, MA.

Jane Chapin has been named a teacher of mathematics at Algonquin Regional High School, Southboro, MA.

Jill Fabricant Corwin serves as a software specialist at DEC in Marlboro, MA.

Garry Crane is with GE in Utica, NY.

David Drevinsky, who is a research assistant for the Metropolitan Area Planning Council in Boston, is working on a manual on "pavement management" to be used by local communities.

Tom Fawcett is studying for his PhD in computer science at Rutgers.

Allan Fish holds the post of technical support manager at Balston Inc., Lexington, MA.

Thomas Horgan, a student at University of Colorado School of Law, works for Sheridan, Ross & McIntosh, Denver.

Kent Larson serves as a management consultant at Touche Ross & Co., Atlanta, GA.

Michael Lombardi is operations manager at New England Construction Co., Boston.

John Noonan is a student at Columbia University Graduate School of Business, New York City.

Jordan O'Connor holds the post of designer at Hovsepian Associates, Architects & Engineers in Worcester.

Craig Reed serves as plant engineer for Georgia Power Co., Waynesboro, GA.

Mark Starr works for Martin Marietta in Denver, CO.

John Zagorski is a graduate research assistant at UMass, Amherst.

1981

Reunion — September 20, 1986

MARRIED: **David Barrows** and Patricia Markey in Worcester on May 18, 1985. She graduated from Worcester State and is an assistant supervisor at Thom McAn Shoe, Worcester. She is also studying for her MS at Bentley College. He is in the MBA program at Nichols College and is an assistant supervisor (payroll department) at Thom McAn. . . . **Dorian DiMarco** and Barbara MacDonald in Palos Verdes, CA, on August 10, 1985. Barbara graduated from Pasadena City College. She is a client administrator with SEI Corp., Century City, CA. Dorian is a senior sales executive with Computervision Corp. in Los Angeles. . . . **Ethan Foster** and Natalie Golden in Leverett, MA, on July 6, 1985. Natalie graduated from Wellesley and is a PhD candidate in psychology at the University of New Hampshire. Ethan is the lead programmer/analyst for New Pathways, Harvard Medical School. . . . **Robert Gormley, Jr.**, to Lori Spencer on June 1, 1985, in Attleboro, MA. Lori graduated from Fisher Junior College. Robert is with KSI.

MARRIED: **Douglas Greenfield, Jr.**, to Julie Sacks in Ocean City, NJ. She is a nursing school student at the University of Vermont. He is a senior associate engineer with IBM in Essex Junction, VT. . . . **Robert Hevey, Jr.**, and Karen Sworen in Westfield, NJ, on July 27, 1985. Karen, an electron microscopy technologist at Rhode Island Hospital, graduated from Chestnut Hill College in Philadelphia. Bob is a project/systems engineer for General Dynamics in Groton, CT. . . . **Michele Neville** and Stephen Krupanszky in Hull, MA. Michele is a senior systems designer at Honeywell. Stephen graduated from the University of Waterloo in Ontario, Canada, and is a staff engineer at Honeywell, Phoenix, AZ. . . . **John Ryan, Jr.**, and Beverley Anne Kelly in Blackstone, RI, on July 6, 1985. She graduated from Brown with a bachelor's degree in applied mathematics and economics and is an actuary with the Hanover Insurance Co., Worcester. John is a grad student in engineering management at Northeastern University, as well as a product support engineer at Compugraphic Corp., Wilmington, MA.

Douglas Anderson is employed by the Environmental Elements Corporation in Baltimore, MD.

Steven Burgess works as an automation development engineer at GE in Lynn, MA.

Katherine Coghlan-Wurm has been promoted to captain in the U.S. Air Force. She is a communications and electronics engineer with the Electronic Systems Division at Hanscom AFB, MA.

Brian Dumont serves as a system engineer for Hughes Aircraft in Anaheim, CA.

Paul Ferrara is an electrical engineer at Gulton Industries Inc., East Greenwich, RI.

Dana Foster is a design engineer at Hamilton Standard, Farmington, CT.

Jorge Garcia continues with the Gulf Oil Company in Panama.

Lisa Kosciuczyk is an associate project engineer for The Irvine Company in Newport Beach, CA.

Ronald Mann is currently working for Martin Marietta Aerospace and residing at 4 Mary Lane, Greenvale, NY, 11548.

Edward McGrath now serves as manager of operations analysis at American Broadcasting Company, New York City.

James Roth is an advance industrial engineer in industrial engineering for the Neutron Devices Department at GE in St. Petersburg, FL.

Stanley Siver continues as a naval intelligence analyst for the U.S. Naval Intelligence Command in Washington, DC.

1982

MARRIED: **Dermot Daley** and Deborah Sessa in Hopedale, MA. She graduated from Burdett School and is employed at Med-Vale Nursing Home. He works for RTS-Diebold in Southboro, MA. . . . **Richard Ferron** to Patricia Horn on August 17, 1985, in Worcester. Patricia holds two degrees from Assumption College, including a master's in rehabilitative counseling. Richard, who is a research engineer at Babcock & Wilcox, Alliance, OH, has his BSME and MSME from WPI . . . . **Mark Geene** and Tamara Kelling on August 10, 1985, in Ocnomowoc, WI. Tamara graduated from Purdue's Krannert School of Business. Both she and Mark are employed at AT&T in Lisle, WI, she with the computer systems division in international marketing and he with the computer systems division in product management. . . . **Daniel Hassett** and Ellin Clifford on June 16, 1985, in Rochdale, MA. Ellin graduated from Quinsigamond Community College, Worcester, and Nichols College, Dudley, MA. She is a customer service representative for Blue Cross/Blue Shield. Daniel, who has two degrees from WPI, is a research engineer at Wyman Gordon Co., Millbury, MA.

MARRIED: **Carl Hefflefinger** and Robin Johnson in Merrimack, NH, in July. Robin, an MBA student at Rivier College, Nashua, graduated from the University of New Hampshire. She is employed as a sales support rep-

Homecoming '85: This day, Trinity got the better of the engineers in the round ball game; No. 46, Joseph Orciuch '85 of Hampton, NH, holding nephew Timothy Orciuch. At right is Joe's brother, Steven, and Timothy's sister, Kaitlyn. Simon (that's Bob Schafer, on stage) says you won't soon forget this *addition to Homecoming fun and games.*

resentative at Teradyne Connection Systems, Nashua, where Carl serves as a sales engineer. . . . **Jocelyn Kent** and Bruce Smyth in Winchester, MA, on August 24, 1985. Jocelyn is with I Teck Corp. of Lexington, MA. Bruce, who graduated from the University of Maine at Orono and who received his master's from Northeastern, works for I Tran Corp. of Manchester, NH. . . . **Joe Mayer** and Carol Stasior on August 24, 1985, in Liverpool, NY. Carol graduated from BOCES and is a nurse in Exeter, NH. Joe is a mechanical engineer in Seabrook.

MARRIED: Edward Mellon and Theresa Ziegler in Lafayette, IN. Theresa, who has a degree in supervision technology from Purdue University, is manufacturing engineer for Texas Instruments Radar Division. Edward is also with Texas Instruments. . . . **Robert Mitchell** to Barbara Hanscom in Brewer, ME, on July 6, 1985. Barbara graduated from the University of Maine at Orono. Both are employees of Union Mutual Life Insurance Co., Portland, ME. . , . **Chris Reeve** and Gordon Barr in Marlboro, MA, on April 14, 1985. Chris is a manufacturing engineer with ADE in Newton, MA, a firm that manufactures non-contact gaging equipment, primarily for the silicon wafer industry. Gordon is a senior technician with Data General in Southboro. . . . **Edward Rizzo** and Maryann Grandelski in Danielson, CT, on March 30, 1985. Maryann graduated from Providence College and is an MBA student at Northeastern University. Edward serves as an engineer-analyst at Boston Edison Company.

Carl Cianci is self employed with Mayo & Cianci in Hartford, CT.

Mary Coyne is with Hamilton Standard in Windsor Locks, CT.

Stephen Fontes is an associate programmer for IBM in Endicott, NY.

Lynn Gustafson holds the post of process quality engineer at GE in Syracuse, NY. She is with the Military Electronic Systems Division. She is also training for her private pilot's license in central New York.

Edward McGuire, a systems engineer at Charles Stark Draper Laboratory, Cambridge, is enrolled in the MBA program at Boston University.

Lynne Ondek is a senior engineer with Honeywell Information Systems, Billerica, MA.

Steven Oxman writes, "I've left the federal government to launch Oxko Corporation."

Brian Renstrom serves as a consultant at Arthur Andersen & Co., Hartford, CT.

John Ricciardi was recently promoted to lead technical engineer, troubleshooting a nuclear aircraft carrier at Newport News Shipbuilding in Virginia.

David Rubinstein and a friend have started their own business, Innovative Information Systems, in Newton, MA.

Vincent Sansevero III now works as a systems engineer for NASA-Goddard Space Center in Greenbelt, MD.

Maureen Seils holds the post of senior associate engineer at IBM Endicott, where she is involved with thermal work. She is located in Binghamton, NY.

Richard Van Houten is an experimental engineer at Hamilton Standard, Windsor Locks, CT.

1983

MARRIED: Deborah Biederman and Kevin Spaulding on June 22, 1985, in Meriden, CT. Deborah and Kevin, a graduate of RIT, are employed by Eastman Kodak. . . . **R. Peter Denkewicz, Jr.,** and Carolann Goodnow in Fitchburg, MA. Carolann, a registered nurse, graduated from St. Vincent Hospital School of Nursing. Peter, a chemical engineer at Philadelphia Quartz Corp., Lafayette Hill, PA, has been studying for his master's degree at WPI. . . . **Donald Jacques** and Barbara Olson on June 1, 1985, in Sutton, MA. She graduated from Quinsigamond Community College, Worcester. He is with Kodak in Rochester, NY. . . . **Robert Kodrzycki** and Elizabeth Womble in West Raleigh, NC, on August 31, 1985. Elizabeth graduated from North Carolina State University. Robert also holds a degree from NCSU. . . . **Robert Massaroni** to Bambi Lynn Hollenbeck of Schenectady, NY, on June 14, 1985. Robert works as a mechanical engineer for the Army at Ft. Belvoir R&D Center, VA.

MARRIED: Jeffrey Moore and Hilarie Clark in Old Lyme, CT, on June 15, 1985. She graduated from the University of Connecticut and is currently enrolled in the graduate program at Yale. He has an MS from UConn and is employed at International Fuel Cells of South Windsor, CT. . . . **James Petropulos** and Lynda Hanson in Paxton, MA, on June 1, 1985. Lynda, a registered dental hygienist, graduated from Quinsigamond Community College, Worcester. James is a civil engineer. . . . **Steven Roy** and **Jennifer Udall '84** in Worcester on July 4, 1985. She is with MITRE Corp., Bedford, MA, and he is with Sanders Associates, Nashua, NH. . . . **Thomas Wester** to Barbara Wioncek in Salem, MA. Barbara is a member of the technical staff at MITRE Corp. Tom is a semi-conductor researcher at MIT.

BORN: to Stacey and **Peter Mott** their first child, Emily, on April 12, 1985. Peter is a software engineer for DEC in Littleton, MA.

Douglas Acker is now a product and process development engineer in an optical waveguide manufacturing facility with the Telecommunications Products Division of Corning Glass Works, Wilmington, NC.

Gregory Fitzgerald works for Analog Devices, CTS Division, Andover, MA.

William "Fitz" Fitzgerald is with GE in Lynn, MA.

Michael Gagnon, a sales engineer for Westinghouse, Albany, NY, is also attending RPI for his MBA.

John Gorman serves as supervisor of production control at GE in Plainville, CT.

John Greenup is a research engineer for RCA, Burlington, MA.

BettyAnn Gustafson, no longer with Science Application Inc., is now a software engineer with Inframetrics, Bedford, MA.

Roger Hanley works as a design engineer at International Harvester in Melrose Park, IL.

Bob Hicks is a junior engineer at Waterbury Farrel, Cheshire, CT.

Lt. **Timothy Horan** is serving with the U.S. Army, 64th Ordnance Co., in West Germany.

John Mar is now employed as a design engineer at GE in Lynn, MA.

Lisa Orfan works for Data General in Milford, MA.

Douglas Oringer serves as a water chemist and chemical engineer at Refuse Fuels Inc., Lawrence, MA.

Michael Quarrey has accepted a post as projects director at National Center for Employee Ownership, a non-profit research group in Arlington, VA.

Richard Scott is a process and development engineer for UNC Naval Products Division, Uncasville, CT.

Eric Schade continues as a mechanical engineer with the Naval Underwater Systems Center, New London, CT.

William Wheaton III is employed as a package development engineer at Pfizer Pharmaceuticals in New York City.

Lt./Jg. **Marshall Young**, USN, who has graduated from the Nuclear Power School in Florida and Submarine School in Groton, CT, is currently an electrical officer aboard the submarine *USS Hyman Rickover* off the East Coast.

1984

MARRIED: Loring Chadwick, Jr., to **Mary Beth Chuplis '86** on August 3, 1985. Mary Beth attends Assumption College. Loring is a lieutenant with the U.S. Air Force 3rd Combat Information Systems Group, Tinker AFB, Oklahoma City, OK. . . . **George Duane** and **Shari-Ann Harvey '83** on October 26, 1985. Shari works for Harris Corp., Syosset, NY. George is with Grumman-Aerospace Corp., Bethpage, NY. . . . **Gerald Fredrickson** to Pamela Stevens on May 26, 1985, in West Boylston, MA. A console operator, Pamela graduated from Becker. Gerald is a chemical engineer with GTE Sylvania in Danvers, MA. . . . **Derek Granquist** and Cheryl Barnes in South China, ME, on July 20, 1985. Cheryl is a senior at the University of Maine-Farmington. Derek works for Raytheon Co., Portsmouth, RI. . . . **Shoshanna Kaplan** and Leonard Eisenberg in Brookline, MA, on June 23, 1985. She is a software engineer at Foxboro (MA) Company. He graduated from Massachusetts College of Art and is a free-lance photographer in Auburndale. . . . **Debbie Lou Neff** and Richard Belculfine in Worcester on May 19, 1985. Debbie is with GE in Cincinnati and Richard, a graduate of Worcester Vocational Technical High School, is a licensed electrician for Milwaukee Electric Tool, also in Cincinnati.

Dick Anderson works for AVCO Lycoming, Stratford, CT.

John Chappell has joined New Hampshire Ball Bearings as a senior manufacturing engineer. Previously he was employed by Eastern Tool Company and the Foxboro Company.

Jennifer Davis is a developmental chemical engineer for Chiron Corp., Emeryville, CA.

Sheryl French serves as a software engineer at DEC in Nashua, NH.

Tina Gorski has been appointed a college representative at Thomas College, in Waterville, ME. She will represent Thomas at high schools, college fairs and college nights throughout New England. Previously she worked in the WPI Office of Student Affairs. Thomas College is a small co-educational

institution specializing in undergraduate and graduate education for business and management professions.

Sue Haupt is a graduate research assistant at the University of Michigan, Ann Arbor.

Christopher Heyl works as a professional development associate at Colt Industries-Firearms Division, Hartford, CT.

Gregory Kelly is an ensign in the U.S. Navy.

Amine Khechfe is a graduate student in the ME department at Stanford University in California.

Stephen LaJeunesse, an analog design engineer at Data Translation Inc., Marlboro, MA, was co-author of "Controller Boards Complement Process-Control Bus," which appeared in the August issue of *Computer Design*. His professional responsibilities include design of data-acquisition modules and interface boards.

Gregory Langer has been commissioned a second lieutenant in the Air Force upon graduation from OTS, Lackland AFB, Texas. Currently he is assigned to Hanscom AFB, MA.

Edward Moffitt continues as a division marketing representative at Westinghouse in South Boston, VA.

Mike Sapack is with Teleco Oilfield Services Inc., Meriden, CT.

Leslie Schur is now employed as a software engineer in VS development at Wang Laboratories, Lowell, MA.

Michael Schwinn works for Automatix in Billerica, MA. He resides in Lexington.

Gordon Young has accepted a post with Rockwell International, North American Aircraft Operations, Palmdale, CA.

1985

MARRIED: David Creem to Mary Beth Baker in Springfield, MA, on June 22, 1985. Mary Beth graduated from St. Vincent Hospital School of Nursing and attends Assumption College, Worcester. She is employed in the intensive care unit at St. Vincent's. David, who has his MBA from WPI and a degree from UConn, is a production planner for Wright-Line Inc., Worcester. . . .**Alan Denko** and Deborah Gillis on June 15, 1985, in Barre, VT. Deborah recently graduated from URI with a BS in pharmacy. Alan has been commissioned an ensign in the U.S. Navy. . . .**Stephen Hooley** to Nancy Irwin in Wayland, MA, on July 13, 1985. She received her degree in business education from Salem State College. He is with Texas Instruments.

Susan Abramson serves as an applications programmer in the Department of Physiology at UMass Medical Center, Worcester.

Ron Achin has accepted a post at Spectran Corporation, Sturbridge, MA.

Christopher Alley has been employed by the Army Corps of Engineers.

Thomas Arseneault holds the post of associate member of the technical staff at RCA Government Systems, Burlington, MA.

William Astore is a second lieutenant with the USAF Space Command in Colorado Springs, CO.

Dennis Aves has joined IBM Corporation.

Dean Ayotte works for Harry J. Ayotte Plumbing and Heating.

Kurt Bahnsen is with Westinghouse Electric.

Orville Bailey is now with General Electric.

Raymond Baker serves as associate engineer for the United Technologies-Hamilton Standard Division in Windsor Locks, CT.

Ben Bakker teaches physics in the Peace Corps in Tanzania, East Africa.

James Ball is with the U.S. Army.

Joyce Barker has joined Du Pont.

Patrick Barry is a graduate student at the University of Connecticut Health Center.

James Barsanti works for Guerriere & Halnon in Milford, MA.

Jonathan Baskin, who is with Mitsubishi Semiconductor of Durham, NC, is currently taking training courses in Osaka, Japan.

Homecoming '85: Alumni Field's new Omniturf surface (opposite page) was no help at all to Tufts this day. This page, bottom left: Kicker Steve Mano '88 combines with Steve Nolan '87 against Tufts. Bottom right: Offensive coordinator and line coach Cliff Schwenke discussing battle plans with the men in the trenches. Final score was 21-13, in WPI's come-from-behind victory.

Robert Bauchiero works for Hamilton Standard.

Monte Becker works for Digital Equipment Corporation.

Gil Benatar is enrolled in the graduate program at Georgia Institute of Technology.

Pamela Berg has accepted a post with Pratt & Whitney Aircraft, East Hartford, CT.

Paul Bergantino serves as a hardware engineer for Data General, Westboro, MA.

John Bernard works for Otis Elevator Division.

Lyford Beverage, Jr., works for Data General.

Sue Bickford serves as a software marketing specialist at Digital Equipment Corporation in Marlboro, MA. She has her MBA from WPI.

Alan Bielawski has had his name legally changed to Alan Beck. He is employed as a software engineer at Data General in Westboro, MA.

Stephen Bitar is now with General Electric.

Shaun Bogan works for Nelmore.

William Botting works at Pratt & Whitney.

"Boz" Bozenhard has accepted a post with General Dynamics-Electric Boat in Groton, CT.

Sue Brackett holds the post of assistant traffic engineer at Storch Associates, Boston.

David Brannon is with the U.S. Navy.

Jeffrey Breed serves as an electrical engineer at GTE-Government Systems in Natick, MA.

David Breininger works for General Dynamics-Electric Boat.

Craig Brodeur works for Bose Corporation.

Cheryl Buitenhuys has joined Hasbro Inc., Pawtucket, RI, as a product design engineer.

Juliann Bussell is with GTE.

Jeff Butler works for Texas Instruments.

Michele Buzzell is an associate member of the technical staff at RCA/Automated Systems, Burlington, MA.

Arthur Cadilek, Jr., has joined Sikorsky Aircraft Division.

Harold Caldwell has joined Fairchild.

Ernie Capozzi is a staff consultant with Arthur Andersen & Company, Hartford, CT.

Bruce Carbone has joined General Electric in Burlington, VT.

Ralph Casale III is studying for his master's degree at Cornell.

Bill Cass is at Western New England College School of Law.

Caroline Cassidy works for Digital Equipment Corporation.

Chris Cavigioli is an electrical engineer with M/A-Com Linkabit in Vienna, Virginia.

Jeff Chaplin has been employed by IBM in Owego, NY.

Andrew Chapman has joined Camp Dresser & McKee Inc.

Christian Chappell works for Teradyne Inc.

Kenneth Chenis has joined Digital Equipment Corporation.

Edward Cheung continues at Yale.

Edmund Chin, who has an MSEE from WPI, works for Raytheon Company, Sudbury, MA. He earned his BS at the University of Rochester (NY).

Paul Chodak is with the U.S. Navy.

Peter Chrissanthis is an electrical engineer with Raytheon.

Mark Cincotta works for General Dynamics-Electric Boat.

Kurt Cleveland has joined Alpha Industries.

Patricia Coghlin has been employed by Alphatech Inc.

Matthew Colbert holds the post of fabrication engineer at R&K Precision Machine, Middleton, MA.

John Cole has accepted a post at Hamilton Standard, Windsor Locks, CT.

David Concordia serves as a software engineer (CAD systems engineering) at Digital Equipment Corp., Andover, MA.

Jay Cormier is a design engineer for Analog Devices-Microelectronics Division, Wilmington, MA.

Ginia Coulter has been employed as a programmer by IBM in Gaithersburg, MD.

Michael Crimmins is an engineer for a non-nuclear submarine at Newport News Shipbulding in Virginia.

Gwyn Crouch has joined Honeywell.

Don Crowley is now corporate fire safety manager at Digital Equipment Corporation, Acton, MA. He has a master's in fire protection engineering from WPI and a BS from Boston University.

Thomas Cucchi is with the U.S. Air Force.

Vinnie Cunningham has joined AT&T Communications.

Thomas Curatolo works for Raytheon.

Joyce Cutting is currently with MMM (3M).

Aldo D'Amico has joined Raytheon.

Louis D'Angio, Jr., works for Upjohn Company.

Steven Davi has joined Data General.

Mark DeLaurentis continues with Texas Instruments.

Russell Delude continues at Vanderbilt University.

Stephen Demers is currently a second lieutenant with the USAF Systems Command at Wright Patterson in Dayton, OH.

Donald Desaulniers has joined Devon Precision Industries Inc., Wolcott, CT.

Michael Deshaies is working on his MS in chemical engineering at the University of Connecticut, Storrs.

Richard Des Jardins works for Central Hudson Gas & Electric Corp.

Richard Desmarais has accepted a position as field engineer at GE in Waltham, MA.

Richard Dickey works for Digital Equipment Corporation.

Mark DiNapoli has joined R.W. Granger & Sons, Shrewsbury, MA, as a field engineer.

Denise Dion is a software engineer and systems manager at Alphatech Inc., Burlington, MA. She has a BSCS from WPI and a BA from Assumption College.

Richard Dipert, who has his MS in fire protection engineering from WPI, is a research fire protection engineer with the National Bureau of Standards, Gaithersburg, MD.

Catherine Dochak is currently with Stratus Computer.

Daniel Doe has been employed by W.R. Grace & Company.

David Dorocke works for AT&T Information Systems.

David Drab has been employed by GTE.

Timothy Dray works as a systems engineer for GTE Government Systems in Needham, MA.

Tom Driscoll, Jr., is employed as a software engineer at Alphatech Inc., Burlington, MA.

Patrick Duffy has joined GTE.

James Dumas works for NYNEX.

James Duncan is currently with Sikorsky Aircraft.

Beth Dupell serves as an actuarial analyst at Northeast Consolidated Services in Concord, NH. She has been taking an actuarial course at John Hancock.

Donald Duwell II is an ensign with the U.S. Navy. He and his wife, Ramona, reside in Windsor Locks, CT.

Jeffrey Eagle has accepted a post with Westinghouse.

Gerard Earabino is enrolled in graduate school at Northeastern University.

Christopher Eckler works for Teradyne Inc.

James Edwards, who has an MSEE from WPI, holds the post of design engineer for LFE Corporation, Clinton, MA. He has a BS from Clarkson.

William Eggleston works for General Dynamics-Electric Boat.

Gary Elias is with TransAmerica Occidental.

Paul Engstrom, Jr., has joined Home Federal Savings Bank, Worcester.

Craig Falkenham works for Raytheon in Bedford, MA.

Theodore Fazioli works for Hewlett-Packard.

Bonnie Fedele is studying for her MS in aero-engineering at MIT.

Gregg Fiddes serves as a marketing/sales engineer for GE in Florham Park, NJ.

Karl Fischer works for RCA in Burlington, MA.

James Fitzer has accepted a post with Perini Corporation.

Richard Fitzgerald has joined General Dynamics-Electric Boat.

Robert Flaherty, who has his MBA from WPI and an AB from Bowdoin, is product sales manager for Pitney-Bowes Inc., Waltham, MA.

William Fleischer III works for General Dynamics.

Mari-Agnes Flynn is with Raytheon Company.

Douglas Foglio, Jr., is with D.C. Foglio Excavating.

Donald Foster is a senior engineer for Polaroid in Cambridge. He has an MBA from WPI and a BS from Southeastern Massachusetts University.

Hazel Fotheringham is with Raytheon.

Nancy Frangioso works for GCA.

Brian Fraser works for UNC Naval Products, Uncasville, CT.

Robert Frey has accepted a post at National Starch and Chemical Corp.

Richard Frost has joined Data General in Westboro, MA.

Paul Furtado is currently with Raytheon, Andover, MA.

Shigeharu Furukawa is a grad student at Cornell.

Robert Galgano is employed as an assistant distribution engineer at Massachusetts

Electric Company in Worcester.

Steven Gardner works for Raytheon Company.

Jodi Gates has joined GE.

Stephen Gilardi is studying at RPI.

Sean Gilland works for Textron/Fafnir Bearings Division, New Britain, CT.

Leslie Gloyd works for Digital Equipment Corporation.

Ferruh Gocemen continues with DEC.

Peter Gosselin is with Procter & Gamble Company.

John Gould III continues as a logistics engineer at Raytheon in Billerica, MA.

Vaughn Grace is with the U.S. Air Force.

Scott Greene is a project acquisitions officer with the U.S. Air Force at Wright-Patterson AFB, Dayton, OH.

Ken Greenwood works as an electrical engineer for Hughes Aircraft, Anaheim Hills, CA.

Linda Groenewal is currently a computer systems analyst with Power Technologies Inc., Schenectady, NY.

David Grusell is a graduate student at Virginia Polytechnic Institute.

Gerard Guillemette is a graduate student at RPI.

Peter Gurney, Jr., is with the U.S. Navy.

Robert Gursky has been employed by Perkin-Elmer Corporation.

Bruce Haley continues at Hughes Aircraft.

Scott Hand is a graduate student at Cornell University.

William Handy is with the U.S. Air Force.

Robert Hansen works for Spectran Corporation.

Timothy Hardy is with Raytheon Company.

Christopher Hatfield has been employed by Boston Gas, Malden, MA.

Blair Hawley holds the post of production control manager at Waring Products in New Hartford, CT.

Kelly Hayes has accepted a post at Raytheon.

Michael Healey is with Raytheon.

Robert Henderson has joined Norton Co.

Scott Heneveld works at IBM.

John Heroux works for General Dynamics-Electric Boat.

Robert Hess is with Sanders Associates.

Charles Hickey is now with General Electric.

Mary Ellen Hickey is with Digital Equipment Corporation.

William Holland has joined IBM Corporation.

Charles Hopkins holds the position of senior engineer at Data General, Westboro, MA. Besides his MSEE from WPI, he has two BS degrees from the University of Maine.

Thomas A. Horan is now with Raytheon.

Thomas E. Horan works for Westinghouse Electric.

Jeffrey Horowitz has accepted a post at Westinghouse.

John Howarth holds the post of project manager at Riley Stoker Corp., Worcester. He has an MBA from WPI.

Michael Hoyt has joined Hewlett-Packard Company.

Gary Iannone works for The Travelers Insurance Co.

Manuel Irujo works for Du Pont.

David Iwatsuki serves as a project leader at Data General Corporation in Westboro, MA. He holds an MBA from WPI.

Daniel Jacavanco is with the U.S. Air Force.

Steve Jackson works for Electric Boat, Groton, CT.

David Jalbert has accepted a post with GE.

Melinda Johnson has joined Digital Equipment Corporation.

Denise Johnston is with Weyerhaeuser Company.

Mark Jutras is now a hardware engineer with Data General, Westboro, MA.

Kun Sok Kang works at Continental Baking.

Jonathan Kaplan works for Camp Dresser & McKee Inc.

Keith Kasregis has joined Raytheon Company.

John Keane, Jr., is with Grumman Aerospace Corporation in Bethpage, NY.

Jean Kelly has joined General Electric.

Stephen Kestner serves as an industrial engineer at Walker Power Inc., Warner, NH.

Sharon Keyes has joined M/A-Com Linkabit, Lexington, MA.

William King works for ITT Electro Optical Products.

Cynthia Klevens is employed as a research engineer by O'Brien & Gere Engineers Inc. in Syracuse, NY.

Enis Konuk is now with Micrion Corporation.

James Krieger has been employed by Digital Equipment Corporation.

Glen Kuo is currently with Telco Systems Inc.

Steven Kurdziel works for Pratt & Whitney.

Daniel LaBella serves as an electronic engineer at Naval Underwater System Center, Newport, RI.

Steven Labitt works at Raytheon Company.

David LaBranche, a second lieutenant with the U.S. Army Corps of Engineers, is attending the Engineer Officer Basic Course at Ft. Belvoir until March. He and his wife, Donna, will then be assigned to Germany.

Christopher Lacey has joined Eastman Kodak.

Steven Lamb has accepted a post at Raytheon.

Robert Laporte, who has an MBA from WPI, serves as a program manager at Nuclear Metals in Concord, MA. He has a BSME and MSME from UMass, Amherst.

Yau-Shing Lee is a graduate student at Columbia University, New York City.

William Lees is a graduate student at Brown University.

Craig Lemmler serves as an associate engineer for Raytheon in Wayland, MA.

Jeff Lenard is at Syracuse.

John Lepore is enrolled in the graduate program at Rutgers University.

Lawrence Leung has been employed at IBM.

Susanne L'Hommedieu has joined Raytheon.

Mark Libby is studying for his master's degree at MIT.

Charlene Linehan works for The Travelers Insurance Co.

Brian Lingard is now associate engineer at Raytheon in Marlboro, MA.

Timothy Loftus has been named as a health underwriter by The Paul Revere Life Insurance Co., Worcester.

Suzanne Logcher is now with Digital Equipment Corporation, Merrimack, NH, where she serves as a software engineer I.

Christopher Logothetis continues at Tufts University, where he is studying for his master's degree.

Paul Lubin holds the post of technical support manager at Polaroid in Cambridge. He has an MBA from WPI and a BS from MIT.

School of Industrial Management

Charles Adams '55, director of procurement for Wright Line Inc., has been elected president of the Purchasing Management Association of Worcester. A certified purchasing manager, he is the 62nd president of the 275-member local association, an affiliate of the 30,000-member National Association of Purchasing Management. Adams has worked for Wright Line for 30 years, spending eight years in production and inventory control and 21 years in purchasing. Prior to becoming president of the PMAW, he had served as vice president and director of the organization, and as chairman of several of its committees.

Kenneth Banfill '85 continues with Coppus Engineering, Worcester. . . . **James Bates** is with Bay State Abrasives, Westboro, MA. . . . **J. Alan Bill** works for Reed Plastics in Holden, MA. . . . **Rodney Breton** is with Plainville (MA) Machine. . . . **Kim Burdon** continues with Bytex Corp., Framingham, MA. . . . **Gilbert Cahill** works for Massachusetts Electric in Worcester. . . . **Robert Campbell** is employed by Norton Company, Worcester. . . . **Richard Cloutier** is with Hyde Manufacturing in Southbridge, MA.

Natural Science Program

Mark Ryan '70, a science teacher at Medford (MA) High School, recently completed a six-week chemistry course sponsored by the Institute of Chemical Education at the University of California at Berkeley. He was one of 50 teachers from 18 states chosen from 140 applicants for the program. The Berkeley workshop, primarily financed by a grant from the National Science Foundation, with additional local support from the Medford School Department, is part of a national effort to improve and influence the quality of science instruction. Among those addressing the group were W.T. Lippincott, director of the American Chemical Society, and Nobel Laureate Glenn T. Seaborg.

COMPLETED CAREERS

Harry P. Storke, tenth president of WPI, died December 4, 1985, in Maguire Veterans' Administration Hospital, Richmond, VA, after a long illness. He was 80 and a native of Baltimore, MD.

Storke was named WPI president in 1962 following his retirement as lieutenant general from a long, distinguished Army career. When he retired from WPI in 1969, *The Worcester Telegram* commented editorially, "He showed a remarkably sophisticated comprehension of what higher education is all about."

President Storke contributed much to WPI and to higher education in general. Many at WPI recall him as a builder. During his tenure, Goddard Hall, Gordon Library, Harrington Auditorium, the administrative center at Alden Research Laboratory and the Stoddard Residence Center were built. A strong believer in cooperation, he was the founder of the Worcester Consortium for Higher Education. He was also a founder and first vice president of the Association of Independent Colleges and Universities in Massachusetts.

In the late 1960s, during a time of tremendous upheaval in higher education, Harry Storke had already established a practice of meeting regularly with student leaders to share views on matters of common concern. He encouraged student self-government. During his tenure, the first two women undergraduates were admitted.

During his presidency, enrollment increased by 35 percent, and the college endowment increased by $25 million. President Storke appointed the original planning committee whose efforts led to the development of the WPI Plan. When the effort was well under way, he retired so that his successor, Dr. Edmund T. Cranch, would have the opportunity to share in the final enactment of the Plan.

Roger Perry '45, director of Public Relations at WPI, remembers vividly a meeting with Stroke in 1968. According to Perry, President Storke leaned back in his chair and said, "I'm afraid I didn't make many friends today."

"*Now* what did you do?" Perry asked.

"I've just appointed a committee of bright young faculty to conduct a study and tell me what this college should be ten years from now." That appointment would become the genesis of the Plan.

David Lloyd, vice president of business affairs and treasurer of WPI, remembers President Storke as a person dedicated to providing strong yet compassionate leadership. His favorite Storkeism is, "When a decision, great or small, has to be made you have two options: 1. Study it so thoroughly that you become so confused with all the information that you likely will end up making the wrong decision, or worse, no decision. 2. Assemble all the facts available in a reasonable length of time and make a decision, at least in concept.

"The odds are that the second option will make you right at least 51 percent of the time."

Says Lloyd, "I believe his commitment to the WPI Plan was the greatest of his correct decisions." In fact, in a recent issue of *U.S. News & World Report,* WPI, in a nationwide survey of college presidents, ranked fourth out of 129 in the East among "larger schools granting more than half their bachelor's degrees in occupations."

William R. Grogan '46, dean of undergraduate studies, remarked recently that President Storke was widely recognized as an outstanding "bricks and mortar" president. "But from my perspective, his greatest contribution was in the academic field. When he arrived at WPI the undergraduate program was almost dead in the water. Working with Dean Price he inspired a new wave of curriculum vitality and the emergence of faculty participation in its own governance."

Prior to joining WPI in 1962, Storke served in the Army for 35 years. He taught ROTC classes for four years at the University of Iowa and also taught English for four years at West Point. He was an originator and the first editor of *Assembly,* the West Point alumni magazine.

A veteran of World War II, he served as assistant commander for the II Corps, field artillery in Italy, and saw action in the five major battles of the Italian campaign. He was then head of the military government in Vienna. He was a veteran of the Korean War, serving as commanding general of the I Corps, field artillery. In that war, he commanded 114,000 American, Turkish, Korean and Thai troops. He was also Army chief of information and chief of Army logistics for Europe in Washington, DC, and rose to commander of allied forces of NATO in southeast Europe.

Storke received numerous service awards, including the Bronze Star, the Distinguished Service Medal, the Legion of Merit and the French Croix de Guerre.

He graduated from West Point in 1926, attended Columbia University and was graduated from the National War College in Washington, DC. He was awarded honorary doctorates from American International College in Springfield, MA, WPI and College of the Holy Cross.

While at WPI, he was a director of Worcester County National Bank, the local American Red Cross, the Worcester Area Chamber of Commerce, State Mutual Life Assurance Co., and the Worcester Orchestral Society. He was a corporator and trustee of Mechanics Savings Bank, and a corporator of the Worcester Boys' Club and Higgins Armory.

A trustee of Worcester Academy, he was also vice president of the Worcester Economic Club, and served on the Massachusetts Higher Education Facilities Commission. He belonged to the American Society for Engineering Education, the Worcester Committee on Foreign Relations, the Newcomen Society, the advisory committee of Faith Inc., the Worcester Club, Tatnuck Country Club, Worcester Rotary, the St. Wulstan Society and the Worcester Fire Society. Later, other memberships were with the Bruton Parish Church and the Middle Plantation Club.

He is survived by his wife, Elizabeth, of Williamsburg, VA; a daughter, Carolyn Mueser of Boulder, CO; two stepsons, Douglas Benson of Clarksburg, MD, and Stephen Benson, of Wilmington, DE; a stepdaughter, Susan, wife of Kenneth Nelson of North Attleboro, MA; four grandchildren, five step-grandchildren, two great-grandchildren and two nephews.

His first wife, Lois Sawyer Storke, died in 1974. Another daughter, Lois, wife of Thomas Davenport of Cleveland, OH, died in 1983.

Ruth R. Taylor, widow of **Herbert F. Taylor '12,** a former alumni secretary and professor at WPI, died August 28, 1985, in Hahnemann Hospital, Worcester. A native of Springfield, MO, she was 92.

Mrs. Taylor was a 1915 honors graduate of Drury College in Springfield, MO, and a member of Pi Beta Phi Sorority. Prior to her marriage, she taught English in an Arkansas high school.

She belonged to the First Baptist Church and First Baptist Church Graduates. For many years she had been a Red Cross bloodmobile volunteer, a Welcome Wagon hostess and a member of the WPI Alumni Wives.

The Herbert F. Taylor Award for distinguished alumni service to WPI was established in her husband's name.

Dr. Leonard Sand, a professor of chemical engineering at WPI for 18 years, died September 20, 1985, in Worcester. He was born in Eveleth, MN, on Oct. 5, 1922.

On April 29 he received the Outstanding Creative Scholarship Award from WPI at the annual faculty dinner for his research in the field of catalysts and the production of uniform synthetic zeolites.

A member of the WPI teaching staff since 1967, Dr. Sand had previously served as chief of the zeolon unit, research and development, of the Refractory Division of Norton Co., Worcester. He was instrumental in developing a synthetic zeolite, a mineral used in the production of petroleum products. He had also been associated with Tem-Pres Inc., the University of Utah (associate professor), Standard Oil and Penn State (research associate).

Dr. Sand received his BA and MA in geology from the University of Minnesota, and his PhD in mineralogy from Penn State. He was a fellow of the Mineralogical Society of America and a member of the Geological Society of America, the Geochemical Society, the Worcester Engineering Society, Sigma Xi, A.I.Ch.E., the American Association of Crystal Growers, International Zeolite Association (executive committee), International Natural Zeolite Association (executive committee), and the Catalyst Club of New England. An expert in his field, he had numerous articles published in professional society journals. He had served as a consultant for Norton Co., Chemetron, Elektrechemiska and Du Pont.

During World War II, Dr. Sand served with the U.S. Army Signal Corps. He belonged to Immanuel Lutheran Church.

Stanton M. Ferguson '18 of Holden, MA, passed away on September 13, 1985. He was born in Pittsfield, ME, on July 4, 1895, and he received his BSCE from WPI.

From 1925 to 1958 Mr. Ferguson was a project and structural engineer with Lynn (MA) Gas & Electric Co. For two years prior to his retirement in 1960, he served the firm as gas distribution engineer. He then joined Valts & Kimberley Inc., Malden, MA, as structural engineer, before his final retirement.

Mr. Ferguson belonged to the Congregational Church and the Masons. He was the father of **Robert G. Ferguson '48.**

Benjamin Luther '18, a retired 38-year employee of General Electric, passed away recently. He was born on October 27, 1896, in Fairhaven, MA, and graduated as an electrical engineer from WPI in 1918.

He joined GE in 1919. Concerned with motor design, he retired as requisition engineer on locomotive controls in 1957. His memberships included SAE, Tau Beta Pi, Sigma Xi, the Masons (32nd degree) and the Shrine. He did volunteer work for the American Cancer Society. A former officer with the Schenectady (NY) chapter of the Alumni Association, he was also a lifetime member of the President's Advisory Council at WPI.

Harold G. Hunt '20 of East Aurora, NY, died on July 10, 1985. A Rutland (MA) native, he was born on Dec. 12, 1897. He was a graduate civil engineer and held an MSCE from Cornell.

During his career he was with Groveton Paper Co., New England Power Co., St. Lawrence Valley Power Corp. Niagara Hudson Power Co. and Niagara Mohawk Power Corp., from which he retired as chief civil engineer in 1963. A professional engineer, he was a member of the ASCE, SPE and Skull.

Joseph P. Harris '27, class president, and a longtime employee of Worthington Pump and Machinery Corp., died of a heart attack in Whittier, CA, on July 26, 1985. He was 80.

The Worcester native was a graduate mechanical engineer. He worked as a sales engineer for Worthington Pump and Machinery Corp., Los Angeles office, for 44 years, retiring in 1970.

Mr. Harris belonged to the Poly Club, Phi Sigma Kappa and Skull. His father, **Clifford** R. Harris (deceased), graduated from WPI in 1896.

George W. Stratton '30 of Rochester, NY, passed away on June 21, 1985, at the age of 78.

He was born in Framingham, MA, and received his BSME from WPI. For four years following graduation, he worked as a civil engineer for the town of Framingham. His career with the New York Central Railroad began in 1936 when he became a trainee for the post of engine house foreman in Buffalo.

During World War II, he transferred from the Navy Reserve to the rank of captain in the 701st Engineers of the U.S. Army Reserve. He organized the transportation of American soldiers by train from the military bases to New York City where they would be sent overseas.

After the war, Mr. Stratton worked for New York Central as a terminal foreman, a statistician and in other management positions. He retired in Rochester in 1964.

A master chef, he enjoyed cooking and spent many hours catering dinners for several large churches. He was also a licensed electrician and surveyor, as well as a skilled upholsterer. Both he and his wife, Eleanor, did volunteer work at Asbury Methodist Church. He was a member of Lambda Chi Alpha.

R. Lincoln Stone '34 died April 19, 1985, in Worcester following a short illness. He was 72 and a native of Otter River, MA.

After studying electrical engineering at WPI, he joined L.S. Starrett Co., Athol, MA. He worked at the company from 1937 to 1977, when he retired as head of the experimental department.

From 1942 to 1966 he was town moderator in Templeton, MA. He was a past chairman of the Templeton Bicentennial Committee and was instrumental in creating the Otter River Recreational Association. He also served on the Massachusetts Industrial Finance Association and was director of the Elizabeth W. Lord Scholarship Fund.

His memberships included the Masons and Lambda Chi Alpha. He served as moderator, deacon, soloist and director of the choir for the First Church of Templeton. For 35 years he played string bass in dance bands. Other interests included boating, the U.S. Coast Guard Auxiliary and ski patroling.

Wesley A. Proctor '35 died on June 19, 1985, in Bradenton, FL, after a long illness. The Saugus, MA, native was 73.

A structural engineer, he retired in 1970 from Stafford Iron Works Inc., Worcester, where he served as president and general manager for many years.

During the 1960s, he served on the Leicester, MA, board of selectmen, two years as chairman. He was also on the town advisory board and the chairman of the town's first planning board.

Mr. Proctor was past commander of the Blue Water Flotilla, Coast Guard Auxiliary, in Worcester and the Nauset Flotilla, CGA, in Orleans, MA.

Norman M. Gamache '38, for many years an employee of Norton Co., passed away at his home in Worcester on September 3, 1985. He was born in Leominster, MA, on Aug. 3, 1915.

After studying at WPI, Mr. Gamache joined Norton Company's Grinding Machine Tool Division in the experimental department. In 1957 he was named a product engineer in the product engineering department of the Grinding Wheel Division. After retiring from Norton, he was a consulting abrasives specialist at Ramsdell Industrial Supply Co.

Mr. Gamache belonged to SAE, the Blessed Sacrament Church, the Massachusetts Professional Engineers' Association, the Tech Old-Timers and the Poly Club. He had served as a coach for the West Side Ruth League and as a Worcester representative on the WPI Alumni Council.

Malcolm R. Chandler '39, the retired building manager of One Thousand Corp. of Hartford, CT, passed away at his home in Canton, CT, on May 15, 1985. He was 67 years old and a graduate civil engineer.

The Haverhill, MA, native, who worked for a year with the TVA in Knoxville, TN, was a Marine veteran of World War II. For 28 years he was with the former A.F. Peaslee Corp. (estimator) in South Windsor, CT. For three years before retiring in 1982, he was building manager at One Thousand Corp. For 16 years he was with the Canton Town Planning Commission.

Mr. Chandler belonged to Phi Gamma Delta, the Poly Club, Skull and Tau Beta Pi. He was the father of Alan Chandler '75.

William J. Sexton, Jr., '39, died at his home in South Wellfleet, MA, on August 1, 1985. He was born in Hartford, CT, on June 11, 1916.

He spent three years as a Coast Guard commander in the South Pacific during World War II, and remained active in the Coast Guard Reserve until 1975.

Prior to the war, he worked for Aetna Life Insurance Co. as a special agent. After the war, he joined Kelly Trucking Co., Torrington, CT, where he was employed until his retirement ten years ago.

After retirement, he and his wife moved to South Wellfleet, where he became active in community affairs. He served on the Wellfleet Personnel Board, Board of Appeals, and with the Civil Defense group. He was the Wellfleet representative on the Cape Cod Regional Transit Authority Board and was involved with the Coastal Zone Management program. For several years, he did volunteer work for the FISH organization.

George H. Loewenthal, Jr., '41, of Middle Haddam, CT, died suddenly of a heart attack on June 24, 1985. He was 67, a native of Middletown, CT, and a graduate mechanical engineer.

For many years he served as president and treasurer of Loewenthal Lumber Company, Middletown. He was an Air Force veteran of World War II. An incorporator of Farmers and Mechanics Savings Bank and Middlesex Memorial Hospital, he also was a former member of the advisory board of Connecticut Bank & Trust Co. He belonged to the B.P.O.E. and the Methodist Church, as well as to Phi Sigma Kappa.

Ralph G. Fritch '42, former business manager of the North Reading (MA) Public Schools, died September 13, 1985, in Melrose, MA, at the age of 65. A graduate mechanical engineer, he was born in Somerville, MA.

Last June Mr. Fritch retired after 12 years of distinguished service as the chief financial officer of the school department. Prior to joining the North Reading schools, he was employed as a supervisor by the Boston and Maine Railroad, and had headed his own firm, Hawkes Grinding and Tool Corp. He had also been director of exhibit productions at the Boston Museum of Science.

His memberships included ATO, the WPI Alumni Council, the board of governors of the Sandy Bay Yacht Club and the Rockport South End Association (president). He was also active with his local Congregational Church and Wyoming Lodge, as well as the Melrose (MA) Boy Scouts (council vice chairman). Interested in the history of railroads, he belonged to the New England Railroad Club and the Association of Railroad Superintendents.

Herbert M. Goodman '42 and his wife, Phyllis R. (Prenn) Goodman, were killed in a single-engine plane crash on Interstate Route 95 in Warwick, RI, on September 21, 1985. Mr. Goodman, a graduate mechanical engineer, was 64 and a native of Worcester.

The founder, owner and president of Herbert Engineering Inc., Worcester, Mr. Goodman was a prominent commercial and industrial developer. In addition, he served as manager of Herbert Management Group. In 1973 he received a professional manager citation from the Society for Advancement of Management.

He was a past president of the Worcester chapter of the Society for Advancement of Management, and a member of Shaarai Torah Sons of Abraham Synagogue West and its Brotherhood, Beth Israel Synagogue and Worcester Lodge 600, B'nai B'rith, Sigma Xi and AEPi. Also, Mount Pleasant Country Club in Boylston, the American Bonanza Society, Probus Club, and the Aircraft Pilots and Owners' Association. In World War II he served with the U.S. Navy.

Mrs. Goodman graduated from the University of California at Los Angeles, where she majored in music. She was a lyric soprano and sang at Carnegie Hall in New York City and at the Hollywood Bowl in Los Angeles. Active with synagogue activities, she also recently spearheaded a drive for passage of state legislation granting grandparents visitation rights with their grandchildren in case of divorce or death of the parents.

Charles H. Parker '42 of Laguna Niguel, CA, passed away last February. He was born in Akron, OH, on July 12, 1920, and graduated as a chemical engineer. In addition, he held an LLB from George Washington University.

In World War II he was an ordnance specialist with the U.S. Navy. He served in the Navy again from 1951 to 1957. Other employment was with Food Machinery & Chemical Corp. and Robert U. Geib (law firm). In 1957 he joined Aerojet-General Corp., Sacramento, CA, where he was a quality engineering department supervisor. He was a retired industrial consultant for the U.S. Naval Weapons Station and a member of Theta Chi.

Joseph S. Marcus '44, who recently retired as associate dean of engineering at the University of Massachusetts-Amherst, died November 1, 1985, at his home in Amherst, MA. The 64-year-old Worcester native graduated with a BS in chemical engineering from WPI, later receiving his MSCE from the University of Massachusetts.

He taught civil engineering at the University for 37 years. Last January he retired. He was a former adviser to many student organizations at UMass, a past national officer of the American Society for Engineering Education and a member of Tau Beta Pi. The president of the National Yiddish Book Center, he was also past president of Congregation B'nai Israel in Northampton.

As associate dean of the School of Engineering, Prof. Marcus took a leading role in expanding undergraduate opportunities, including the women's engineering program. He instituted projects that fostered greater cooperation between the university and high schools and community colleges, and was instrumental in establishing the Smith College-UMass Dual Degree Program in Engineering.

George Marston '30, the first dean of the School of Engineering at UMass, hired Marcus as an instructor in civil engineering in 1948. Over the years they became close friends. "I always thought highly of Joe Marcus," he says. "He was a gifted administrator, and above all, a respected counselor of students and associates. His greatest recognition came from the many students and alumni who counted on him as a friend and advisor. He was a loyal alumnus of WPI, yet he made a major contribution to his profession through education at a neighboring institution. At the university, he served under five different deans of engineering, and I was most fortunate to have been one of them. One of them

STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION

Title of Publication: WPI JOURNAL (ISSN 0148-6128)

Frequency of Issue: Four times a year

Location of Known Office of Publication: Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA 01609

Headquarters of the Publishers: Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA 01609

Publisher: Worcester Polytechnic Institute, Worcester, MA 01609

Editor: Kenneth McDonnell, 100 Institute Road, Worcester, MA 01609

Owner: Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA 01609

	Average Each Issue Preceding 12 Months	Actual Number, Issue Nearest Filing Date
Total number printed	22,000	22,500
Paid circulation	—	—
Free distribution	21,600	22,100
Total distribution	21,600	22,100
Office use, etc.	400	400
Total	22,000	22,500

said to me, 'Joe Marcus was a most unique person, admired by all who knew him. He will be missed.' "

During his career, Prof. Marcus received three awards from UMass, including the Chancellor's Medal for his service to the university, the Metawampe Award from the students and the Distinguished Teaching Award. In October the university designated the former Engineering East Building as Joseph S. Marcus Hall. It also created the Joseph S. Marcus Yiddish Book Collection at the university library.

Harry F. Ray '60, manager of the Trenton (MI) plant of the Monsanto Industrial Chemicals Co., died suddenly on September 20, 1985, after suffering a heart attack at his home in Grosse Ile, MI.

He was born in West Palm Beach, FL, on Dec. 14, 1938, and received his BS in chemical engineering from WPI. He also earned a master's degree in chemical engineering from Washington University in St. Louis, MO.

After joining Monsanto at the W. G. Kummrich plant in 1960, Harry received progressively more responsible assignments. In 1979 he was named plant manager at Trenton. Colleagues, shocked at his unexpected death, were saddened by the loss of his leadership, but noted that he has left a legacy of confidence in the Trenton plant's ability to perform.

Paul Bayliss, president of the Alumni Association, said, "We will remember Harry for his quick wit and good humor. He was always ready with a joke and a smile. He was active in alumni affairs and was a key member of our 25th-reunion class gift solicitation team. Harry maintained close ties with WPI and many of our alumni. We have all lost a very dear friend."

Harry belonged to Phi Sigma Kappa, PDE, Skull and the Poly Club. Other memberships included the Downriver Community Conference Growth Alliance, the American Theater Organ Society and Rotary International. He is survived by his wife, Thyra, and three children, Tim, Kevin and Susan.

Donald A. Taylor '60 died October 12, 1985, at his home in Perrysburg, OH. He was 51, a graduate civil engineer, and a native of Brattleboro, VT.

He had been employed as a project superintendent at Sterns Catalytic Inc. in Toledo, OH, for 25 years. Earlier he was briefly with Du Pont. A past president of his local school board, he also belonged to the Presbyterian Church. He was a member of Sigma Phi Epsilon and the Poly Club.

Stephen T. Harrington '66 died at Hartford (CT) Hospital on June 23, 1985, following a four-year illness. He was 41.

He was born in Providence, RI, and received his BSEE from WPI. For a number of years he was with Pratt & Whitney Aircraft-United Technologies, East Hartford, CT. He had an MBA from the University of Connecticut.

Thomas D. Craig, Jr., '67SIM, a longtime employee of Crompton & Knowles, died in Charleston, SC, on May 25, 1985, at the age of 63.

While with Crompton & Knowles in Charlotte, NC, he served as manager of special projects. Previously he had been with the firm in Worcester. In 1983 he formed his own textile machine company, the Thomas Craig Co.

Mr. Craig graduated from Norwich University. He belonged to the Narrow Fabric Institute and the American Textile Machinery Institute. Also, he was a former member of the Northern Textile Association, the Charlotte Textile Association and the Southern Textile Club.

Thomas J. McGinn, Jr., '68MNS, a math and science teacher at Woodward School in Southboro, MA, for 24 years, died July 20, 1985, in Worcester following a long illness. He was born in Worcester on June 16, 1938.

Besides his degree from WPI, he held two degrees from Holy Cross. He was a retired officer from the U.S. Navy. A member of the National Education Association, he was a member and past president of the Southboro Teachers' Association. He also belonged to the Westboro Firefighters' Volunteer Department and St. Luke's Church, as well as to the Jaycees and the Knights of Columbus.

Ralph M. Banwell, Jr., '80SIM, vice president of sales for CPC Engineering Co. of Sturbridge, MA, died May 8, 1985, in Southbridge, MA. He was 60 and a native of Woburn, MA.

He joined CPC in 1955 as a sales manager and in 1960 was named manager of sales. In 1964 he was promoted to vice president. A graduate of Tufts University, he was a Marine veteran of World War II.

Mr. Banwell was a past president and Paul Harris Fellow of the Sturbridge Rotary Club. In addition, he was a member of the Brookfield Congregational Church and the Elm St. Congregational Church in Southbridge. He was a Royal Arch Mason and active in the Boy Scouts of America (Eagle Scout).

David L. Thompson '81, a molecular biologist and laboratory technician at Genetics Research Institute in Cambridge, MA, was killed in a motorcycle accident on July 26, 1985, in Waltham, MA. He was born in Cambridge on March 1, 1959, and received his BS in life sciences from WPI.

Prior to joining Genetics Research Institute, David had worked for another Cambridge firm, Biogen. He belonged to Tau Beta Pi.

FEEDBACK

Editor:

I was delighted to see that Elmer Scott ['41, deceased] and Charlie Schmit ['46] were elected to the Athletic Hall of Fame. I was playing freshman baseball when Elmer had his lung punctured while blocking home plate. What a tough guy he was!

Charlie and I played basketball together for two years. He was a tremendous ball handler and defensive player. I remember so well the last few minutes of games we were winning—we'd just give the ball to Charlie and he'd dribble the time away. In football, my clearest memory of him was on fourth down, when he would drop back to punt and invariably run for the first down.

My congratulations to Charlie and posthumously to Elmer. It's hard to appreciate the kind of athletes they were unless you've played with them.

William E. Stone '44
North Falmouth, MA

Editor's note: Bill Stone was quite an athlete himself while at WPI, competing in basketball, baseball, track and swimming.

Editor:

Since I am an admirer of the Art Deco, Art Moderne and early International styles, I enjoyed Robert Kanigel's "The Garage War" (August 1985). I especially took delight with the Shell station that lit up all its walls.

However, I think it is misleading to say that architecture was influenced by automobile design, or even that the style of design of automobiles of that era contained original elements inspired by the particular design requirements of motorized transportation. In fact, the winds of fashion blow equally on all sails, and so the "streamline era" was an expression of society's ever quickening pace which was applied concurrently to architecture, appliances, furniture and the different modes of transportation: cars, trains, planes and even boats. The GM pavilion pictured in the article plainly showed the form of a massive railroad locomotive, so it could hardly be said that the building's design was inspired solely in the image of automobiles. If any one mode of transportation could claim to be the originator of streamlined design, it would be airplanes, since they alone at that time stood to benefit materially from reduced aerodynamic drag.

While the automobile has indeed, as Mr. Kanigel has amply demonstrated, had a profound effect on the architectural configuration of homes and other structures that involve use of autos, origination of the "streamline era" of design is not something the automobile can uniquely claim.

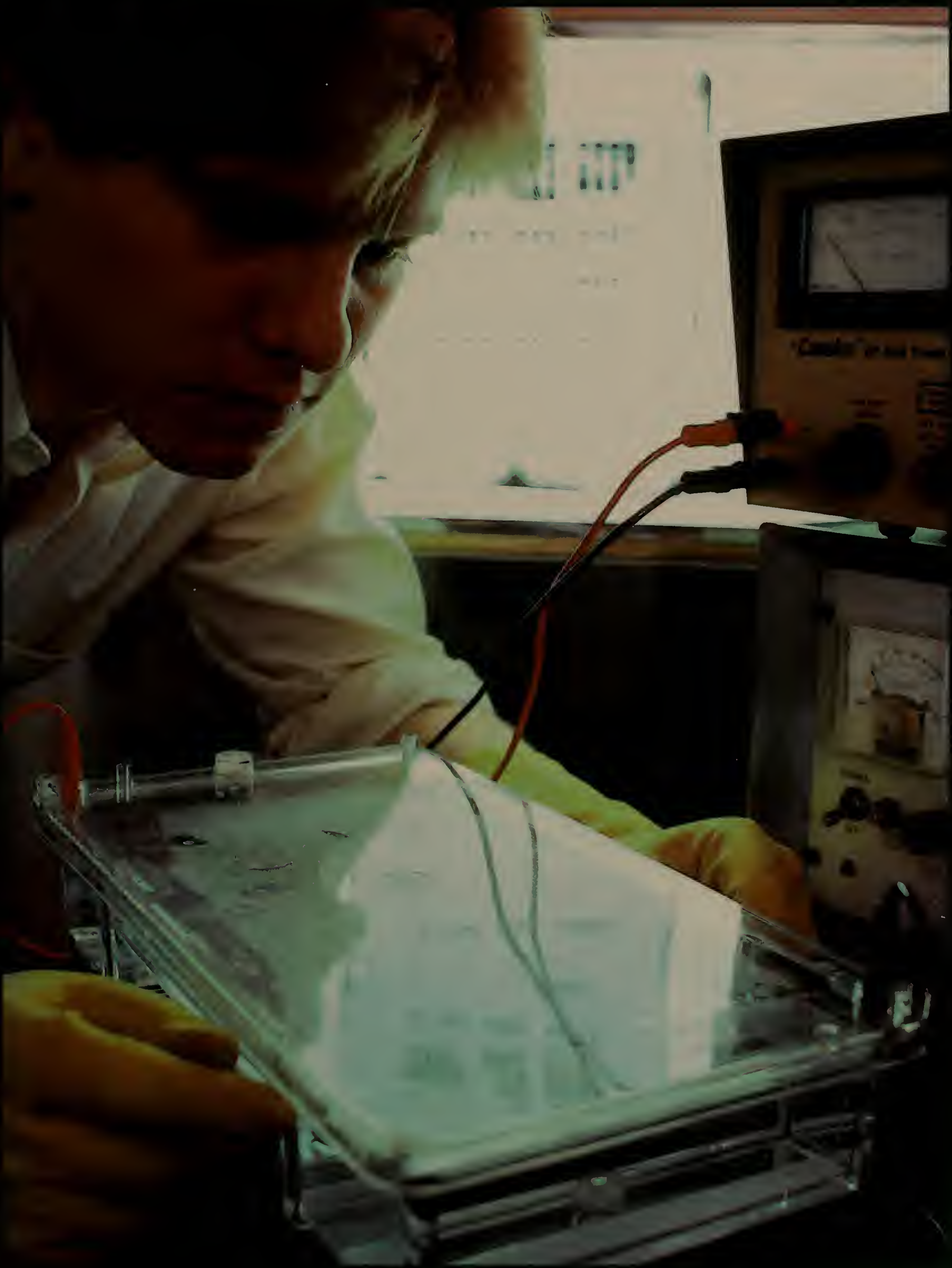
Jeffrey English
Troy, NY

MARK YOUR CALENDAR

Classes of 1926, '31, '36, '41, '46, '51, '56, '61, '66.

WPI Journal

WORCESTER POLYTECHNIC INSTITUTE MAY 1986



Biotechnology: The New Frontier

Higher Education in Japan • WPI's Expert Witnesses

A MESSAGE

From Dr. Jon C. Strauss
President

As you read this message, Richard Gallagher, dean of the faculty, Donald Berth, vice president for university relations, and I will have completed cross-country pre-inaugural tours that enabled us to meet with hundreds of alumni and friends. The fundamental message we carried to those groups was one of our excitement for WPI and for the challenges ahead.

In 1935, Ralph Earle, WPI's sixth president, captured the essence of our message when he noted: "The state of the college is excellent, but if we stop progressing or changing, we will atrophy."

As in 1935, the state of the college is indeed excellent:

- The WPI Plan is widely recognized as one of the most innovative and appropriate curricula of any college or university.
- Our students come to us with outstanding quality indicators and leave with excellent problem-solving and communication skills.
- Our faculty is first-rate, demonstrating excellence in teaching, and improving in peer recognition for its scholarship and research.
- Our staff members are loyal and hard-working.
- Our alumni are generous of both their time and their financial support and are justifiably proud of their alma mater.
- Our trustees are excellent stewards of the college both as a corporation and as a living institution.
- Local and national foundations and corporations as well as many individual benefactors are increasingly generous in their support of the college.
- Our physical plant is exceptional. Many of our buildings are old, but nearly all have been renovated and maintained to the most modern standards.
- Our finances are in excellent shape: We borrow little, and our endowment of almost $68 million is quite respectable for a college of our size.

However, with the half-life of engineering knowledge now estimated to be less than five years, it is today even more imperative than it was in the days of President Earle that we not for a minute stop moving forward with ever greater momentum.

Dick Gallagher and I are working with the deans, department heads, and faculty to develop WPI's strategy for excellence. The key elements of our plans for moving WPI toward the 21st century are based on five integrated steps:

1. Identify existing strengths. In every department, we have specific areas of strength: gene structure and function in biology; noninvasive sensors and physiological modeling in biomedical engineering; catalysis and biochemistry in chemical engineering; photochemistry; computational mechanics and construction management in civil engineering; artificial intelligence in computer science; image processing and power systems in electrical engineering; music and history in humanities; manufacturing technologies in management; fluid dynamics, laser holography, and robotics in mechanical engineering; spectroscopy in physics; and fire protection engineering. The list goes on.

2. Reinforce existing strengths with additional resources. Stanford University refers to its most outstanding disciplines as "steeples of excellence." Stanford's move to pre-eminence in the 1950s was based on a strategy of identifying these steeples, reinforcing them with faculty and resources, and then filling in the "valleys" starting where the synergy was greatest. This strategy will work for WPI as well.

3. Encourage faculty members to improve their personal scholarship. At WPI, every faculty member in our areas of strength is involved in personal scholarship oriented toward research. Many other faculty members, perhaps not as well known for their research, are also active in scholarship focused in many instances on education. We all may not be researchers in the traditional sense, but as members of the academic community we all should be "scholars." We should be developing new ideas and approaches, presenting them to our colleagues, and defending them before our peers. Scholarship is our common ground. It is what unites us.

4. Improve student recruiting. WPI offers an excellent "product" at a competitive price. We must, however, do a better job of apprising outstanding prospective students of this quality and encouraging their matriculation. The number of secondary school graduates will drop by more than 40 percent in the next decade in the Northeast, and by more than 20 percent nationwide. Consequently, WPI must increase its market share in order to maintain enrollment and enhance quality.

5. Improve our recognition. WPI, like Worcester itself, is not as well known as an institution of its quality deserves to be. To enhance our reputation, we must secure the resources necessary to develop programs and recruit faculty and students. But to accomplish this, we must be better recognized. It's a chicken and egg situation.

With your help and the proper implementation of the strategies outlined here, we can break what appears to be a closed loop and turn it into an expanding spiral of greater quality, leading to greater recognition, leading to greater resources.

As Albert Camus, the Nobel laureate noted, "An achievement is a bondage: it binds one to greater achievement."

WPI is in bondage to its past achievements, and they challenge us for the future. We are about to embark on a major effort to raise the resources necessary for WPI to rise to these challenges. We hope and expect that each member of the WPI family will join us in making WPI all that it can be.

WPI Journal
WORCESTER POLYTECHNIC INSTITUTE

VOLUME 89, NUMBER 4

MAY 1986

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, Hartwick College, Johns Hopkins University, Villanova University, Western Maryland College, Worcester Polytechnic Institute) and appear in the respective alumni magazines of those institutions. Second class postage paid at Worcester, MA, and additional mailing offices. Pages 1-22, 39-60 1986, Worcester Polytechnic Institute. Pages I-XVI © 1986, Johns Hopkins University.

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

Diverse views on subjects of public interest are presented in the magazine. These views do not necessarily reflect the opinions of the editors or official policies of WPI. Address correspondence to the Editor, *The WPI Journal*, Worcester Polytechnic Institute, Worcester, MA 01609. Telephone (617) 793-5609. Postmaster: If undeliverable please send form 3579 to the address above. Do not return publication.

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Cover: In a molecular biology laboratory, Russell Brierly '86 M.S., who is now employed by Upjohn Company, uses agarose gel electrophoresis to analyze recombinant DNA molecules. Photo by Michael Carroll.

Joaquim (Joe) S.S. Ribeiro '58 ME

WPI Names Alumnus V.P. for Business Affairs

Joaquim (Joe) S.S. Ribeiro '58 ME has been named vice president for business affairs. Ribeiro is former vice president and chief financial officer for Infocom, Inc., a developer and marketer of interactive software for personal computers in Cambridge, MA.

Ribeiro began work in January, succeeding David E. Lloyd, who is retiring after 32 years of service to WPI. (A profile of David Lloyd begins on page 20.)

In his new post, Ribeiro is responsible for all of WPI's business and financial operations, including budget preparation and control, together with investment administration.

Before assuming his post at Infocom, Ribeiro was vice president and chief financial officer for Jamesbury Corporation, a Worcester-based manufacturer of industrial valves and controls, which was acquired by Combustion Engineering in 1984.

Howard G. Freeman '40 ME, founder and president of Jamesbury and chairman of the WPI Board of Trustees, calls Ribeiro "an exemplary individual, enormously competent in the world of finance . . . he's just a great guy."

President Jon C. Strauss echoed these sentiments, saying of the announcement, "Joe brings excellent financial skills, enthusiasm and community contacts to WPI. We'll miss Dave Lloyd's leadership, but we know the financial health of the Institute continues in good hands."

Ribeiro serves on the boards of directors of several local educational, banking and hospital organizations. He, his wife, Sarah, and five children reside in Jefferson, MA.

Institute Appoints Graduate Dean and Research Administrator

The Institute has announced the appointment of a new full-time dean of graduate studies and research and the creation of a new administrative post, director of research administration, according to Dr. Richard H. Gallagher, vice president and dean of the faculty.

William H. Taft, a geologist by training and an environmental consultant, became WPI's full-time dean of graduate studies and research in April. He succeeds Dr. Wilmer L. Kranich, who retired in June 1985 after 37 years of service to WPI.

Andrew W. Shepard

With the appointment of Taft, WPI is expanding the position of graduate dean from its traditional half-time status to a full-time post, according to Gallagher.

"Graduate education is playing an increasingly vital role at WPI," says Gallagher. "Our graduate programs are rigorous and well-respected on their own. By expanding this position to full-time we are recognizing the growing task of managing the widening scope, and size, of the WPI graduate program."

Taft, a native of San Francisco, received both his B.S. and Ph.D. degrees from Stanford University and his M.S. from the University of South Dakota. He taught geology at the University of South Florida in Tampa from 1963 until 1978. During that time, he also held several administrative positions at the University, including director of research and director of graduate studies.

There he established the Research and Development Center, designed to facilitate the creation of multidisciplinary research endeavors, as well as a research group focusing on exceptional children and adults.

To complement the growth of graduate activity at WPI, Andrew W. Shepard has

William H. Taft

been named to fill the post of director of research administration. A 1975 graduate of Tufts University, Shepard was supervisor of sponsored programs accounting for Tufts until 1983. In that position he oversaw the cost accounting and control of more than $25 million in federal and private research grants and contracts annually. In 1983, he joined the staff of the Dana-Farber Cancer Institute in Boston as manager of research administration.

At WPI, Shepard's role will include supervising funded faculty research. In 1985, sponsored and contract research revenues for WPI and the WPI Alden Research Laboratory totaled nearly $4 million. Shepard will also assist faculty with the preparation and submission of research proposals to various agencies, administer WPI's patent and copyright programs, publish research reports and inform faculty of new sources of funding.

Questions Linger on Future of Space Shuttle Projects

In the wake of the tragic flight of the space shuttle *Challenger* on January 28, questions have surfaced on campus and off surrounding the future of WPI's joint venture with MITRE Corporation, of Bedford, MA. Prior to the *Challenger* catastrophe, WPI students had been busily preparing experiments for liftoff aboard a space shuttle flight originally scheduled for late 1986.

Now, several months later, the questions linger. But according to EE Professor Fred J. Looft III, a member of the program's Technical Steering Committee, "NASA has instructed us to proceed at full speed to prepare our GASCAN [Get Away Special Canister]. Still, there's no way to predict when our canister will be launched."

MITRE Corporation, a non-profit government contractor, supplied the canister hardware necessary to house and protect the five experiments planned for the flight, experiments ranging from a solid-state earth imaging system, to a space-based energy generation device.

However, Looft notes, according to his contact person at NASA, it is likely that, once shuttle flights begin again, WPI's GASCAN will be among the first of many to go aloft. He adds that up to 30 canisters can be loaded into the shuttle's 60-foot-long cargo bay. And with the backlog of flight-ready GASCANs reported to number about 50, WPI's students and faculty advisors may well see their experiments tested relatively soon.

One more element enters the equation, he says. "The early flights of the shuttles will carry non-commercial payloads—no commercial satellites or experiments because of insurance companies' reluctance to underwrite potentially devastating losses.

"These flights will be essentially engineering and evaluation flights," he adds, "leaving lots of room on board for GASCANs."

In another recent development, MITRE has offered WPI a second GASCAN. Preparation of GASCAN II experiments, according to Looft, is also proceeding at full speed, in one of the Institute's most challenging and rewarding project programs.

A reception for Jon and Jean Strauss at Boston's Computer Museum was the fifth stop on a national tour that will carry Dr. Strauss' message for the Institute's future to alumni in 21 cities. The tour will culminate with Dr. Strauss' inauguration on May 10—the 121st anniversary of the signing of WPI's charter by the Commonwealth of Massachusetts. Left to right: Jon C. Strauss, Robert ('85 M.B.A.) and Patricia ('75) Flaherty, Judy Nitsch '75 and Jean Strauss.

Winter Sports Wrap-up

Senior guard Kimberly Fay set a new standard for women's basketball at WPI, as she completed her career with 1,475 points. The four-year starter and All-New England performer surpassed the mark set by Terese Kwiatkowski '83 who had 1,454 career points. Fay led the Engineers to a 13–10 record and an appearance in the MAIAW Tournament. Her play also helped first-year head coach Naomi Graves get her collegiate coaching career started on the winning road.

The men's basketball team also compiled a 13–10 record, marking the Engineers' fifth straight winning season, a feat accomplished only once before at WPI. Junior guard William McCullen helped ease the loss of Greg Fiddes and Orville Bailey, both '85 graduates, as he averaged 19.4 points per game in his first starting season. With almost everyone back next year, WPI should once again contend.

WPI wrestling continued its dominance in New England as the Engineers posted a 15–1 dual meet season and captured second place in the NECCWA Championships. Senior Nickolas Triantafell was undefeated in dual meets. He and two other NECCWA WPI champs advanced to the NCAA Division III Nationals.

Men's swimming turned in a winning season and a strong showing at the New Englands. Freshman Andrew Owen beached many opponents this season and could own the WPI record books before he's through.

Women's swimming came on strong at the end of the season and showed promise for the future.

Two men's tracksters placed in the Indoor New Englands, but all efforts are directed toward the spring season and competition on WPI's new all-weather track.

In early March, WPI was notified that the new running track, made of multi-colored Action Track 400T, received the Goddard Award for Aesthetic Excellence presented by the U.S. Tennis Court and Track Builders Association at its annual convention. The installers, American Surfacing Company of Baltimore, MD, received the actual award, and WPI will receive a plaque.

As part of renovations to its outdoor recreational facilities, the college installed the track last fall as well as the Omniturf multi-purpose field, lighting systems and scoreboards, and other improvements.


Michael Carroll

Tuition and Fees Up for 1986–87

Worcester Polytechnic Institute has announced that tuition and fees for the 1986–87 college year will be $9,820, an 8.2 percent increase over the previous year. Total estimated cost for a typical resident student for room, board, tuition and fees will be $13,315.

In addition, the Office of Residential Life announced increases to campus housing costs ranging from $200 to $300 for next year, depending on the particular residence and whether the arrangement is for single, double, triple or quadruple housing.

The WPI *Undergraduate Catalog* for the current year lists tuition and fees at $9,008 with an estimated average room and board charge of $3,410.

Nationwide, total college costs are expected to rise an average of 5–6 percent next year, according to an American Council on Education report released in March.

In his letter to parents announcing the tuition increase, President Jon C. Strauss wrote, "WPI tuition and fees are set so that the resulting predicted revenue from all sources will cover the total costs required to maintain the quality of a WPI education.

"Additional support from philanthropic foundations, from industry, and from our alumni, parents and other friends of WPI is a gratifying response to our efforts to provide a quality education and setting," continued Dr. Strauss. "Further, this support covers almost half the total real cost of a WPI education."

Richard W. Lyman to Deliver Commencement Address

Richard W. Lyman, president of the Rockefeller Foundation since 1980 and president emeritus of Stanford University, will deliver the commencement address at WPI's 118th graduation exercises on May 24.

The Rockefeller Foundation is one of the most distinguished philanthropic organizations in the United States with a record of outstanding achievement in agricultural, population and health sciences; international relations; and the arts and humanities.

Before being named to head the Rockefeller Foundation, Lyman had served for 10 years as the president of Stanford University. A *New York Times* profile written at the time Lyman was named to head the Rockefeller Foundation commented that he had "acquired a national reputation as one of the country's most prominent educator-administrators, providing firm leadership during the time when the university, like many others, was torn by student demonstrations against the war in Vietnam."

Lyman was born in Philadelphia in 1923. He is the son of the late Charles M. Lyman, a 1921 graduate in chemistry from WPI, and Aglae Lyman, who now resides in Palo Alto, California.

After serving with the U.S. Army Air Force for three years during World War II, Lyman graduated from Swarthmore College in 1947. He earned an M.A. in 1948 and a Ph.D. in 1954 from Harvard University.

During his academic career, Lyman distinguished himself as a historian. Among his numerous publications are *Major Crises In Western Civilization* (with Lewis W. Spitz), published in 1965, and *The First Labour Government*, 1957. Lyman was also a special correspondent for *The Economist* between 1953 and 1966.

Sigma Phi Epsilon To Reopen

According to Bernard H. Brown, vice president for student affairs, Massachusetts Beta chapter of Sigma Phi Epilson will reopen in the fall of 1986. This

Roger Perry Jr. '45

In March, 106 area high school students participated in the 31st annual Worcester Regional Science and Engineering Fair, held in Alden Hall. The winners were John Butare, for his project "How Effectively Can a Robot Define, Operate in, and Adapt to Diverse Environments?" and Athena Demetry for "The Bending Strength of Turkey Leg Bones." Athena is the daughter of Electrical Engineering Professor and Mrs. James S. Demetry.

action concludes months of collaboration between the fraternity leadership and the Institute's administration.

During the summer of 1985 the Sig Ep chapter was closed by a decision of the fraternity's alumni board. Reasons cited for the closing included noncompliance with WPI hazing and Interfraternity Council (IFC) guidelines.

Originally, the fraternity was to reopen no sooner than the fall of 1988. But since the decision to close was made by the fraternity alumni, and not the WPI administration, the option existed for reopening earlier.

WPI and the alumni board of Sig Ep have approved the plan. In conjunction with the national office of Sigma Phi Epsilon, the WPI Sig Ep alumni and the college have issued several guidelines to be followed during the first year of reinstatement. According to IFC President Michael Gonsor '86, those guidelines include having a member of the national fraternity staff based at WPI from September to December 1986 and insuring that the alumni take an "active role" in house activities.

In addition, Sig Ep will remain on academic probation for the 1986–87 academic year.

During the 1984–85 school year, approximately 48 members lived in Sig Ep's two houses, located adjacent to one another on Boynton Street at Institute Road.

All of the Sig Ep brothers removed from the house last May are presently recognized as suspended members, though upon graduation they will be given full privileges as alumni members.

If the reopening does take place as scheduled, all remaining suspended members (who will be members of the class of either 1987 or 1988), may be fully reinstated.

Brown also announced that Sig Ep will be the first fraternity at WPI to have a dry rush, in the fall of 1986. This has become a widespread trend across the nation, though the IFC has yet to adopt this policy campuswide. A representative of the fraternity's national organization will assist in function planning for the coming year, says Gonsor.

Commenting on the planned reopening, Brown indicates that he is "very interested" in seeing the chapter reopen. Parents of the brothers, he says, "played an important role in the process."

"There was a history of problems associated with the fraternity," he says, and adds that he believes these problems have been resolved. On the subject of Sig Ep's dry rush, Brown indicates that the Dean of Students staff has been "encouraging a dry rush," and that he hopes "the IFC will adopt this policy for all Greek organizations on campus."

Richardson Appointed Dean of Students

Janet Begin Richardson has been appointed Dean of Students, according to Bernard H. Brown, vice president for student affairs at WPI. Richardson was formerly associate dean of students.

"Janet's qualifications as a professional educator, her goals for the dean of students' office and her proactive approach to student life issues should bring an exciting dimension to the student affairs division," Brown says.

Dean Richardson will oversee areas of student affairs such as residential life, fraternities and sororities, student activities, and the international student program.

Before coming to WPI, Richardson, who received her B.A. from Salem State College and her M.S. and Ed.S. from the State University of New York (SUNY) at Albany, was an administrator at Pennsylvania State University. Among the positions she held there were area coordinator in the residential life program and coordinator of the Interest House program.

Prior to that, she was residence hall director at State University College of New York in Oneonta, admissions counselor at SUNY-Albany and resident assistant at Salem State College.

She is married to Donald G. Richardson, technical reports librarian in Gordon Library. They live in Worcester and are the parents of one son, Matthew.

Marvin Richmond

Janet Begin Richardson

By Paul Susca

As WPI crosses the new frontiers of biotechnology, faculty members and students are uncovering mechanisms of life itself. And to find solutions to human problems, they're exploring the worlds of everything from brine shrimp to slime molds.

When the lilacs are in bloom on Cape Cod, the horseshoe crabs come home to spawn. And every day at sunrise during May and June, fishermen walk along the shores and shallows of Cape Cod's Pleasant Bay scooping hundreds of the largest egg-laden females into plastic buckets. Then they haul the buckets off to a factory in nearby Falmouth, where workers use hypodermic needles to drain off a third of each crab's cloudy blue blood. On an average day, the Falmouth plant processes about 1,200 horseshoe crabs. The harvest continues until October, when the crabs go out to sea.

All of this has Professor Daniel G. Gibson III and junior Maureen O'Leary worried. O'Leary, herself from Falmouth, did her IQP—Interactive Qualifying Project—on the impact of harvesting on horseshoe crab populations in Pleasant Bay and other nearby areas. The object of O'Leary's work, which was done last year under Gibson's direction, was to study the interaction between a biological phenomenon and society. O'Leary concluded that the current practice of removing crabs—predominantly females ready to lay eggs—and taking a third of their blood before returning them to the Bay is likely to disrupt the life cycle of the armored arthropods.

Bleeding horseshoe crabs is a lucrative business because a substance called LAL (*Limulus* amebocyte lysate) is stored in ameba-like cells in the crabs' blood. LAL, a highly potent mixture

of proteins which serves a defensive blood-clotting function in the crabs, is currently used in the only FDA-approved procedure for screening intravenously-administered drugs for bacterial contamination.

Before LAL's unique properties were discovered, a drug sample was found to be contaminated if a rabbit injected with the sample developed a fever. With the LAL test, pharmaceutical companies have eliminated the expense and waiting involved in the rabbit test, but their actions have also put a high price tag on horseshoe crabs.

Gibson and O'Leary are worried about what is happening to *Limulus* populations in the meantime. If a crab is taken, bled and returned to another part of its native bay days later, what becomes of it? "Will they spawn that year? Will they ever spawn again? These are questions that I don't think we'll ever know the answers to until someone does a 20-year study," says Gibson. "Meanwhile, bleeding the crabs may not be necessary at all if the cells can be grown in culture."

Although others have tried and failed, Gibson and two of his students, seniors Geraldine Farley and Jeffrey Winick, are currently trying to find a way to grow the LAL-producing cells in culture.

In WPI's first-of-its-kind course on large-scale bioprocess engineering, Professor Pamela Weathers looks on as William Skea of Millipore Corporation, which provided equipment for the course, instructs Jeffrey Kelly '86 in use of a high-pressure liquid chromatograph.

Horseshoe crabs harbor another biological mystery that fascinates Gibson. In his human physiology course, Gibson uses the horseshoe crab heart as a model for neurophysiology.

Limulus hearts fascinate Dan Gibson because for many years scientists believed that the horseshoe crab acquires cardiac nerves only as it matures. Gibson's work showed that the nerves are there all along. He first found that heart nerves in the larval crab became visible under an electron microscope, and his recent experiments with various dyes have shown there is not just one, but two kinds of nerves in a crab's heart.

Now, together with Ph.D. student Arthur Meuse, Gibson wants to find out how new nerve cells are put to work in the crab's existing nervous circuit without disrupting the regular beating of the heart. "It's a hardy and accessible model of how neurons are recruited into a functioning circuit," Gibson says, adding that this work should contribute to an understanding of the process of circuitry development in human brain tissue.

Horseshoe crabs may seem an unlikely place to look for answers to modern medical questions, but biologists are increasingly looking to lower forms of life to find clues about basic biological processes that they have in common with humans. Since uncovering some of the secrets of life on the cellular level—the structure and role of DNA, the decoding of genes, and the manipulation of genetic material, for instance—biologists have delved more and more deeply into aspects of cell biology that hold promise for eventual breakthroughs in understanding, preventing and treating medical, agricultural and industrial problems.

Salisbury Laboratories is the rethought, redesigned and remodeled home of WPI's Department of Biology and Biotechnology. The B&B Department, like the building, has undergone dramatic change in the last few years as the life sciences have enjoyed a renaissance in interest in the media, in industry and among students.

"Students are suddenly seeing that biology isn't just memorizing the names of butterflies and leaves," Professor Ronald D. Cheetham says. "They are recognizing that biology enables them to produce industrial products of great economic value." As a result, the jump in the popularity of this new biology has been so dramatic that, according to department head Joseph C. Bagshaw, the number of B&B majors has grown threefold in the last four years.

WPI has been quick to respond to the increased interest in biotechnology. In addition to providing a strong foundation of courses in biology—especially cell and molecular biology—WPI's Biology and Biotechnology Department is providing unparalleled training for the next generation of biotechnologists, emphasizing both research techniques and industrial biotechnology skills.

Industrial development of biotechnology will require several groups of technical personnel, says Bagshaw, such as molecular biologists, immunologists and bioprocess engineers. It's the latter group—the limited number of experts now engaged in bioprocess engineering—that is of particular concern to WPI.

"We're working to prevent a critical shortage of trained people for jobs which didn't exist two years ago," he says. "All predictions point to a rapid rise in the need for these specialists."

Massachusetts, which takes pride in its thriving high technology industries, recognizes that this shortage could dampen the rapid development of its fledgling biotechnology businesses. Companies that will locate in Worcester's new 75-acre, $165-million Biotechnology Research Park, says Bagshaw, will need such experts.

The first of its kind in the country, WPI's new course in bioprocess technology, which focuses on exploiting industrial scale biological processes developed in the laboratory, emphasizes what has always been a hallmark of WPI education—hands-on experience.

Funded through a partnership with local industry and the quasi-public Bay State

Life's Little Secrets

Skills Corporation (BSSC), the bioprocess course trains WPI students in the tricky business of bioprocess scale-up, or the design of commercial-scale processes based on laboratory-scale experience. The course also includes a session on laboratory robotics and hands-on experience running large-scale bioprocess equipment at Norton Company in Worcester.

BSSC has committed nearly $86,000 to the WPI effort over a two-year period. Seven Massachusetts firms have together pledged another $118,000. A major part of the industry support, says Professor Pamela Weathers, who is teaching the course, is in equipment given by Millipore Corporation, of Bedford. Included in the gift is a high-pressure liquid chromatograph with scaling columns, computer software and membrane processing equipment for both laboratory and pilot-scale operations. In addition, Zymark Corporation is providing three robots to perform routine laboratory procedures.

A blue-ribbon advisory board consisting of industry experts is assisting the WPI faculty in developing future directions for this vital course.

In the course's first year, half of the students will have worked on separation problems on-site with local companies, according to Weathers. "Students completing the course will have a unique edge in the job market. This kind of training is not available at any other college in the country," Weathers says.

One of two biology professors concentrating on bioprocess technology, Weathers has also been developing a novel method for culturing hybridoma cells. Already widely used in the production of monoclonal antibodies (a new class of bioengineered substances used primarily in medical diagnostics), hybridomas are hybrid cells formed by fusing two different cell types—such as human tumor cells and antibody-producing spleen cells from mice.

Weathers recently started work on a new method of growing animal and hybridoma cells in cultures based on a technique that she and a colleague have already perfected for plant cells. She asserts, "We believe it will revolutionize the tissue culture industry."

Professor Judith E. Miller is the Department's other bioprocess specialist. Just back from sabbatical managing fermentation processes for a biotechnology firm in Cambridge, MA, Miller teaches a course in fermentation. Her current research focuses on a basic problem in bioprocess technology: cell immobilization.

Currently used in a wide variety of bioprocesses, including those that yield amino acids for food supplements, steroids for birth control pills, and sweeteners and antibiotics, cell immobilization encompasses an assortment of techniques for getting cells to stay put while they make a useful product. In a wastewater treatment process, for example, immobilization may be as simple as coating a bed of gravel with bacteria, Miller explains. At the opposite end of the spectrum, some scientists propose injecting insulin-producing cells immobilized in microscopic capsules into the bloodstreams of diabetics.

Under Miller's direction, master's degree student Francis McConville '76 is mathematically modeling the productivity of yeast cells immobilized in gel beads. Miller and McConville hope that the information they are collecting will prove useful in the design of other bioprocess systems.

In Miller's laboratory, gel beads whirl around in bench-scale fermentors resembling jars of barley soup. The bench fermentors are a critical part of WPI's biotechnology program, Miller points out, because laboratory work is what sets B&B apart. "We have a higher proportion of lab courses in our curriculum by far than any other department at WPI," Miller says.

She also points out that the Department badly needs a fourth teaching laboratory to keep up with the dramatic growth in the number of B&B students. She notes that soon the Department expects to be handling 20–25 majors in each class, which contrasts dramatically with the late '70s, when Miller recalls the Department having fewer graduating seniors than faculty members.

Students have serious career goals in mind, and they see biotech as an up-and-coming field," asserts Professor David S. Adams, who introduces nearly all of the Department's majors to the brave new world of biology through his courses in cell biology and molecular genetics. Adams is also one of the Department's "gene jockeys," practitioners of recombinant DNA research techniques.

In the laboratory, Adams' students use modern molecular and immunoassay methods to coax orange slime molds, which normally make their living off decaying wood, into revealing secrets about human blood diseases. The blood comes from hospitals in New York City and Worcester, where it is removed from patients with *lupus erythematosus*, a disease in which blood-borne antibodies attack the patients' vital organs and tissues.

In her course on fermentation, Professor Judy Miller confers with graduate student and teaching assistant Francis McConville, while senior Pasquale Sacco works on his Major Qualifying Project, growing the yeast Saccharomyces cerevisiae, *commonly used for bread, beer and wine making.*

Adams, together with graduate students Henry Skinner and Timothy Burn, is using lupus antibodies in an investigation into the structure and function of molecules called small nuclear RNAs or snRNAs. SnRNAs are known to perform a role in controlling gene expression, information about which is central to understanding cancer and autoimmune diseases such as lupus. This work also gives Adams' advanced cell biology students hands-on experience with biomolecular methods.

But why slime mold? "What makes this system so interesting is you can grow it in a culture ten centimeters in diameter—and that's all *one* cell," Adams says, "It has millions and millions of nuclei not surrounded by cell walls, and they're all dividing in synchrony throughout the cell cycle. So it's an ideal organism for analyzing the cell cycle and what controls it."

When the lupus antibodies encounter specific slime mold snRNAs in Dave Adams' lab, they stick to each other and fall out of solution. This technique, called "immunoprecipitation," has enabled Adams and his students to collect samples of different snRNAs from slime mold cells in various stages of their life cycle.

Having thus laid the groundwork by studying the


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presence and relative abundance of snRNAs in slime molds at different times, Adams' group now intends to take a closer look at the role of various snRNAs in regulating genes during cell differentiation.

Differentiation, which occurs when a cell ceases to divide and begins to specialize, can be a turning point in the development of cancer cells. And while slime molds may seem a strange place to look for a solution to cancer, the differentiation process—common to all known complex life forms—is the focus of a great deal of current biological research.

Molecular biology has made tremendous strides in the three decades since the discovery of the helical structure of DNA—the material that contains the genetic code of living things. The next challenge has been to understand the forces that affect which genes are "expressed," or converted from instructions to action. A better understanding of the control of genes is central to understanding—and conquering—many of the major health problems of the day, from cancer, to AIDS, to aging.

Another of the Department's gene jockeys, Professor Rene J. Herrera, hopes to use the DNA probes produced in his lab by graduate student Jin Wang and Steven Mann '86 to analyze the abundance and the rate of transcription (a step in reading the genetic code to produce proteins) of key RNA molecules in order to shed light on the process of human aging. These molecules include snRNAs, which are central to the regulation of gene expression, and collagen and fibronectin RNAs, whose proteins form important cellular structures and are known to decrease with aging.

"This is a relatively new area," Herrera says in a quiet but intense manner, "which so far has been ignored by science." Studies on aging have previously focused on symptoms such as anatomic or blood composition changes, rather than phenomena on the cellular and molecular levels, he explains.

So far, Herrera and his students have been collecting tissue samples from individuals of various ages, with the help of the University of Massachusetts Medical Center's Department of Surgery and St. Vincent Hospital's Department of Pathology. Herrera plans to use these tissue samples—along with his DNA probes—to study cell aging in people as well as in cells growing in test tubes in terms of specific RNAs linked to aging phenomena. Improved understanding of the correlation between aging processes on the cellular and molecular levels and on the individual level should eventually lead to ways of controlling some factors that contribute to premature aging and health problems of the aged.

Herrera's other work includes the development of a new mutagenicity assay, a technique that assesses the tendency of specific chemicals to cause changes in the genetic material of cells—changes that could lead to cancer and birth defects. Previously, mutagenicity tests have depended on changes in the genetic material of mammalian cells. Herrera's technique relies on larger-scale exchanges of genetic material referred to as SCEs (sister chromatid exchanges) in mosquito cells, which he says are easier to study.

Students get hands-on experience with the techniques used by Herrera and B&B's other gene jockeys in a course in recombinant DNA methods taught by Joe Bagshaw. One of the sources of genetic material for the course's laboratories is Bagshaw's current studies of the mechanisms of gene regulation in brine shrimp (*Artemia*).

Bagshaw uses brine shrimp because they are easy to obtain (they're sold over the counter anyplace that sells fish food), and because their "eggs" are not really eggs, but encysted gastrulae, a much later stage in the organism's development. The gastrulae exist in a state of suspended animation—sometimes for as long as 70 years—before being brought to life, according to Bagshaw. Thus, the eggs represent a form of stored information—all of the information needed to grow a living brine shrimp, complete with specialized nervous, digestive and muscular tissue.

Bagshaw explains why the brine shrimp genes are important: "Most of the diseases now facing mankind in the developed world are problems of gene regulation," he says. "Specific genes function at specific times. A gene gets turned on, it does its job, and it gets turned off." As a result, the control of gene expression is now "the fundamental issue of molecular biology," according to Bagshaw. Brine shrimp are drafted for this work because gene regulation processes are thought to be similar across all organisms and because, as Bagshaw points out, "It would take 50,000 pregnant mice to produce the same number of embryos produced by *Artemia* in a half liter of brine."

To study gene regulation in brine shrimp, Bagshaw looks at the presence of messenger RNA, or mRNA, which plays a role in carrying genetic information from genes to polysomes, where cell proteins are manufactured according to the specifications of the mRNA.

Bagshaw, with help from Gary Denton '86, who is completing his Major Qualifying Project (MQP) in this specialty, takes brine shrimp mRNA, uses enzymes to convert the information into DNA (the form in which genetic information is stored and transferred to other organisms), clones the DNA in another organism, and then takes a close look at the resulting DNA. This tells him what kinds of mRNA are present at various stages in the shrimp's development.

Bagshaw is using this method to test for two possible mechanisms of turning on the inactive brine shrimp genes. Either the genes are newly transcribed (copied onto mRNA) or the mRNA exists, sequestered somewhere in the cell, and later comes out of hiding. Bagshaw hopes his work will add another piece to the gene regulation puzzle, and to the larger picture of understanding cancer and other diseases.

Professor Theodore C. Crusberg, who teaches molecular biology with Bagshaw, also works on the cancer puzzle, but rather than concentrating on events leading to the formation of cancer cells, Crusberg studies the human body's natural process of attacking tumors.

For the past five or six years, he has been studying how monocytes, a type of human white blood cell, identify and destroy tumors. Normally, when monocytes detect a tumor, they stick to the walls of nearby blood vessels, squeeze through the chinks in the walls, and then attack the tumor cells. Crusberg's work involves using digital imaging techniques to microscopically study the monocytes' sticking, spreading and moving behavior.

He explains why it is important to see how the killer cells move: "On occasion the tumors avoid the monocytes—maybe just by luck. The other possibility is that one of these tumor cells could develop the ability to produce a product that could inhibit monocyte migration into the tumor." And when that happens, tumors can grow beyond the point where monocytes can kill them. To find out how the tumors ward off monocytes, Crusberg, who has his Ph.D. in chemistry, is testing the effects of various proteins on monocyte behavior.

Crusberg's work also involves pre-monocytic cells, which are supposed to differentiate and become tumor-stalking monocytes. The pre-monocytes were taken from a leukemia patient whose cells failed to develop the tumor-hunting behavior. Initially, Crusberg obtained pre-monocytes because he wanted to produce a line of monocytes to use in his other work. Crusberg's own blood is still the only source of differentiated monocytes for his work; he explains, "I basically wanted to remove my name from the list of monocyte blood donors."

But now Ted Crusberg, along with MQP student Patricia Campie, is studying the differentiation process itself. "What we're doing is using vitamin A derivatives

Professor David Adams (left) and graduate student Timothy Burn examine x-ray film of ribonucleic acid (RNA) bands following electrophoresis, to determine what genetic information the RNA carries.

and vitamin D-3 derivatives to induce the cells to differentiate," he says. "From this we hope to learn which proteins are synthesized during differentiation and identify which genes are turned on by these chemicals."

Campie's project focuses on morphological changes brought on by treatment with chemicals. In addition to showing which genes are responsible for the monocytes' ability to attack tumors, this work has implications for understanding tumor formation, since, as Crusberg points out, "Getting an undifferentiated cell type to differentiate is a very important problem in understanding cancer."

While modern medicine still needs to enhance its understanding of the minutiae of cells, their genetic material, and why they sometimes go haywire, some already very well-understood bacteria have still found refuge, even in the industrialized world. Professor Ronald D. Cheetham, one of the Department's ecologists, is teaching students to seek out how and why these bacteria can sustain themselves.

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Over the past five years, Cheetham and his students have been tracking down bacterial contamination in Worcester's water distribution system, where 100-year-old pipes harbor colonies of bacteria. Cheetham's work has shown that amphipods—tiny, almost microscopic animals resembling crayfish—play an important role in protecting bacteria from death by chlorination. The amphipods, sheltering large numbers of bacteria in and around their bodies, easily survive the chlorination that kills unprotected bacteria, and later release the sheltered bacteria when their bodies are split open at the kitchen tap.

As a result of the work of Ron Cheetham and his colleagues and students, the City of Worcester has installed secondary chlorinators, has begun an active pipe relining program, and is planning a new filtration plant.

Cheetham's next attack on waterborne pathogens? Right now, he and master's degree students Jane Haselton and Lynda Laine are testing the adequacy of disinfection techniques used at children's play pools at hospitals, schools and other public facilities. "We're looking for an environment where these waterborne pathogens might pose a public health risk," Cheetham explains, "and we thought that hospital environments, where there are likely to be antibiotic-resistant strains of bacteria, deserve some looking into."

In the late '70s and during the early part of this decade, when environmental protection was a higher national priority, Cheetham and his students focused on the effects of acid rain on fish and on the plankton that fish depend on for food. They found that the reproduction of both fish and the water flea *Daphnia* were halted by acid rain levels of pH 5, "which is not uncommon in poorly buffered soils," according to Cheetham.

They also showed that algae, which serve a crucial role in the food chain, are among the first victims of acid rain. It is now well known that acid rain, seeping through acid-vulnerable soils and bedrock characteristic of much of New England, leaches out aluminum and other metals, carrying them into streams, rivers and lakes. There, in acquatic environments, a wide range of organisms including fish can be directly poisoned by the dissolved metals.

A few years ago, Cheetham and his students studied aluminum poisoning of various algae: greens, diatoms and blue-greens. The findings? Ron Cheetham answers with a hint of resignation, "It doesn't take a lot of acid rain in unbuffered soils to reach aluminum levels toxic to diatoms and green algae."

Now that the environmental effects of acid rain are well demonstrated and ecologists wait for the federal government to act, Ron Cheetham is working with Professor Pamela Weathers and seniors John Niedzielski, Jeffrey Blanchard and Edward Nowak on a wastewater processing problem for a nearby electronics producer.

Weathers explains, "What we're working on is a feasibility study for a bioprocess. Can we use an organism to accumulate copper and then release it from the organism in a concentrated form?" The results so far are promising. Weathers reports: "We can see that under certain circumstances the organism will absorb a lot of metal and it will do it within five minutes." The next step in the project is to design a process around the organism. Master's student Xiaojun Zhang will try to find a way to immobilize the organism, but the trick here is to find a medium that can withstand the corrosive wastewater and high flow rates of the process, according to Weathers.

The wastewater project is an interdisciplinary one, and as such it exemplifies the *new* biology and biotechnology program, which goes far beyond traditional biology to prepare graduates for leadership roles in the ongoing biological revolution. The teaching of computer techniques for image processing, DNA sequencing analysis, economic analysis of bioprocess designs, and a strong emphasis on recombinant DNA and other new research techniques are all part of this program. All ensure that B&B will deliver the education that students and faculty are committed to.

As Joe Bagshaw says, "We don't want to crank out lab technicians. We view the program as producing the research scientists of the future."

Ted Crusberg offers another view. "All this research activity might indicate that faculty members are usually off in their labs doing their own thing. Actually, about 80 percent of our time is spent with students—in class, working on projects, integrating the findings of our research into the educational process. There's a lot going on here, and it all ultimately benefits our students."

Paul Susca is a freelance writer living in Rindge, NH.

TED COGHLIN '56:
Looking Ahead to The Second Century

By Ruth Trask

Edwin "Ted" Coghlin, Jr., '56 ME, well known Worcester businessman, not only likes to build on the past; he also likes to look to the future. As president of Coghlin's, Inc., and treasurer of Coghlin Electric, which recently celebrated its 100th anniversary, he is in a perfect position to do both.

Ted and his brother, Jim, are the third generation to stand at the helm of Coghlin's. Says Ted, "Jim does the selling and I worry about internal things, like engineering and construction details."

John P. Coghlin '93, Ted's grandfather, was an inventor and true entrepreneur—well before the word was coined! He purchased Page Electric, founded in 1885, after establishing himself by inventing a dynamo (in the Washburn Shops), the most efficient of its time. He founded Columbia Electric and Central Electric, and then Coghlin Electric.

Coghlin Electric has always had WPI family ties. For a time, one of John's younger brothers, Peter '97 EE, was with the firm. In 1919, "J.P.," as John was known, was joined in the business by his sons, John W. Coghlin '19, and Edwin "Ted" Coghlin '23. Other WPI family members besides Ted Jr., include Frank Harding '49, John P. Coghlin '63, Joe Ratte '84 and Tricia Coghlin Williams '85, a total of nine to date, through four generations.

Today, Coghlin Electric Company consists of three segments: electrical construction, electric and electronic wholesaling, and interior design with furniture.

Over the years, Coghlin's has succeeded primarily because of its willingness to change. It took advantage of timely opportunities and was quick to move out of unprofitable ventures.

At the turn of the century, Coghlin's provided electrical contracting work in the mills up and down the Blackstone Valley. It followed a specific clientele—even to the point of going south with the textile mills to help them get started in their new locations, or west to Niagara Falls to wire Nabisco's corporate headquarters—a contract J.P. won, in part, thanks to the influence of one of his WPI professors.

At the helm at Coghlin's: Jim (left) and Ted '56 (right).

Worcester Telegram & Gazette

Coghlin's doors have always been open to new ideas. As the fortunes of some industries waned, other industries sprang up to take their place in the roster of companies with which Coghlin's has done business. John W. and Ted learned many valued lessons from their father.

As an electrical contractor, Coghlin's has been linked for 100 years with Worcester area businesses. A map of downtown Worcester or central New England is a veritable checkerboard of Coghlin's electrical installations. Included are work for the Worcester Art Museum, Lincoln Square Boys Club, Worcester Center, YWCA, Commerce Building, AT&T, Shawmut Worcester County Bank, Holy Cross, Assumption, Clark, Anna Maria, Norton, Wyman Gordon, Cincinnati-Milicron, G.F. Wright Steel & Wire, American Optical, Raytheon, Digital Equipment Corporation, Sanders, Simplex, Polysar, Astra and Foxboro Company. The list goes on. WPI is in there, too.

According to a recent article in *Business Digest*, the success of Coghlin's has been due to "hard work, foresight, a willingness to take risks and learn from mistakes, teamwork, commitment and civic duty."

Ted, Jr. is carrying on the tradition molded by earlier generations of Coghlins. He started his career on the run. The day after his graduation from WPI in June 1956, he began work on State Mutual Life Assurance Company's 500,000 square foot headquarters in Worcester.

The $1.5 million project was a turning point for the company, Ted notes. "The job consumed the most manhours in our history—more than 100 workers were on the job payroll."

State Mutual was the largest electrical contract ever awarded in central New England up to that time. The building was the biggest office complex in central Massachusetts.

With the State Mutual project successfully concluded, Coghlin's reputation grew, placing it on a footing with New England's best companies. Soon after, when Norton Company began expansion plans, Coghlin's was named to engineer and install the facilities.

In the 1960s, Coghlin's young electrical construction team stretched its wings. When Ted, Sr. returned from a vacation, he was greeted with the news that Coghlin's was the successful low bidder on the new Raytheon manufacturing facility in Andover, MA.

True to form, the senior Coghlin responded, "How low?"

At the time, the Raytheon facility was the largest all-electric manufacturing plant constructed in New England and one of the largest in the country. Everything about the job was big says Ted today—the quantities of materials, the specialized requirements, and the added challenge of working with regulated government agencies. Material shortages and persistent labor problems added greater challenges to the project.

Managing these complexities seasoned Ted and his associates into a smooth-working unit. In the end, though, the project made only a modest profit for Coghlin's. Still, the members of the team had proved themselves and went on to other projects, further establishing a reputation for completing work on time—and within budget.

Ted, Jr.'s ability to get things done has carried over into his community associations, as well. "If I'm going to get involved," he says, "I like to get involved all the way."

As a Coghlin, he closely follows the example of his dad, who won numerous civic awards, including the Isaiah Thomas Award from the Worcester Advertising Club in recognition of his distinguished community service. Ted's uncle, John, was a WPI trustee and civic leader.

Also active with WPI, Ted, Jr. serves on the Alumni Fund Board (Leadership Gifts Committee chairman) and has held the post of president for the Poly Club and for the Worcester Chapter of the Alumni Association. In 1981, the Alumni Association presented him with the Herbert F. Taylor Award for outstanding alumni service to the college.

Ted's list of community involvements is nearly as long as his client ledger. Currently president of the Central Massachusetts Chapter of the National Electrical Contractors Association, he is a past president of the Mohegan Council Boy Scouts of America, and of the Worcester Young Businessmen's Association. He has served as chairman of two school building committees in Shrewsbury, and on the boards of the Worcester Boys' Club, Worcester Science Center, Mechanics Bank, Anna Maria, and Central New England colleges.

Active in Rotary, he is a Eucharistic minister of St. Mary's Church as well. Other posts include advisory board member to the electrical department of Worcester Vocational Schools and a Shrewsbury town meeting member.

"I've primarily centered my activities on youth and education," says Ted. "I'm just a big kid at heart."

Ted's enthusiasm carries over into his Coghlin post. He cites changes and growth in the company, such as the reshaping of the Main Street store from appliances into a much-talked-about interior design and high-fashion furniture store.

The store has come a long way from the days of original Tiffany shades. Says Ted, "Boy, do I wish we had some still available at $5 to $10." Today, he says Tiffany shades are worth $1,000 or more.

He also recalls the years when "a young, enterprising member of the Coghlin family" ran electric trains in the store window.

More recently, the firm acquired RM Electronics to bring both electrical and electronics products to the marketplace in a single, computerized inventory program.

In the future, according to Ted, Coghlin's plans more specialized services for wholesale customers, expanded interior design to more executive office furnishings, and, in construction, expansion into data wiring, fibre optics, clean power systems for computers and "turn key" programmable control for industrial applications.

Still, says Ted, "The key to Coghlin's second hundred years is our family of employees—175 strong. You can't run a business of this size successfully without dedicated people at every level."

Architect for a Growing Worcester: Stephen C. Earle (1839–1913)

By Curtis Dahl

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Curtis Dahl is Samuel Valentine Cole Professor of English Literature at Wheaton College, Norton, MA.

Stephen C. Earle

Stephen Carpenter Earle was lucky. His was a wonderful era to be an architect in Worcester. From 1853, when he came down from the hills of his native Leicester to complete his education and begin his architectural career, to the time of his death in 1913, Worcester grew from a moderate-sized town of about 17,000 to a great city of over 100,000. As the city grew, and grew so quickly, it desperately needed new buildings of all kinds. Stephen Earle was there to design them. Indeed, no man by his artistry more profoundly shaped nineteenth-century Worcester than he. It would have been hard to look anywhere in the city without seeing his work.

But Earle was not only lucky; he was also able, hard working, well trained, with highly developed skills and taste—a man excellently qualified to take best advantage of the architectural opportunity that the phenomenal growth of Worcester presented. He was a member of an astonishingly talented and influential Quaker elite who in the 1840s and 1850s left their ancestral homes in Leicester and other surrounding hill towns to play leading roles in the burgeoning city. Throughout his life, Earle had close contacts with many of the city's most important men. After his father's death and his mother's move to the West, he lived in the fine Summer Street home of his cousin Edward Earle (at various times alderman, congressman and mayor of Worcester), who became virtually a foster father to him and who was well placed to exert influence on his behalf.

To earn money, Stephen worked in the T.K. Earle card-manufacturing company owned by Edward and other cousins. He received the best education for an architect of his time. After two years at the Friends Boarding School (now Moses Brown) in Providence, RI, and graduation from Worcester High School (Mrs. Edward Earle was on the school board), he trained as draughtsman and apprentice architect in the office of Calvert Vaux, one of the foremost architects and landscape designers in New York City.

Returning to Worcester late in 1863, after a stint as medical corpsman in the Civil War, he worked briefly as a draughtsman for Elbridge Boyden, designer of Mechanics Hall and, at the time, the leading architect of Worcester. Earle then signed on as an engineering draughtsman for the Hoosac Tunnel railroad project before leaving in 1865 on the architectural tour of Europe that was then the dream and virtual obligation of every fledgling American architect.

On his return in 1866, he already had the commission to build his cousin T.K. Earle an impressive, Gothic stone mansion high on Edward Street and was in correspondence with a Quaker Meeting in Brooklyn about a new meeting house. Poised for success, he hung out his shingle. Success came quickly.

In Earle's day, an architect, especially an architect in a smaller city like Worcester of 1866, did not specialize in any one style or in any one kind of building. He built anything, and he used whatever style he and his client felt fashionable and appropriate. He was not averse to mingling styles either. In Worcester alone—with no consideration of abundant and important commissions elsewhere—Earle designed everything from the Public Bath House and a bandstand for Institute Park to a huge, polychrome,* granite-and-brownstone imitation of the Cathedral of Notre Dame in Paris for his Chestnut Street Congregational Church. He designed grand stone mansions and charming little frame cottages. He designed churches (23 in Worcester alone), college buildings [such as WPI's Boynton Hall], the main portion of the Worcester Public Library, an addition to the American Antiquarian Society, and the first building of the Worcester Art Museum. He built schools, fire stations, mills, warehouses, commercial buildings, apartment houses, tenements and horse sheds. He also designed pergolas, furniture, clocks, sundials and drapery. Nothing was too big or too small or too unlikely.

The diversity of Earle's work is one of its main attractions. It also reflects the many-sidedness of the man himself. For 60 years Stephen Earle was at the heart of Worcester's cultural, religious commercial and educational life. His early journals, recently edited by his grandson Albert Southwick, show that even as a youth, he was interested in the myriad activities of the city. After his conversion about 1869 from the Quaker faith, he was a leading Episcopal layman and a founder of Saint John's parish. He was a member of Mechanics Institute, a leader in musical activities, a member of the Board of Directors of the YMCA, a donor to the American Antiquarian Society, a charter member of the Board of Directors of the Worcester Art Museum, and, in his last years, an instructor in the school department's Free Evening Drawing School. From its founding to Elbridge Boyden's death in 1898, he was vice-president of the Worcester chapter of the American Institute of Architects; thereafter, he held the office of president. For 30 years, he was president of the Worcester Cooperative Bank. His hand was everywhere, always working for the good of the city.

The well-known architectural historian Henry Russell Hitchcock has described Earle as perhaps the earliest and surely one of the best followers, both in Gothic and Romanesque, of the great Henry Hobson Richardson. But Earle should not be regarded only as Richardsonian. Like many of the architects of his generation, he was extremely catholic in his choice of styles. He happily and effectively worked in Gothic Revival, Stick Style, French Second Empire, Lombardic and Richardsonian Romanesque, Queen Anne, Shingle Style, Colonial Revival, Neoclassical, Italian Villa and Palazzo and many permutations and combinations of these. How the styles follow each other and mingle during his long career not only throws light on his skill as an architect, but also reveals the changes in architectural taste that occurred from when he hung out his shingle in 1866 to his death in 1913.

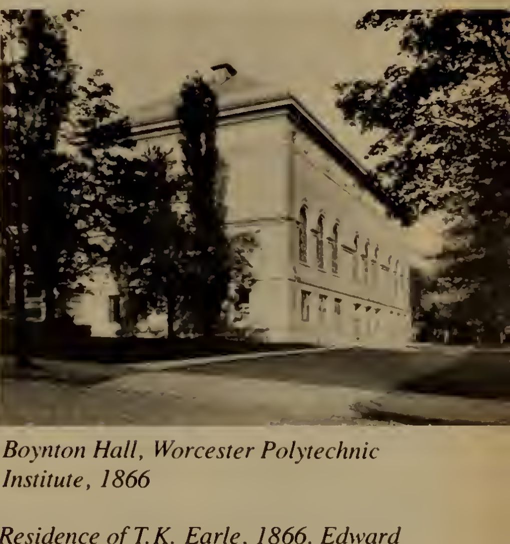
Earle's first two outstanding designs in Worcester—those which earned him and his new firm, Earle and Fuller, their initial reputation—were in heavy, stone Gothic and date from 1865. One, the T.K. Earle mansion already mentioned, might, at the time, have been called Norman. Its large size, high pointed and crested tower, steep, slated roofs, arched windows, and cloister-like porch and porte-cochère—all in local Millstone Hill granite—made the house an impressive example of both the solid Gothic style of the day and the kind of expensive mansions with which newly rich industrial-

In architecture, the term means executed in stone or bricks of various colors.

Courtesy American Antiquarian Society

Courtesy Worcester Historical Museum

Collection of Worcester Art Museum



Boynton Hall, Worcester Polytechnic Institute, 1866

Residence of T.K. Earle, 1866, Edward Street (demolished) Courtesy Worcester Historical Museum

Original building of the Worcester Art Museum, 1897, Salisbury Street (now surrounded by later additions)

Courtesy Worcester Historical Museum

Courtesy Worcester Historical Museum

Butterick and Whipple Building, 1874

French Catholic Church of Notre Dame, 1880

ists were beginning to ring the growing city. It became one of Worcester's show places.

The same industrial growth that enabled the mill-owners to build such lavish residences also demanded technical education. When Earle won the commission to design the first building for the Worcester County Free Institute of Industrial Science (now WPI), he again turned to heavy, stone Gothic, even repeating the shape of the tower and some of the detailing from the Earle mansion. But in this design he pioneered an American academic Gothic that blended elements from the ancient colleges of Britain with the tall, broad facade and imposing presence of the new High Victorian Gothic. The mixture is an outstanding success. Boynton Hall's granite solidity, patterned buttressing, high, narrow gables, clustered chimneys, and arched triple window in its large chapel gable give it power and variety. The magnificently staunch tower to the right, with its steep, polychromed, slated mansard roof, boldly stated the practical importance, yet also hinted at the cultural aspiration of the new institution.

In the seventies, Worcester's churches doubled and redoubled in number and size, necessitating constant remodeling and new construction. In 1870, for instance, Earle almost wholly rebuilt the Salem Street Congregational Church. And though he adroitly used elements of the old design, the result was not altogether happy. The new, up-to-date Lombardic Romanesque facade and high, Georgian-style tower built in front of the old, hexastyle portico looked awkward.

Ten years later, however, when he rebuilt the First Methodist building (1845) on Park Street for the French Catholic Church of Notre Dame, he was more successful. Although here, too, modern taste might prefer the original Georgian design, the new facade was imposing.

But Earle had not given up Gothic. In 1870, for the expensive new Trinity Methodist Church at the corner of Main and Chandler Streets, he made a foray into an unfortunate kind of contemporary Gothic that merely pasted thin Gothic decoration onto what was essentially a conventional Georgian brick block. In 1874, however, for All Saints Episcopal Church (then his own church), he turned back to an authentic stone Gothic ultimately derived from the ancient English parish church, but modified by British and American ecclesiologists and other Gothic Revival architects. Today, unfortunately, only the tower and one cloister survive.

In the seventies and for the next two decades, Worcester's commercial center continued to grow, and Earle designed building after building. Ultimately, he was responsible for perhaps a third to a half of the most important business structures on Main and Front Streets. In the same year (1874) in which he designed All Saints Episcopal Church, Earle jumped abruptly to a tremendously busy, stridently polychromed High Victorian Gothic for the Buttrick and Whipple Building on Main Street.

Some aspects of the building recalled the modulated orderliness of People's Savings Bank five years before: its high ground floor, which rested, in part, on cast-iron columns; the graduation from floor to floor of the arching of its windows; and the strong cornice over its fourth floor. But its much larger size, the loud contrasts between its white marble walls and strongly patterned bluestone trim, and particularly the treatment of its fifth level—part pyramid-roofed tower, part steep mansard cut by an intrusive, gabled dormer—made it a thing apart. Here was High Victorian Gothic at its extreme.

In Earle's other downtown buildings—in the Sumner Pratt Building (1877) on Front Street, the brick-with-brownstone-trim Salisbury (1877) and Dean (1880)

Buildings at Lincoln Square and the J.G. Clark and Whitcomb Buildings (both 1883) on Front Street—High Victorian Gothic elements still appeared, but they were relatively sedate and were integrated into fairly conventional commercial designs.

The only other major building that Earle was to build in High Victorian Gothic style—and here the style may have been chosen by the patron—was Jonas G. Clark Hall of 1887, the first, and still the main, building of Clark University. While abstaining from the extreme busyness of the Buttrick and Whipple Building, he nevertheless followed the style in a high, long, balanced facade, strident polychroming, mixture of rectangular arched openings, and strongly projecting central tower bay. Although the massive building was not designed, as legend has it, for possible conversion to a factory in case the university failed, its resemblance in silhouette to many of the better-designed Worcester mills may not be wholly coincidental.

In the late seventies and early eighties, the demand for fine dwellings continued. But now it was not only the very rich mill-owners, but also an increasingly prosperous group of upper-middle-class professionals and businessmen who engaged Earle. He responded with large houses that mingled High Victorian Gothic with chateauesque elements inspired, at least in part, by Richardsonian Romanesque.

How such elements could be combined with a basically Queen Anne design Earle magnificently demonstrated in the G.H. Whitcomb mansion (1879), his masterpiece of residential architecture in Worcester. Built of two shades of modestly contrasting Monson granite—darker and rough in the walls, lighter and smooth in the trim—with dark red stickwork on the dormers and porches, this superbly designed house was meant to be viewed from the corner of Harvard and Highland Streets. The high, relatively slender, cone-roofed tower divides the formal and carefully balanced Harvard Street facade from the more irregular and intricately patterned Highland Street flank with its several porches, gabled stickwork dormers, and sharply projecting stone porte-cochère (now removed). Rich patterning is everywhere on the building: in the diaper decoration under the peak of the front gable, in the wrought-iron railing of the balcony over the colonnetted front portal, in the woodwork of porches and gables, in the powerful granite arch and transom of the now-demolished porte-cochère, in the carefully planned irregularity of roof lines and fenestration, even in the way the motifs of the mansion are echoed in the adjoining stable. Yet all is restrained by good taste. This is Queen Anne at its best.

The 1880s and 1890s were still times of great growth and prosperity for Worcester. Earle continued to build churches; indeed, during these years they rose from his drawing board in unprecedented numbers. They were also far larger and more elaborate than before. By now he had developed the Richardsonian Romanesque style—and its permutations—for which he is best known.

In the Pleasant Street Baptist Church (1890), for instance, Earle made effective use of his favorite Richardsonian motifs: gabled porch with round arch supported on polished-granite colonnettes, half-conical-roofed turret set against a square main tower, and rose window—all adroitly compressed into a variegated, but extremely compact block. The Pilgrim Congregational Church (1887) on Main Street is heavier and more solid, and in the round corner turrets of its lofty, open belfry, as well as in the stubby Byzantine columns supporting the heavy, brownstone triple arch of its Italianate loggia-porch, it refers more directly to Richardson. But again, Earle's own special touch is seen in the great front rose window, gabled left-flank portal, and odd cloister-like element on the building's right flank. In both churches, he also shows his particular talent for designing interiors: he envelops wonderful open spaces with richly glowing wood, open beaming and stained glass.

In later years, Earle carried on the style in the impressive, but slightly chilling,

Marvin Richmond

Chuck Kidd

Courtesy Worcester Historical Museum

Magnetic or Electrical Laboratory, Worcester Polytechnic Institute, 1887

Jonas G. Clark Hall, Clark University, 1887, Main Street

G.H. Whitcomb Mansion, 1879, Harvard Street

Courtesy Worcester Historical Museum

Courtesy Worcester Historical Museum

Courtesy Worcester Historical Museum

Pilgrim Congregational Church, 1887, Main Street

Friends Meeting House, 1907, Oxford Street

Central Congregational Church, 1883, Salisbury Street

gray-granite South Unitarian Church (now Armenian Apostolic Trinity) of 1894 on Main Street, and in the charmingly modest, semi-Gothic brick-and-terra-cotta Friends Meeting House (1907) on Oxford Street, his last important commission. But in none of these later Romanesque designs did he ever surpass his magnificent Central Congregational Church (1883), just off Lincoln Square on Salisbury Street.

Here, each element is finely delineated, but also worked into a carefully thought out plan. The lofty, square, pointed tower is the central focus. Its triple-arched portal picks up both the stone-and-timber gabled porch under the great rose window on the Salisbury Street facade and the simpler, gabled round arch of the Sunday School entrance on Institute Road. On Institute Road, the sharp, pyramidal point of the exceedingly high tower to the far right makes a pleasingly varied descending sequence with the tall, conical tourelle in the middle and the half-conical round bay to the far right. Pattern, variation and fine workmanship are everywhere; but because the whole structure is constructed of a single color of reddish sandstone, there is no sense of ostentation or busyness. This may be Stephen Earle's finest creation.

Like the city itself, Worcester's educational institutions grew quickly in size and wealth during the eighties and nineties. For Clark University, Earle designed nothing more except for a nondescript brick Chemistry Building (1880). For Worcester Polytechnic Institute, however, he served as college architect for nearly 30 years, designing a tiny, chateauesque Magnetic Laboratory (1887)—a bijou of Richardsonian brownstone and granite—the Salisbury Laboratories (1887), a large addition (1892) to Elbridge Boyden's Washburn Shops, Stratton Hall (1893) and the power plant (1894). Aside from the superb little laboratory, these highly practical, but handsome brick-with-brownstone-trim buildings have no great architectural significance. Far more striking—though it looked more like a chapel than the gymnasium it was—was the sturdy Richardsonian stone building he designed in 1895 for Worcester State Normal School.

Even in these later years, however, Earle kept pace with the architectural changes of the times. Davis Tower (1889) in Lake Park, the Round Tower (1892) in Institute Park, and Bancroft Tower (1900)—all exemplified his success in designing the craggy, romantic, ornamental towers then popular in American parks. In the new, semi-vernacular, yellow-brick-with-limestone-trim commercial style, he built the Five Cents Savings Bank (1891) on Main Street, the handsome Lowell Building on Foster Street (1897), and the large Prentice apartment house further out Main Street (1896). Far more important, however, was his work in Colonial Revival, which, at the time, was moving steadily toward more accurate imitation of original models. In its irregularity, multiple porches, and eyelid dormers, the large, wooden Colonial Revival house that he designed in 1894 as the residence for the president of Worcester Polytechnic Institute (and in which his son President Ralph Earle later lived) is still close to Queen Anne and even Richardsonian Shingle Style. The more intimate house that Stephen Salisbury III commissioned in 1898 on Institute Road for his close woman friend, Mrs. Lawton, blends Colonial Revival with then popular Tudor half-timbering. But the symmetry, hipped roof and balanced chimneys of the grand Whittall mansion of the following year on Southbridge Street came close to making it a reproduction.

This same movement toward historical authenticity shapes Earle's late Gothic. In 1884, for Saint John's Episcopal Church on Lincoln Street, the church that Earle helped found and in which he worshipped until his death, he made a delightful excursion away from Gothic Revival into a simple, but warm, wooden-shingle-style Gothic, with low-sweeping roof and offset, shingled tower. But when he returned to stone Gothic in 1893 for Saint Matthew's Episcopal, though many of the motifs intentionally recalled those of All Saints (1874), much of the earlier warmth seems to have evaporated. As in much church architecture of the period, the forms are authentic, but the spirit is not.

On a much larger scale—indeed, on the largest scale that Earle ever built—the huge Chestnut Street Congregational Church (1895) also has some of this coldness. Although unwisely built in what by then was becoming outdated pink-granite-and-brownstone polychromy, the building has imposing grandeur with its twin Notre Dame towers, high nave and the huge columns and high, vaulted roof of its interior. He tried hard and with some success to reproduce the flavor of Paris. Yet, his clients' wishes apart, one wonders why here and elsewhere during these late years he turned increasingly toward pastiche. Was it architectural fashion? Was it a sense that Worcester had finally attained the status of a great city and thus needed great monuments? Was it his own, and his time's, increasing interest in historic preservation, as witnessed in the Trumbull mansion restoration? Or was Earle a little tired, and was it easier now to imitate rather than create?

One other style in which Earle worked in the 1880s and 1890s remains: the Renaissance or Italian Palazzo style, for it is the style he used when he designed the first building of the Worcester Art Museum in 1897. Earle had begun his career late for the Italianate or Italian Villa style, and he seems to have used it in Worcester for only one small building, the John C. White house (1871) on Irving Street. But when he built the 1877 addition to the American Antiquarian Society building on Lincoln Square, he had followed with great sensitivity the fine, mid-century Italian Palazzo style of the original 1853 structure. He has also hinted at the style in his 1888 addition (which has an art gallery on its top floor) to the Worcester Public Library.

In the middle and late nineteenth century, the style was particularly associated with learning and the fine arts. Although tradition was a strong factor, an even more powerful influence on Earle's 1897 Worcester Art Museum design was the recent completion of McKim, Mead and White's Boston Public Library on Copley Square (1895). Earle took this famous structure as his model. For his Roman-brick-and-marble building—which is now almost completely concealed by later accretions—he gracefully simplified and modified the ornate Boston design. Instead of the library's long, impressive arcade of tall, round-capped windows reaching up nearly to the cornice, Earle set three triplets of more modest-sized windows fairly low over the watertable that separated his main structure from the high, rustic basement. He joined the round, molded, marble caps of these windows across the whole facade by a marble string course. Except for a band of molded, marble wreaths (simpler echoes of the elaborate medallions in Boston), the upper surface of the whitish brick wall was left plain. The cornice, too, was far less ostentatious; but, as in Boston, the dark green of the high copper roof was contrasted pleasingly with the lighter walls.

If this well-planned building had a fault, it was its lack of a strong, ceremonial entrance like the three impressive, arched openings at Boston. But Earle's failure to provide one is explained by the fact that the building was intended to be the rear element of a quadrangle; its front door, therefore, ultimately was to open only to an interior courtyard. As always, Earle knew what he was doing. Indeed, with new construction recently completed, we may take the opportunity to question whether Earle's quandrangle plan might not have been better in the long run—and whether a Renaissance design might not have had more symbolic meaning than the Neoclassical design of the 1933 addition, which obscured Earle's facade. In any case, Stephen Earle's fine work—right down to the tesselated floors—appropriately remains at the heart of the museum and the cultural life of the city to which he contributed so much.

Courtesy Worcester Historical Museum

Courtesy Worcester Historical Museum

Courtesy American Antiquarian Society

Lowell Building, 1897, Foster Street

Bancroft Tower, 1900

President's House, Worcester Polytechnic Institute, 1894, Boynton Street (currently Sigma Phi Epsilon Fraternity)

The Numbers in his Head

Three decades is a long time. Yet David E. Lloyd, retiring after 32 years of managing WPI's finances under six presidents, looks back at the experience with all the vigor he brought to the job.

By Rachel Faugno

On a bright, warm morning in May 1954, a tall, wavy-haired young man made his way across the WPI campus to assume his duties as the Institute's first business manager.

Thirty-year-old David Lloyd saw in his new post a chance to meld the realities of finance with the finer ideals of education. But his optimism was soon to be tempered by the less than auspicious greeting he received from acting president Francis Roys.

"Well, I don't know what you're going to do," Roys told Lloyd, "but we'll find something for you."

Roys, a member of the Mechanical Engineering Department since 1910 and one of the most influential and respected people on campus, had not been involved in hiring Lloyd.

Now, as Lloyd approaches retirement, those words seem to have been a spectacular understatement, for WPI did indeed find "something for him."

In the years that followed, Lloyd, vice president for business affairs, treasurer and assistant secretary of the corporation, would play a key role in WPI's greatest period of growth: Between 1954 and 1985, enrollment would increase from 775 students to 3,350, no fewer than 10 buildings would be constructed or renovated; and he would oversee an annual budget that rose from $1.2 million to $45 million.

Despite his apparent inclination toward financial leadership, Lloyd has never seen his role as one of just money management. Rather, he has always tried to keep an overview of the total educational mission of WPI.

"As education goes," he says, "so goes our society, and I wanted to be a part of it. I'm not a teacher, so I do what I *can* do."

He has a no-nonsense approach to life, but he's not above philosophical meanderings or poking fun at himself.

"I came to WPI because I figured higher education was a growth industry," he says. But a stint with the 100th Infantry Division in Europe had left him with the desire to make the world a better place.

A graduate of Cornell University, Lloyd had spent six years managing a hotel in LaPorte, IN, before coming to WPI. He rejuvenated the hotel in just two years by adopting, as he says today, management that emphasized low overhead and a dedicated staff.

It was an approach that would also work at WPI, which has always been known for careful management of its resources.

Lloyd's earliest projects at WPI reflect the "finance for services" philosophy that would distinguish most of his career. One of his first duties was to take care of delinquent student loans. "Oh, yes, we had them even then," he notes, but points to WPI's better-than-average performance in this arena.

In 1954 he helped plan a face-lifting of Sanford Riley Hall and oversaw the first renovation of Boynton Hall in 1955. By 1956, he was involved in the planning of Morgan Hall, which was completed in 1958, and with Olin Hall in 1958 as well.

WPI's building boom was underway, as the school hustled to keep up with an expanding enrollment, which Anthony J. Ruksnaitis, college engineer since 1956, says was increasing by "leaps and bounds in the 1960s. Dave was 100 percent involved in this growth, helping to select architects and seeing each building through to completion."

In 1959, the Institute broke ground for four renovation projects: Atwater Kent, Washburn Shops' North Wing, Olin Hall, and an addition to Alumni Gymnasium. Daniels Hall, Goddard Hall, Gordon Library and the Stoddard Residence Center followed in quick succession.

Ruksnaitis remembers those days as hectic, but fun. "Dave and I would often be on campus at 8 a.m. and by 5 we'd have seen the architect in New York City and returned to Worcester," he recalls. Noting that those were "different times," he adds, "We weren't afraid to put in 14-hour days or seven-day weeks."

More construction followed: the Ellsworth and Fuller townhouses, the Wedge, and major renovations of Salisbury Laboratories, Sanford Riley Hall, Boynton Hall, Atwater Kent and Washburn Shops.

But by then, Lloyd says, the Institute's finances were becoming increasingly complex, and by the late 1970s, he was forced to concentrate more of his personal energies on financial planning than on physical expansion.

"Budgeting at the college became increasingly complicated," he says. "Our goal was to adapt the business organization to the Plan, with a minimal increase in staff."

Besides maximizing the effectiveness of every dollar spent by WPI, Lloyd and

Michael Carroll

a team of financial planners began looking for ways to obtain higher yields on endowment investment funds. The endowment had grown from about $4 million in 1954 to more than $50 million in the late '70s, but inflation threatened to erode that financial base.

In 1976, he says, 60 percent of the endowment was placed in the hands of a money management firm. "In this way, we could meet the everyday cash flow requirements of the college while maintaining the purchasing power of the endowment." Over the next several years, the college averaged a 16-percent total return on its investments, compared with a Dow Jones Industrial average of 11 percent and a Standard & Poor's 500 average of 13.3 percent.

David Lloyd worked closely with WPI President Emeritus Edmund T. Cranch, who says that Lloyd was able to save the Institute a substantial amount of money over time. In addition, says Cranch, today president of Wang Institute of Graduate Studies, "Dave put funds in reserve so that when really important projects came along, we had the flexibility to do those things. That's tremendously important to the college."

Owing largely to Lloyd's financial leadership, the college is currently in "excellent financial condition," according to Controller and Assistant Treasurer Frank P. Conti, "Dave has acted as a watchdog over the assets of the school while building the value of its real estate," he says. Under Lloyd's management, the plant fund assets have increased from $2.6 million to $52 million, while the endowment has grown from $4 million to $65 million. And the horizon looks just as bright.

"WPI has a fantastic future!" Lloyd says confidently. Although the Institute, like other colleges in the Northeast, faces a dwindling college-age population, Lloyd feels that WPI will be able to maintain its planned enrollment of 2,400 to 2,500 undergraduate students without sacrificing quality.

"Since WPI is an engineering and science college," he maintains, "we have a competitive edge over most liberal arts schools." But vital to this institutional health, according to Lloyd, is sustaining what he calls the WPI educational mission: "If we maintain the quality of student life, provide first-rate facilities, and keep the quality of our faculty and staff high, then we will be able to meet our enrollment goals."

Although tuition has risen from $700 to $8,900 during Lloyd's career, he says he doesn't feel that the costs will become prohibitive. Through a host of student aid programs and other resources, he adds, WPI is accessible to any student who really wants to come here. "More and more, people look on education as an investment. Students who earn WPI degrees can often command better employment prospects than those coming out of other schools, where graduates need advanced degrees to compete on the same level. In that sense, WPI could end up costing less."

"Tuition continues to make up about 50 percent of our income," he says. Other revenue sources are endowment, gifts and bequests, and miscellaneous education-related revenues. Still, he admits, WPI will have to explore new creative business ventures. "This is simply a reality of the financial milieu in which all colleges find themselves today."

In spite of his continuing enthusiasm for his life's work, Lloyd seems to feel no regret that his WPI role in its future will be less active. He says he's looking forward not to retirement in June, but to pursuing other of his interests more fully.

"I came to WPI planning to stay a few years," he says with a smile. "It has become a home to me." The people of Worcester and the WPI community, he says, are like family, particularly people such as Dorothy Burdulis, who has been his trusted secretary since 1956.

But the time has come to move on, he admits. "Ideas are very important. We need to find new and viable ways to fund them." He feels that he can contribute to the success of other non-profit groups as a consultant by making their operations more efficient. "People will always work for the intrinsic value of something," he says.

It's obvious that Dave Lloyd is going to enjoy the challenges in his future as much as he has enjoyed those of the past.

"Strategies often vary greatly between the worlds of commercial and nonprofit finance," he maintains. "It's the philosophy behind what we do that makes it all fun!"

Rachel Faugno is a freelance writer living in West Brookfield, MA.

Teaching Refugees to "Swim" in Somalia

Hattem (l.) and helper unloading pumps.

Sending money for food or medicine to refugees in stricken areas is like throwing a drowning person a life raft without teaching him how to swim."

That's the opinion of Dennis Hattem '74, a civil engineer working in a Save the Children Federation (SCF) refugee camp in Southern Somalia. "Donating money for emergency items, no matter how helpful initially, is only a temporary solution." Dennis, with his engineering expertise and SCF guidelines, is teaching a number of the 40,000 refugees in the camp how to "swim."

His main job responsibility is the design and construction of an irrigation scheme on 320 hectares (about 800 acres) of refugee farm land. He also provides technical input to SCF-assisted projects, many utilizing appropriate technology methods.

Most of the refugees have lived in the camp since the war over the Ogaden region in Ethiopia in 1977–1978 forced hundreds of thousands of people to leave their homelands. "Since six years is obviously a long time to receive handouts," Dennis says, "my efforts here, in line with SCF's philosophy, are focused on development rather than relief."

The majority of Somalia's refugees, he explains, have a nomadic heritage, with little or no experience in agriculture, especially on irrigated land. With overgrazing, recurrent droughts and an unstable political environment, the nomadic lifestyle is becoming insecure. SCF's objective is to train these people in the agricultural skills necessary for their own self-sufficiency.

"In order to meet this goal, I work with other SCF staffers, mostly Somali, and the refugees themselves, in the design and construction of the scheme," he continues.

The irrigation scheme consists of one main canal and four pump stations each supplying 300 liters/sec. More than 14 km. of secondary canals deliver almost 1,500 liters/sec. to the farm. Except for some major earthworks, the majority of the farm's structures have been designed to maximize the use of local materials and skilled and unskilled refugee labor. Thus, even before completion, training has begun in construction techniques and irrigation theory.

The recipients, because they have helped with the construction, also gain a sense of ownership, Hattem explains. With the first irrigation recently begun, the farmers are also organizing to ensure efficient use of the irrigation supply and to improve yields and plant diversified crops.

Dennis, a professional engineer, has been with Save the Children since September 1984. Five years prior to joining SCF, he was with Metcalf and Eddy in New York City. Earlier, he had met Frances Riemer while both were Peace Corps members in Malaysia—they are now married. Frances is currently the coordinator of SCF community development projects in the camps and surrounding villages.

In October, Frances and Dennis worked with other SCF staff members planning a luncheon for a VIP from back home. They made a party of it, sitting on the floor of a local restaurant (owned and operated by a group of refugee women assisted by SCF) and eating goat meat and rice with their fingers—Somali style.

"We told her about our work," reports Frances, "all about working with people to help them recognize and meet their own needs, whether it be to start a small business, to improve their existing health care services, or to improve traditional farming techniques."

Their guest became a bit glassy-eyed during the account, possibly because she'd gotten up at 5 a.m. that day to attend a UN-sponsored women's conference nearby. The guest's name was Maureen Reagan.

HOW TO SUCCEED IN COLLEGE WITHOUT REALLY TRYING

Flunking out of a university in Japan is hard to do—but for Japanese students, college is just a short vacation in a lifetime of learning.

By Leslie Brunetta

Japan has a joke university system," says John Zeugner, professor of history at Worcester Polytechnic Institute. Between 1976 and 1983, Zeugner spent four years in Japan as a Fulbright Senior Lecturer and visiting professor of cultural history. At the prestigious Osaka, Kobe, and Keio universities, he was surprised to find dingy buildings and infrequently used libraries. Students enrolled in up to 30 courses a term, did little or no homework, spoke up only when called on by the professor, and sometimes made their first appearances at final exams.

Yet, joke university system or no, Japan produces twice as many engineers per capita as the U.S., and its production workers use sophisticated mathematical operations on the shop floor. And even though it has a land-mass the size of Montana, the world's greatest population density per acre of arable land, and nearly no natural resources, Japan is the second-greatest economic power on earth, ranking only behind the U.S. Something's going right in Japan's educational system. What is it?

The answer is not as simple as some would-be American education reformers would have it. Just zeroing in on differences in teaching techniques, government expenditures, or number of hours spent in school ignores some larger issues. "There's the open assumption in Japanese society that age zero to five is a time for you, university days are a time for you, and late retirement is a time for you," says Zeugner. "The rest of the time is for Japan." It's this concept—that the successful individual belongs to the group and cooperates with others to bring about the group's success—that perhaps most distinguishes Japan's cultural ethos from that of the U.S.

Most people in Japan define themselves by the role they play in the workforce—a person is measured by what he does and where he does it. And the social system is intensely hierarchical: "It is almost true," says Norman Taylor, Charles A. Dana Professor of Economics and director of Japanese Studies at Franklin & Marshall College, "that no two people are on exactly the same social plane."

But Japan's hierarchy is not based on a Western notion of class privilege at birth; 96 percent of Japanese people consider themselves middle class. A Japanese student has one chance, and probably one chance only, to stake a place in society—and that chance is the university entrance examination.

"How you do at university in Japan," says Robert H. Chambers, president of Western Maryland College, who spent a sabbatical in Japan, "is much less important than which university you go to." Everyone in Japan knows that Tokyo University, known as Todai, is the country's No. 1 university. It's not that Todai is the oldest, or the most socially exclusive, or has the strongest academic departments, it's—simply—No. 1. If you want to enter the government bureaucracy, which is the country's most prestigious profession, then you have to go to Todai: The bureaucracy recruits from Todai, and from Todai only.

Everyone knows what the second, third, fourth, and 15th universities are, too. And which university feeds Honda, which feeds Mitsubishi, which feeds Hitachi. Couple this with the fact that most of the country's prestigious jobs amount to lifetime affiliations, and the entrance exam suddenly becomes just about the most important event in life. "Once you get a very hierarchical system pegged to an entrance exam to a university system," says Zeugner, "then that one shot is going to take care of your career."

The employers' recruitment system is so entrenched that almost every student in Japan—98 percent attend high school (which is noncompulsory), with 40 percent going on to college—understands from an early age that doing well on the university entrance exams is crucial. The exams are grueling and they're the only criterion for entrance to universities: It makes no difference if you're a good baseball player, a good musician, or a student leader. How you stack up against everyone else taking the test is all that counts.

"The Japanese system is almost the opposite of the American system, where the high school is a kind of socializing joke and college is where you knuckle down," says Zeugner. In Japan, high school is the most intense part of an educational crescendo leading to the university-exam climax. From the ages of five, four, and sometimes even three, Japanese students are encouraged to take their studies seriously.

The curriculum studied by six-year-olds in Tokyo is the same as that studied by six-year-olds in the country's rural areas: The entire public education system is controlled by a central authority, which can build a general, national consensus on what and how children should learn. That's not the only basic difference between Japan and the U.S.: In Japan, the school year is 240 days long, children have quite large amounts of homework from the first grade on, there's no tracking, and school populations are amazingly homogeneous, both racially and economically.

To a large extent, rote learning is an essential part of Japanese education simply because being able to understand the written language means memorizing thousands of ideographic characters—it's often not until the twelfth grade that students can fully understand a daily newspaper. It's relatively easy, then, to use rote learning in other subjects, too. But the common Western stereotype of the Japanese child being force-fed history dates and math formulae is far from the truth, according to Merry I. White, director of international education at Harvard's Graduate School of Education. Observing Japanese elementary school classes, White found children to be actively engaged in their lessons, enthusiastically shouting out questions, answers, and suggestions to their teachers.

In a fifth-grade math lesson on cubing, for instance, the teacher asked the students to write down their feelings about this new concept, and then asked them to think how the surface and volume of a cube might be measured. The class then broke up into study groups: some were given cardboard and rulers, while others worked together on problems. Each group competed to finish first. Later, the teacher gave the groups a problem whose solution was beyond them, but did not provide an answer at the end of the class nor set a deadline for finding the solution. White discovered that the children remained interested in the problem, even though they could not answer it for several days.

There are a few things to notice here, White says. One is that the teacher was more interested in getting the kids into the process of learning than in simply getting the answer out of them. Another is that the major emphasis was placed on group rather than individual achievement. Teachers are responsible for making up groups of mixed abilities and for making sure that everyone takes an active part. "To the Japanese," says White, "effort is much more important than ability."

Where the tempo quickens is in junior high school. Here, most students encounter scholastic stratification for the first time—they have to worry not only about the entrance examinations for universities, but also about getting into the high schools with the best university entrance results. By this time, nearly 60 percent of urban students attend *juku*—the private after-school schools (paid for by parents and unregulated by the central educational commission) that prime students for this series of entrance exams.

"There's a dual track," says Zeugner. "There's public or private school from 8:30 to 3:00 and on Saturday mornings, then there's *juku* for a few hours every day." Karl Zimmer, industrial professor of Mechanical Engineering at Villanova University, has stayed with families while on cultural exchange trips to Japan and says that children aren't forced by their parents to go off to *juku*: "Students are very anxious to go. The son of the family we stayed with went to *juku* two or three days a week even in the summer. During the summer, he only had two weeks off."

"The relationship between the family and the school can get very heavy in junior high and high school," according to Merry White. Because the politically left-of-center national teachers' union exerts pressure for reform of the exam system, teachers in the regular public schools try to teach a broader range of topics and interpretations than that tested by the entrance examiners. While parents may not like the idea of the more narrow *juku* system, most find it hard to sacrifice their child's future chances for their own ideals.

Given this hard-driving system, Japanese teen-agers live considerably differently than do their U.S. counterparts. When the hours spent by Japanese and U.S. students are added up, the Japanese have spent four more years in school over the twelve years of elementary and secondary school than have the Americans, even if *juku* is excluded. Academic students rarely take after-school or summer jobs, and they spend relatively little time with their friends. Almost all their efforts are toward the exams. The result is that Japanese high school graduates perform better on standardized tests than their peers in any other country, and are reckoned to have achieved a level of education equal to that of average U.S. college graduates.

"We've broken you, so now you have four years to put yourself back together." That's John Zeugner's interpretation of the university experience for most Japanese students. Once students get into university—and some spend a year or more as *rōnin* ("lordless wandering samurai"), studying independently to retake the exams—they play sports, join clubs, and socialize with all the energy once reserved for their studies. A few students do take their studies seriously, says Zeugner, "but they're considered a bit strange, and there isn't any support mechanism for them."

Just because most Japanese students slack off during their college years doesn't mean that age 18 marks the end of their education. "Obviously, Japanese primary and secondary education work terrifically," says Zeugner, "but it's the follow-up that works even better."

Once the government or a private company picks up its graduates from the universities, it provides them with a broad practical education not only in the specifics of their own jobs, but also in the workings of the industry or government as a whole. "There's a little shutdown period from 18 to 22," observes Zeugner, "but from 22 to 60 there's enormous pressure to get more and more knowledge." Companies sponsor in-house study groups, seminars, and usually an experience abroad for their employees. Perhaps because companies can count on retaining employees over the course of a career, they don't feel obliged to justify such training with short-term benefits. "There may be long-term payoffs," says Zeugner, "but to the Japanese, the learning itself is payoff enough."

In any case, the Japanese businessman's definition of useful knowledge is much broader than that of his competitor in the U.S., according to Leon Stover, a 1950 graduate of Western Maryland College, professor of anthropology at the Illinois Institute of Technology, and the first non-Japanese to teach at Todai graduate school: "The Japanese have a very practical approach. Professionals say, 'We study literature in order to understand human nature so as to use it in business.' " Much of Japanese culture is based on ancient Chinese philosophy, says Merry White, and it shows in modern corporate and government policy: "The Japanese see education as a lifelong process. It's an ancient Chinese tradition that virtue is acquired through learning."


Jeff Dever

It's almost impossible in Japan to be a self-made man," says Takeko K. Stover, senior lecturer in Japanese history at Roosevelt University and a graduate of Japanese Women's University, "so people feel you can sacrifice your younger years in order to get into the best university." Karl Zimmer found this to be a sobering aspect of Japanese life: "The children don't have any opportunity to play or just to do nothing." And, says Merry White, the system can be unbearable for the out-of-the-ordinary child: "There really isn't a place for the kid who's truly eccentric or extraordinarily bright."

There are some educational as well as social drawbacks to the Japanese system, according to American observers. "By high school, their education is very much a cramming," says Norman Taylor. "They know a lot more than their U.S. counterparts, but they don't get much training in analytical thinking until after university." And many Americans tie this cramming and the slacking off during college years with the Japanese's reputation as copiers, rather than innovators: "Science and math people say the critical moment for new ideas comes between the ages of 18 and 35," says Zeugner, "and the Japanese are throwing a sizable chunk of those years out the window."

But the Japanese recognize the weight of these problems and take them seriously as stumbling-blocks on the path to post-industrial success. Education consistently shows up on Prime Minister's Office polls as the nation's No. 1 concern, and education makes the headlines nearly every day. Says Merry White, "Just the fact that education can be such a high-profile topic in Japan is humbling for Americans."

PANIC

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Hijackings, AIDS, missing children, international terrorism, natural and industrial disasters—everyone can list events with the potential to ignite outbreaks of fear. It's much harder to explain how panic works.

The Baltimore News American—Randall Roberts

AP/Wirephoto

The only thing to fear is fear itself, Franklin Delano Roosevelt told the nation in his first inaugural address. Today, fear seems inescapable. Forty percent of Americans expect a nuclear war within 10 years; the same number predict another industrial accident on the order of 1979's Three Mile Island catastrophe. And in the past year, 1.4 million Americans changed their travel plans in the wake of the hijacking of the Achille Lauro.

By Marshall Ledger

After the hijacking of the cruise ship *Achille Lauro*, Marilyn Klinghoffer, widowed when the hijackers killed her wheelchair-bound husband, Leon, told a subcommittee of the U.S. House of Representatives: "My husband's death has made a difference in the way people now perceive their vulnerability. I believe what happened to the passengers on the *Achille Lauro* and to my family can happen to anyone at any time and at any place."

She gauged the American pulse accurately. Of 6.5 million Americans who had arranged trips abroad last year, an estimated 1.4 million changed plans because of that hijacking and other incidents. The figure represents a massive shift in reaction to activity that, as tolled by the Vice President's Task Force on Combatting Terrorism, claimed only 23 American lives in 1985.

Terrorism is not the only locus of perceived vulnerability for Americans. AIDS—Acquired Immune Deficiency Syndrome—is causing fearful parents to yank their children from schools in which a schoolmate, or even a sibling of a classmate, has been diagnosed as having the disease. At a March conference in Washington, D.C., health-care officials talked of colleagues afraid to treat AIDS patients. Elisabeth Kubler-Ross, known for her work with dying people, spoke of the resistance she encountered in trying to establish a hospice at her Virginia farm for 15 children dying of AIDS; property values would fall, her neighbors told her.

Approximately 18,500 cases of AIDS have been recorded in the U.S., including 9,800 deaths. Research is gaining ground. The virus has been identified. All in all, no evidence points to contagion by casual contact. Nonetheless, as Merle A. Sande wrote recently in *The New England Journal of Medicine*, Americans—physicians among them—are gripped by "an epidemic of fear."

Americans are also growing more fearful of atomic power. Howard Ball, dean of the College of Social and Behavioral Science and professor of political science at the University of Utah, traced the development of one such instance in *Justice Downwind*, published in February: When the U.S. government conducted above-ground nuclear tests in Nevada in the 1950s, the Utah residents in the path of the fallout were assured of the safety of the blasts. An editorial in one local newspaper was headlined, "Spectacular Atomic Explosions Mean Progress in Defense, No Cause for Panic." Children played in the radioactive dust as though it were snow, and the various cancers they have since developed are now a cause for lawsuits.

Industry is suspect, too. In the early 1960s, according to Roger E. Kasperson, of Clark University's Center for Technology, Environment, and Development, the public expressed confidence about the disposal of radioactive wastes. Since then, following leaks of stored waste, not to mention explosions in transporting such material, disposal has led to "volatile" community reactions all over the country. As many as 50,000 people fled their homes in the wake of the 1979 accident at Three Mile Island. Public opinion polls tell a similar story: Some 40 percent of Americans predict a catastrophic industrial accident in the near future: the same figure expect a nuclear war within ten years.

Officials now speak of "unscaring" the public, but the task is not easy. People overestimate the risks of dramatic or sensational causes of death and underestimate undramatic causes, says Paul Slovic of Decision Research, a Eugene, Oregon-based risk assessment firm. The "imaginability" of an event, he says, blurs the distinction "between what is (remotely) possible and what is probable."

When people are uncertain, Slovic continues, they reduce the anxiety generated by denying the uncertainty, "thus making the risk seem either so small that it can safely be ignored or so large that it clearly should be avoided." They hate probabilities; "they want to know exactly what will happen." Slovic tells of an experimenter who tried to convey the smallness of one part of toxic substance per billion by comparing it to a single crouton in a five-ton salad. The comparison made the degree of contamination so easily imaginable that it was grossly and erroneously magnified. The analogy, meant to reassure, backfired—adding to the potential for panic.

Panic—not necessarily in a medical sense, but in the sense in which Utahans and parents concerned about AIDS and 1.4 million would-be overseas travelers understand it—is a possible result of something mysterious, perceived as unpredictable in occurrence, erratic, dreaded, and a threat to life and social values. But what panic is, is less easy to say. (A list of conflicting opinions is found on page XI.) Unfortunately, panic is not detected simply, as Sophocles suggested, by seeing whose hair is standing on end.

"Panic can take many forms," says Stewart Agras, director of behavioral medicine at Stanford University and president of the Association for the Advancement of Behavior Therapy. Agras treats individuals, and describes the obsessiveness of afflicted individuals in *Panic: Facing Fears, Phobias, and Anxiety*, but he suggests that inchoate fears experienced singly might apply to people in groups as well: "I think the feeling state is identical"—wanting to flee a situation, stopped only by consideration of what others may think. "And all the physiological changes would be similar—blood pressure and heart rate going up, increase in the hormones that get these things going, the muscles tensing, ready for flight."

In clinical practice, can he separate the biological, cultural, psychological, and social factors of panic? "In an individual, it's almost impossible," he says, "and when you come down to it, it doesn't matter very much."

"There are major problems of getting back and forth from psychological and sociological processes," says Peter H. Knapp, associate professor of sociology at Villanova University. "Everyone recognizes that it's important to do so, but how one does so, and gets a whole that is more than the sum of its parts rather than less, has proven to be very difficult."

Knapp offers a sociological explanation for one variety of panic: wild flight, the sort that is discouraged in packed theaters and nightclubs. "What is involved," he says, "is a kind of 'prisoner's dilemma,' in which, yes, if every-

Signs of fearful times: Queens, N.Y., students boycotted their school (below), which admitted a student with AIDS; the U.S. embassy in Paris beefed up its security after the 1982 murder of a military attaché.

one walks to the nearest exit of a burning building, almost everyone will get out, and if everyone stampedes to it, virtually nobody will get out.

"And so, in the abstract, it would be better for people not to stampede. But people in the building are not in the abstract—they're in the building, and if they see others running to the exit, they know that anyone who *walks* there is surely not going to get out. Yet running means the likelihood of a jammed exit. Obviously, powerful emotions are aroused, but they aren't the key to the thing. The key is that the outcome for you depends on other people. The objective consequences of running or not running suddenly become very different."

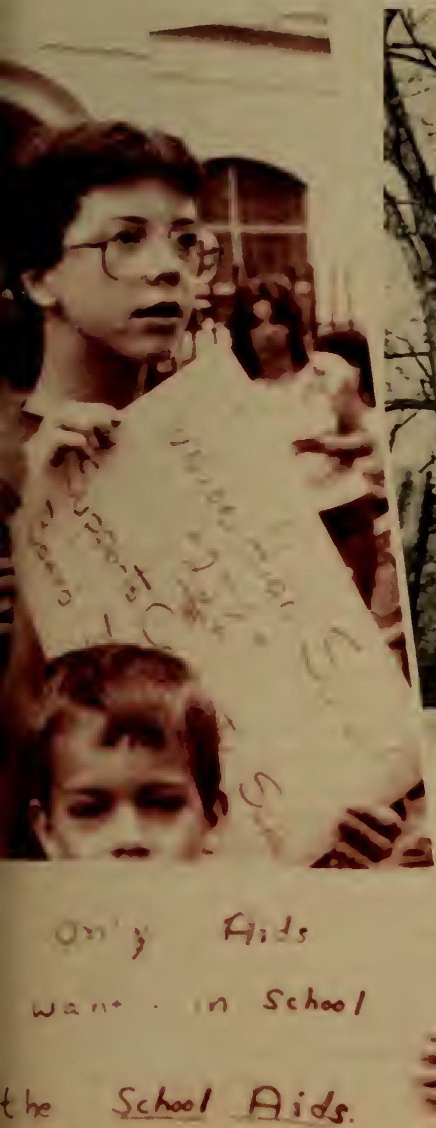
Panic, Knapp continues, is an unstable, self-reinforcing event. But he feels that it is difficult to formulate an umbrella theory of panic because responses to AIDS or terrorism or industrial accidents might be "not a set, but *sets*, of different things." And theory requires a more systematically defined data-base. The alternative approach to studying panic, he points out, is case history, discrete events in which a plausible interpretation is put forth for each one.

Case histories are the staple of Charles Mackay's *Extraordinary Popular Delusions and the Madness of Crowds* (the first edition was published in 1841). One of Mackay's examples of economic speculation involves the tulipomania that seized Holland in the 1630s—when prices for the bulbs fell abruptly, there was widespread commercial ruin. But in the boom's heyday, a landowner went so far as to offer 12 acres of land for a single bulb.

Mackay attributed the Dutch infatuation with tulips to solicitude for the weakness of the cultivated plants ("as a mother often loves her sick and ever-ailing child better than her more healthy offspring"). He needed different explanations to account for such other mass attractions as the Crusades, [illegible] hunts, alchemy, beards, thieves, [illegible] and prisoners—a series of what he called "moral epidemics," about which he concluded that people "go mad in herds, while they only recover their senses slowly, and one by one."

Recent research is more precise and intellectually satisfying, but it has not resolved the question of how masses of people fall into panic. Hadley Cantril, a public-opinion expert based at Princeton University, studied the famous overreaction to Orson Welles's "War of the Worlds" radio play broadcast on Oct. 30, 1938. Cantril and his associates were on the scene promptly (their book, *The Invasion from Mars*, appeared in 1940), and they ascertained that a panic actually occurred: Of an audience of 6 million, an estimated 1.2 million were taken in.

After interviewing 135 people, Cantril



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"War of the Worlds," a radio play presented by Orson Welles on Oct. 30, 1938, didn't seem like fiction to an estimated 1.2 million listeners. Not only did most of the victims tune in too late to catch the disclaimers, they were also, claim some researchers, susceptible to panic because of their own personality traits—phobias, lack of self-confidence, individual worry.

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A stranger's death in dramatic circumstances touches others. Perhaps the "stranger" has already touched lives through his work, as Beatle John Lennon, murdered in December 1980, had affected a generation. Or perhaps strangeness is removed by the event's horror. Aid poured into Mexico City from around the world after last year's earthquake. Many "victims" rose above the panic to become heroes—University of Delaware sociologist Enrico Quarantelli estimates that victims and neighbors performed as much as 85 percent of the rescue work.

AP/Wide World Photos

concluded that the victims failed in "critical ability," by which he meant that they did not correct their misperceptions by turning to other stations or calling friends. They accepted the prestige of the radio and the supposed newscast, and of the authorities, including the announcer, the "Secretary of the Interior," and the Princeton astronomer played by Welles.

The victims, Cantril went on to state, were susceptible because of their own personality traits—phobias, lack of self-confidence, individual sources of worry. They were also influenced by having tuned in late (thereby missing one of the disclaimers), by seeing others disturbed, and by being separated from their families when they were listening. He also cited some general conditions: a disturbing sense that the economic, social, and political worlds of 1938 were changing; fear of technology; and the war scare.

The day after the broadcast, *The New York Times* reported, "Radio Listeners in Panic, Taking War Drama as Fact." The Federal Communications Commission threatened an investigation. A congressman wanted controls slapped upon radio broadcasts. Dorothy Thompson, writing in *The New York Tribune*, felt that the panic did the United States a favor. It revealed, she claimed, an American susceptibility to demagoguery and the failure of the educational system. In particular, it uncovered the dangers of the popularization of science, which "has led to gullibility and new superstitions, rather than to skepticism and the really scientific attitude of mind." She went on to argue for freedom of the air waves.

Howard Koch, the play's scriptwriter, looks back on the event with relief that nobody died in the panic. (He himself found out about the uproar only the next day, at the barbershop.) He credits Thompson with turning around an angry public by her argument that the nation should strengthen itself. A few years later, he notes, "War of the Worlds," translated into Spanish, was broadcast in Lima, Peru, and resulted in a similar panic; there, however, the duped and angry audience turned on the radio station and burned it down.

Koch sees an ominous parallel in the climate of 1938 and that of 1986. "We're living in a kind of dangerous time, anyway—the nuclear thing hanging over us. People sometimes ask me: Would it happen if the play were done again? I would be unwilling to write it now because I think that the state people are in, it *could* happen again." He adds, "We learned from that to be careful in what news we spread—at least, that's what we should have learned."

The Salem witch trials are probably the most scrutinized instance of mass hysteria in U.S. history—"an instance of *something;* I don't know if *hysteria* is the right word," says Paul Boyer, professor of history at the University of Wisconsin, who co-authored *Salem Possessed: The Social Origins of Witchcraft*. That outbreak of fear in 1692, he notes, "did not simply explode in a random, formless way." Rather, it followed established lines of economic and political conflict in Salem village (where the events occurred), which was

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split in its attitude toward the neighboring town of Salem. The panic was triggered by the universal belief in witchcraft ("It was no more unrealistic for them to be afraid of witchcraft than it is for us to be afraid of AIDS," he says) and the hysteria of the afflicted girls, but the hatred had been pent up by decades of factional tensions.

In the past 10 years, separate studies of the Salem panic by a psychologist and a historian have argued that the panic can be traced to food poisoning: Some of the villagers were eating bad rye bread. The bread, a Puritan staple, supposedly was contaminated by a fungus similar to LSD, called ergot, which thrives in cool, damp weather—precisely the weather in Salem in the early 1690s.

Nicholas Spanos, professor of psychology at Carleton University in Ottawa, Canada, dismisses that proposition by saying, among other things, that the symptoms of illness exhibited by the girls did not sufficiently fit those caused by ergotism—including permanent neurological damage, even death—which, he feels, should have occurred if the poisoning lasted as long as the events demand.

Instead, he returns to Boyer's conviction about local factionalism and extends it, arguing that authority figures must legitimate the proceedings that lead to panic. Elsewhere in New England, he observes, ministers tactfully steered allegedly possessed individuals away from pressing their charges. In Salem, however, the minister encouraged the girls; one was his own daughter, and another lived in his house. The courts, contrary to their convention, chose to accept "spectral" evidence—hallucinations or coincidences—and the girls, allowed to make unanswerable accusations, were legitimized as genuine witchfinders.

Because confession was generally a method to escape execution, most of the accused confessed, adding to the credence of the charges. And this large number of confessions added to the stature of the "evidence" while simultaneously fueling the panic.

Spanos suggests that mass psychogenic illnesses—a different sort of hysteria—have a similar dependence on figures in authority. At a football game in California, the public-address announcer warned spectators to throw away the concessionaire's soft drink because it might be tainted. Hundreds of people showed signs of food poisoning, whether they had drunk any soda or not. Everyone recovered as soon as officials announced that the soft drink had passed a health test. Typically, biological experts are called in to investigate, and typically they are baffled—until the incident is stamped as a psychological epidemic. "That stops it," Spanos says. "No one wants to get labeled as crazy."

Do Americans constitute a society that is especially liable to panic? Not according to one psychiatric view. Granville Tolley, director of the Dorothea Dix Hospital, a state psychiatric facility in Raleigh, N.C., says, "Avoidance and fear in the absence of clear understanding, or in the presence of what turns out later to be a misunderstanding, is quite a common reaction."

On the other hand, David Riesman, professor emeritus of social sciences at Harvard University, feels that the United States is threatened, in part, because it is a "volatile" society: "My image is of a ferryboat with a very shallow keel, in which people rush first to one side and then to the other, and it's just good luck that it doesn't tip over."

Americans, he continues, have an "idling panic-proneness" that, once shifted into gear (as in the Tylenol scares), quickly spreads nationwide. The delayed, then overdone reaction reminds Riesman of an episode on, of all things, "Candid Camera," Allen Funt's television program. Movers, Riesman recalls, were called to a particular address to carry away a trunk for shipment. While the owner proceeded to give directions on how to hold the trunk, noises emitted from it. The owner talked on, as if nothing were amiss. The movers glanced warily at the trunk but took no action, even as the noises turned into groans. Only when the voice in the trunk screamed did the movers leap to help.

A contemporary illustration of Riesman's idea of overreaction came recently from Dr. Benjamin Spock. The famous pediatrician was criticizing the wide distribution of pictures of missing children, especially the tactic of printing them on milk cartons. Spock complained that it is "scaring tens of millions of children" for a questionable degree of protection or even aid in finding them. The problem, in part, is social: "In America, we ignore dangers for a long time, then get hysterical about them."

To which Riesman replies, "That sounds like the groaning trunk."

In any contemporary potential panic, the American media act as a sort of wild card. They foster fear and calm; they inform the public about the incident and, in the very process of presenting it, "make it a different thing," as Villanova sociologist Knapp puts it. There are those who feel, for example, that if the media could have been persuaded to stay away from the U.S. embassy in Tehran for three days, the Iranian hostage crisis would have ended within that time.

In arguing in *The New England Journal of Medicine* that physicians must spread the appropriate word about AIDS, Sande indicates his own frustration when he says that "the new knowledge has often produced more public concern than relief." But he does not suggest how his recommendation will change the way even correct information is received.

In some ways, Americans may be steeled against panic—or perhaps are only set up for a bigger fall in yet another version of the groaning trunk. As

Michael Maccoby, a Washington, D.C.-based psychiatrist, psychologist, and anthropologist, puts it, Americans like to take risks: "We have a hard time getting workers to take safety precautions; we don't like to wear seatbelts. As a country, we're rather macho in this regard. We don't like people who are scared."

The trait is historically derived, he points out, since the United States was founded by people who took incredible risks in crossing the ocean, then settling the land. "You could say it's part of our strength. Look—the astronauts are ready to go up again in the shuttle. The country's spirit is: Faint hearts never won anything. But it creates a tendency to repress and deny fear." Maccoby, who has consulted for the State Department on terrorism, adds, "We might be a little better off if we were a little more frightened."

As it happens, the State Department tries to stave off the worst aspects of panic by teaching its foreign-service employees what to expect at their overseas posts. Some need their machismo whittled down, and others need bolstering.

William Burke, who coordinates administrative training in the department, finds that those heading overseas must learn to leave home the American work ethic of getting to the job punctually and regularly (and supervisors must learn to accept the new arrangement). Americans feel that if they have a commitment, they must always deliver on it, he says, "and that's wrong now. You have to be more flexible." And so, if they look out their door in the morning and see anything out of the ordinary, they are told to go back in—and make up the time on Saturday or in some other way. If they enter an airport and sense anything suspicious, they are advised to leave and take a later plane.

Becoming more aware of your surroundings, he says, is a part of the training transferable to the public at large. He remembers reports that passengers on the *Achille Lauro* noticed the terrorists as individuals who acted strangely prior to sailing. "I could see myself, two or three years ago, seeing all that—and getting on the ship, too!"

His course makes students handle models of explosive devices, so that they will recognize them, and it teaches them how to examine a car for a planted bomb. And it advises students to put their papers in order before they leave the U.S., to set up powers of attorney and make wills; and when they reach their posts, to fill a "bug-out bag" with important documents and a set of clothing in case of a quick evacuation. Is there stress simply from the nature of this advice? "It's less frightening to confront the possibility of danger."

Burke's view is corroborated by Marilyn Holmes, who prepares education films for the State Department. It is hard for the unprepared consular officer to go to a morgue to "identify dusty fingers," she says. The films warn the viewers about bad dreams and depression, too. "We bring it up front," she says. "A lot is sensitization and allowing awareness to come through, instead of keeping a stiff upper lip and pretending you're the only one in the whole group who's not a coward." She adds, "There is no panacea, there's nothing anybody can really *do*, but if you are empowered with knowledge, if you can do a little bit to help yourself, you'll be a lot better off."

When disaster does strike, Holmes has learned, the victims "become heroes"—their adrenalin flowing, they pitch in—to a fault. "They don't know how to limit themselves, they lose their potential for good judgment about rest and food." A similar reaction has been discovered and repeatedly verified by Enrico Quarantelli, professor of sociology and co-founder of the Disaster Research Center at the University of Delaware. "People are not, contrary to certain imagery, stunned into shock or a state of unresponsiveness or passivity," he says. "They generally rise to the stress of a disaster. They act reasonably and responsibly, as best they can."

The "myth of panic," suggests Quarantelli, serves a function for the victims of a disaster—it gives them an excessively low level of expectation that they and their neighbors will cope adequately, a level that makes them feel good when they notice how well they have actually performed. "It doesn't mean that everything is done perfectly or that everything that needs to be done is done. But, to overstate in order to make the point, if the only problem we had in disasters was the attitudes and behavior of individual victims, we could all go home." For example, he estimates that in last year's Mexican earthquake, victims and neighbors performed as much as 85 percent of the rescue work, even though foreign teams received more publicity.

For hostages, of course, the panic also takes place at home, among their families, who often vent their anger at the Citizens Emergency Center, headed by John H. Adams, Jr., at the State Department. His office has a double agenda: to provide families with reassurance and assistance and also to ease their frustration so that they do not carry their complaints to the media. By denouncing either the U.S. or the government of the country where the incident is taking place, he says, "they could negatively affect foreign-policy interests in the short term."

Some families want the U.S. to send Marines in right away; others want negotiation, nothing that might threaten lives directly. Whatever they might have earlier known about the government's policy toward terrorists—that the U.S. does not make concessions or pay ransoms or change its policies—"when it's their own," he says, "it takes a different coloration."

"The government is seen as part of the problem," Adams continues. "We refer to it as the families-of-victims syndrome. Initially, they're shocked by the news, they need contact. Then they become extremely frustrated as the incident wears on, then they get angry and lose confidence in authority figures, including this government. There's a tendency on the part of the family to unconsciously discount, even disregard, the efforts being made. It's obviously impossible, under the circumstances, to do enough for a family."

Fears for the victims by those beyond the family is not merely a matter of the outsiders seeing their own skin saved in a similar situation. "To the credit of Americans," says Riesman, they show "a certain empathic generosity to individuals," so that they are touched by the deaths of, say, Leon Klinghoffer or teacher-astronaut Christa McAuliffe.

Psychiatrist Tolley also suggests why a stranger's death in dramatic circumstances affects others: "Death never occurs in the absence of a context," he says, and part of that context, for outsiders, is "the conscious and unconscious freight" that they attribute to the dead person. In Klinghoffer's case, for instance, people feeling bad for him may not have known that they responded because of his hometown or his ethnic identity or his age or his handicap or the unjustness of losing one's life on vaca-

AP/Wide World Photos

AP/Wide World Photos

"I believe what happened to the passengers on the Achille Lauro and to my family can happen to anyone at any time and at any place," said Marilyn Klinghoffer, shown placing flowers on her husband's casket.

tion or the reminders of events in the Middle East. As for McAuliffe, says Tolley, "She inspired a strong sense of identification by offering qualities that people place a high value on."

Thomas Paine, philosopher of the American Revolution, thought well of panics. "They produce as much good as hurt," he wrote in *The American Crisis*. "Their duration is always short; the mind soon grows through them and acquires a firmer habit than before. But their peculiar advantage is that they are the touchstone of sincerity and hypocrisy and bring things and men to light, which might otherwise have lain forever undiscovered."

Panic may be useful in "legitimate doses," agrees David Riesman, explaining, "All of us who are sensitive and not boosterish or sanguine must feel apprehension about the continuity of life; a bit of group panic gives the comfort that our feelings are, at least in this case, shared. We have the fear, but we're not alone." He compares the experience to a roller-coaster ride, in which there is some apprehension that is not totally negative. "There's a certain solidarity when it isn't too threatening," Riesman says, suggesting that group panic may serve as a "vaccination." Then he adds, with concern, "A vaccination that can itself become the disease."

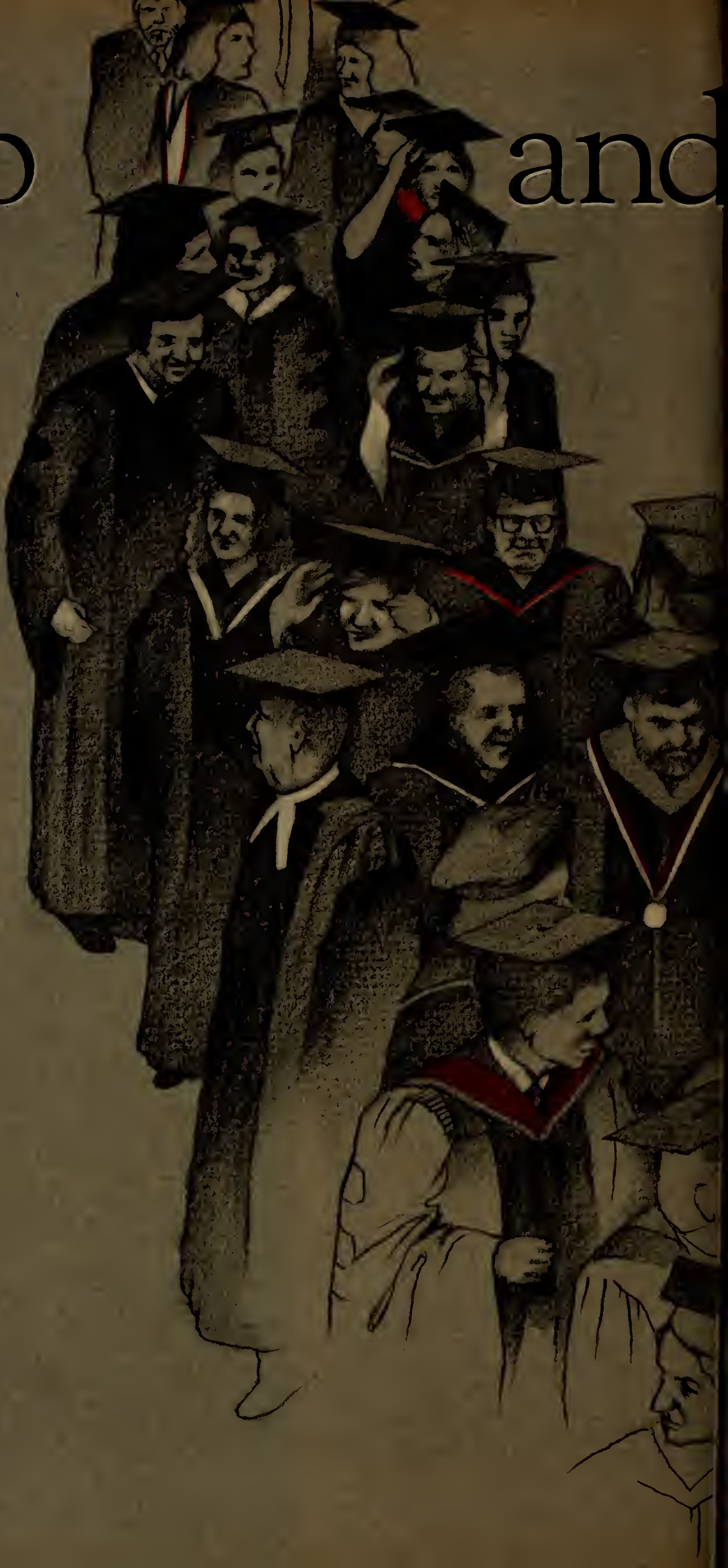
Marshall Ledger, associate editor of The Pennsylvania Gazette, *is making his third appearance as a contributor to the Alumni Magazine Consortium.*

THE CONTRARITIES OF PANIC

compiled from scholars and others

• **Panic is an individual psychological process; each person runs individually, not because others are running.**	• *Panic requires social interaction and social cues.*
• **In panic, one senses the futility to stem the inevitable, feels hopeless.**	• *One flees, implying there is a way out.*
• **Panic is an appropriate reaction to life-threatening situations, a natural reaction.**	• *Panic is irrational, even pathological.*
• **Panic is seen in paralysis of activity.**	• *It is seen through wild flight.*
• **Panic situations have inherent characteristics.**	• *Each panic situation must be defined on its own terms.*
• **Panic is the release of tension.**	• *Panic can be instantaneous and does not require time to build up, as "release" implies.*
• **Panic is a "contagion" that others catch without knowing the original cause of fear.**	• *People are active agents of their own participation in a panic; they select what they will respond to, after they define the situation.*
• **Panic is a subjective state of mind.**	• *Panic is an act of observable behavior, or physical activity.*
• **Panic is an emotional reaction that results in nonfunctional behavior (leaving by the same exit as everyone else).**	• *Panic is an appropriate reaction to the way a situation is perceived (fleeing, but not by the same exit).*
• **Panic is antisocial—the self over others.**	• *Panic is asocial—people look out for themselves without being conscious of others.*
• **Panic is physiological—the mouth is dry, the palms sweat, the body trembles.**	• *Panic is psychological or emotional.*
• **Panic is a reaction to the unknown.**	• *Panic participants know what they are running from (although it may be an illusory threat).* —ML

Pomp and



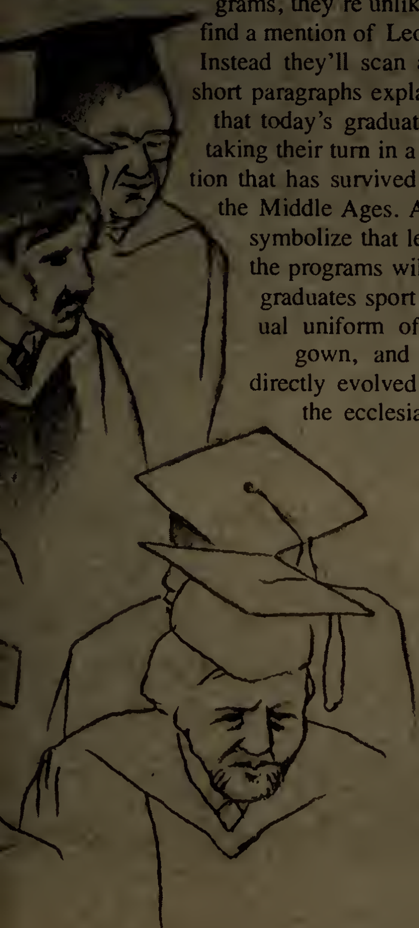
There's more to academic caps and gowns than the history given in most Commencement Day programs.

By Leslie Brunetta
Art by Allen Carroll

its Circumstances

Gardner Cotrell Leonard, scion of the Albany, N.Y., dry-goods firm of Cotrell and Leonard and a Williams College freshman, was disappointed with the caps and gowns used by Williams' graduating class of 1883. When it came time for his own graduation three years later, he designed the caps and gowns himself, and had the family firm make them up for his classmates. Not content with such a local solution to the problem, he then travelled to Europe to study academic costume and heraldry. He returned with his own designs, which he sold to faculty at the University of Chicago, Yale, Princeton, and Columbia. A tradition was born—or, reborn.

This May and June, as graduating students and their fan clubs in the audience flip through Commencement Day programs, they're unlikely to find a mention of Leonard. Instead they'll scan a few short paragraphs explaining that today's graduates are taking their turn in a tradition that has survived since the Middle Ages. And to symbolize that legacy, the programs will say, graduates sport a ritual uniform of cap, gown, and hood directly evolved from the ecclesiastical garments worn by medieval scholars.



Yet what we today recognize as academic dress did not even appear on American campuses until the late 19th century: Before then, graduating classes wore either their Sunday best or uniforms incorporating anything from sailors' caps to sombreros. Indeed, the first seniors agitating for mortarboards invoked faculty wrath. Oberlin College students, for instance, fought to adopt caps and gowns in the 1880s and '90s, extolling their democratic effect, while the faculty denounced the garb as divisive. (Ironically, in 1970 Oberlin's graduating class elected to abandon the costume as elitist, while "traditionalists" among the faculty protested.)

Students at Worcester Polytechnic Institute started pushing to wear caps and gowns in 1910, but only succeeded in instituting them at the 1914 commencement over faculty protests, according to John P. van Alstyne, current dean of academic advising: "The engineering faculty wanted no part of such fancy trappings." It wasn't until the Institute's 50th anniversary the following year that the faculty joined in, worried, perhaps, about being upstaged.

But such gown and gown infighting is the heart of academic costume's history—just what a cap and gown and hood have meant in the past and should mean in the present have been matters of controversy since the beginnings of the first universities.

In medieval times, gowns and hoods were the everyday clothing of men and women of all social stations—including scholars. These men were not necessarily monks or other ecclesiasts. (It wasn't until the Reformation that scholars had to take an oath of allegiance to the Church of England before matriculating at Oxford and Cambridge.) Instead, they were "clerks" who enjoyed clerical status: They answered to church authorities, not to secular law officers. This separation of church and state came in handy—clerks were a rowdy bunch. Medieval town and gown battles were often brawls that left corpses in the streets, and clerks' masters and bishops were more likely than local magistrates to be lenient with their charges.

With this privileged status developed the idea of a special academic costume. Along with clerical status went the concept of belonging to the scholars' guild, of having a well-defined place in what amounted to a teachers' union. (Universities were originally recognized simply as guilds rather than as corporate entities—*universitas* at first meant any organization of citizens; it acquired its present meaning later.) Masters of the arts—who, like masters in the other trade guilds, wanted to be set apart from their underlings—had begun, well before the 1350s, to wear the first true academic costume: a cope (the regular clerical outerwear) and hood bordered with a white fur called minever.

Even so, for a long time there were no strict dress codes. Lecturing masters at Paris were simply ordered in 1215 to wear a "cope, round and black and reaching to the heels—at least when it is new," and the 1264 statutes of Oxford's Merton College specified only that "the Scholars who are appointed to the duty of studying in the House are to have . . . a dress as nearly alike as possible."

By the middle of the 14th century, though, the question of academic wear came to be taken more seriously. At Oxford, the chancellor ordained that tailors who stinted on robes ordered for members of the university could be imprisoned: "For it is decent and reasonable that those whom God has distinguished with inner qualities from laymen also be different from laymen in their appearance."

Hoods also came to be subject to restrictions as ordinary men began to phase them out of their wardrobes. Originally appendages of copes, hoods had been transformed by the 13th century into separate articles of clothing, and

In a uniform sea of caps and gowns, today's graduating students distinguish themselves with corsages, neon socks, and messages taped across their mortarboards.

were worn thrown back over the shoulders when not in use. (These hoods often had long tails, or liripipes, which one 15th-century rule forbade undergraduates to wear wrapped around their necks.) As the hood became less common among ordinary folk, it became more useful as a distinctive badge among scholars: By 1432, only masters, nobles, and wealthy students (who were rarely denied any privileges) were allowed to line their hoods with minever (or silk in summer), while bachelors had to settle for lamb's wool or rabbit's fur. By the end of the 16th century, undergraduates weren't allowed to wear hoods at all.

It's not known exactly when other headdresses first came to be used, but by the middle of the 16th century, caps of two main types had become regular features of academic dress. At Oxford and Cambridge, only doctors of theology, canon law, or physic were allowed to wear caps at first, and they wore a pileus, a round skullcap with a small point at the crown.

At Paris, caps were made up of four square pieces of material whose top seams were flat-stitched together to form a raised X. From this design came the biretta, or square cap, which eventually developed into the mortarboard, equipped originally with a tuft rather than a tassel. Strange stories have sprung up about the mortarboard's origin—one has it that it mimics the shape of students' books, another that it echoes the plans of college quadrangles. And one story, stemming from a one-line joke in *Verdant Green*, a popular 1854 novel about Oxford life, dogs the cap to this day—that it evokes the mortarboard of the master workman, the master scholar's equal in the builders' guild.

Although the basics of modern academic dress were in place by the end of the 16th century, the costume was abused by both students and masters. The early scholars were not only rowdies, they were dandies as well. As early as the 1340s, rules chided scholars for their "excess in apparel," and whenever any new style of clothing showed up on the street, scholars had to be warned about (and sometimes punished for) abandoning their robes.

As the Reformation began to sweep through England, the reformers tried to enforce not only a uniformity of religion at Oxford and Cambridge, but also a uniformity of dress. (In fact, the Reformation accounts for the lack of "traditional" caps and gowns at most German and Swiss universities, where Luther and Calvin held sway.) At Oxford, the 1636 statutes of William Laud, Archbishop of Canterbury and Chancellor of the University, included an enactment that "all the heads, fellows and scholars of colleges, as well as all persons in holy orders, shall dress as becomes clerks. Also that all others (except the sons of barons having the right of voting in the Upper House of Parliament, and also of barons of the Scotch and Irish peerages) shall wear dresses of a black or dark colour, and shall not imitate anything betokening pride or luxury, but hold themselves aloof from them."

Seemingly reactionary in its call for a return to clerical traditions, the statute was actually radical: From medieval times, the gowns and copes of scholars had assumed colors from blood-red to green. But the scholars proved to be traditional in a way Laud and other reformers hadn't reckoned on: They had flouted the rules before the reforms, and they continued to do so for decades after. The 1750 Cambridge "Orders and Regulations" demanded that students appear without "lace, fringe, or embroidery"; a 1788 report entitled "Remarks on the Enormous Expence in the Education of Young Men" complained that the dress of the undergraduates was "Indecent, Expensive, and Effeminate."

Such personal sartorial rebellions allowed for the evolution of the cleric's original gown, cope, and hood into the amazing variety of costumes seen at

Cambridge and Oxford today. The result is that few articles of present academic uniform can truly be called medieval survivals. A rare relic can be seen at Cambridge—on a degree-day, the vice-chancellor wears a scarlet, sleeveless, minever-lined cloak with attached tippet and hood, a replica of those worn by the Oxford chancellor in a 14th-century miniature.

In 1636, the same year that Laud issued his Oxford code, Harvard College was founded in Massachusetts Colony. It's not known for sure whether the first students at Harvard wore academic costume of any kind, but by 1655, the College Laws charged that "noe scholler shall goe out of his Chamber without Coate, Gowne, or Cloake." According to one college history, "coate" and "cloake" probably refer to the doublet (a tight-fitting jacket) and

cape favored by the Puritans. But as "gowne" is translated to *toga* (the Latin word used for the academic gown since medieval times) in the Laws of 1692, it seems likely that the gown was in use. Probably, these gowns were like the "mourning gowns" then worn at Oxford and Cambridge. Plain and black, they registered no academic status—which would appeal to the Puritans, who were always on the lookout for signs of "vestarianism."

Academic dress rules at other new colonial colleges varied. Yale, founded as the Collegiate School by Connecticut clergymen in 1701, preferred Protestant clerical to academic dress in its early days, although by 1773 all students except freshmen wore gowns. At King's College (later renamed Columbia), caps and gowns were instituted as daily wear by an early president who had worn academic garb while at Oxford.

But academic costume never really caught on in the New World. A few of the first schools modeled their dress on the Oxford-Cambridge design, but at the newer colleges, graduates simply wore their best clothes at commencement. By the middle of the 19th century, even Harvard had modified the costume to the point that many English visitors found American students' appearance ridiculous.

Fresh interest in academic regalia sprang up after the Civil War as universities spawned graduate schools and Americans with European degrees returned home with cap and gown in hand. With little thought given to uniformity, a few schools began to try out caps and gowns at commencements. Or rather, caps *or* gowns—many ceremonies featured one without the other, often in combination with outrageously colored hoods and the extravagantly cut suits popular in the late 19th century.

A graduate of Oxford visiting Harvard in 1894 applauded the trend toward greater ceremony, but harbored a few reservations: "The Harvard men in their imitation of the English universities are doing better in their attempt to introduce the cap and gown. The need for ceremony is gradually becoming felt. On Commencement Day, . . . the gown has for some while been commonly worn by 'the graduating class.' The bright adornment of the hood was for the most part wanting. The square cap has been but lately introduced—not I believe before the summer of 1892. Till then the tall silk hat had always been worn with the gown."

He wasn't the only one with reservations. Many American professors and trustees saw the advent of academic costume on their campuses as an anti-democratic trend, and worse, as a symp-

Many American professors viewed the advent of academic costume on their campuses as an anti-democratic trend and, worse, as a symptom of virulent anglophilia.

tom of virulent anglophilia. At many colleges, faculties would not accept the garb until the 1910s, when their own ranks began to fill with a generation of professorial men and women who themselves had worn the costumes as undergraduates.

Gardner Cotrell Leonard, that enterprising Williams undergraduate, had a good idea—and he knew how to market it. In an 1893 article, "The Cap and Gown in America," Leonard argued the case for academic dress in terms calculated to overcome the worst fears of resistant faculty. First, he appealed to their institutional pride, saying that the costume had been tried with success at "our leading centres of higher education." And then, he tried to allay their fears of a return to Old World decadence and class distinctions: "On the [gown's] democratic side, it subdues the difference in dress arising from the differences in taste, fashion, manners and wealth, and clothes all with the outward grace of equal fellowship which has ever been claimed as an inner fact in the republic of learning."

Leonard's argument must have hit its target. In 1895, the president of Columbia, the chancellor of New York University, and trustees of Princeton and Yale formed the Intercollegiate Commission to discuss a code of academic dress. They asked Leonard to be its technical advisor, and designated Cotrell and Leonard as the sole repository of designs and materials. The Academic Costume Code that emerged from the Commission's meetings is still used today, with slight modifications, at nearly all American colleges and universities.

The designs adopted by the Commission are loosely based on several Oxford gowns. The American bachelor's gown, which is long, black, closed at the front and has long, pointed sleeves, is a closed version of the Oxford bachelor's gown. Until 1959, an American master of arts wore a near replica of his Oxford counterpart's gown. Black and long, it had sleeves with closed ends and a slit for the arms to pass through at the elbows. After 1959, the opening for the arm was moved to the end of the sleeve. The doctor's gown is the only trimmed American gown: Long and full with bell-shaped sleeves, it's faced with velvet down the front and has three velvet bars across the sleeves, either in black or in the color designating the subject of the degree.

It's in this coding of hood and facing colors that the American system veers most violently away from the Oxford-Cambridge model. Although a given gown and cap at Oxford designate a given degree, the system seems to have evolved more as a function of increasing spectacle than as a function of logic. At Oxford, a doctor of divinity, a doctor of music, and a doctor of medicine, for instance, all wear gowns of differing shape, material, and color, and the doctor of divinity wears a mortarboard while the other two wear velvet bonnets.

Once you've learned to make those distinctions, you're only a third of the way home—those are only the "full dress" costumes, worn at the most formal of occasions. The holders of doctors' degrees also wear a special habit at convocations (except for doctors of music, who don't have one) and an "undress" gown while lecturing and at other less formal occasions. And each British university has a different system. To know who's who at Encaenia, when honorary degrees are handed out, it's a good idea to bring a guidebook with color keys and a pair of binoculars.

Thanks to Gardner Leonard and the Academic Code, the spectator can rest easy at an American graduation. The gown will easily tell what degree the wearer holds, and the hood will tell where it's from and what it's for. In fact, all this information can be deciphered from the hood alone: A bachelor's hood is three feet long with two-inch-width edging; a master's is three and a half feet long with three-inch edging; a doctor's is four feet long with five-inch edging. The color of the edging will tell the subject of the degree (copper is economics, purple law, pink music), and the color or colors of the lining will reveal what university or college granted the degree.

The more things change the more they stay the same: Americans may have almost completely redesigned the traditional cap-and-gown uniform and then attempted to fix this new design for all time, but the traditional spirit of academic dandyism is not so easily suppressed. Against a background of black caps and gowns and uniformly colored hoods, students today distinguish themselves with corsages (strictly against the Code), neon socks, and messages like "Hi, Mom!" taped across their mortarboards. And even though there have always been schools (like Harvard) who preferred their own designs for gowns and hoods to those specified by the Code, now even long-time Code observers have begun to bend the rules just a little bit to add some extra splendor to commencement.

"What I find interesting," says Linda Risinger, Academic Consultant for the Collegiate Cap & Gown Company, the largest business of its kind in the world, "is the new trend in trustee apparel." At many schools, trustees (who have always been entitled to wear doctors' gowns, no matter what degrees they actually hold) have switched from black gowns to gowns in the school's colors. "It seems to have started with the presidents, who are allowed under the Code to wear any design the school comes up with," says Risinger. "It's not really a new idea, but it's grown. After all, commencement is the culmination of the education process: You want it to be impressive. A little extra color brings a lot of excitement."

Leslie Brunetta, assistant editor of the Alumni Magazine Consortium, wore an advanced student's gown as a Fulbright scholar at Oxford University.

AND NOTHING BUT THE TRUTH

To WPI faculty and alumni who offer their expertise in courts of law, speaking from the witness stand is as natural as delivering a lecture.

By Linda A. Blackmar '86

It's like playing one-on-one basketball," says Mechanical Engineering Professor Allan H. Hoffman '64. "What you have to do, particularly when you're dealing with good opposing attorneys, is anticipate where they're leading you five questions ahead. They try to get your guard down, and vanquish you with a final question."

Hoffman and other WPI faculty members and alumni appear in court not as defendants or plaintiffs, but as expert witnesses. As they vow to tell the whole truth, these technical authorities commit their knowledge and experience to protect or defend the use or safety of engineering products, projects or services.

And to be successful, according to Wilson G. Dobson '75, '77 MS, who works extensively in this field, "You have to explain highly technical and vital concepts to jury members who basically know very little."

Expert testimony, say most, requires cunning as well as technical competence, and provides ways for witnesses' knowledge to make a real mark on both the non-academic and—indirectly—the academic worlds.

For some experts, it's the opportunity to exercise technical knowledge and analytic ability that encourages them to work on a case.

Consider the experiences of Professor Carlton W. "Spike" Staples' '58 ME with machinery failure cases. Mechanical principles govern the operation of the mechanical components, he says, but analytical insight is needed to get to the exact cause of mechanical failure.

Because each case presented to an expert for consideration is entirely different from the previous one, he adds, the element of variety adds to the enticement. "If you're involvement in a case is successful," he says, "Your credibility is enhanced, opening further opportunities for you to provide expert assistance."

The role of expert witnesses has gained increasing importance in recent years largely in response to the dramatic jump in the nation's litigation involving products liability. Cases ranging from poorly constructed lawnmowers, to faulty chain saws, to safe dosages of anesthetics have come across the desks of WPI's expert witnesses.

Litigation surrounding public health and safety issues has also increased the need for expert testimony. Consequently, experts in virtually every discipline of science and technology are finding more opportunities to use their know-how in what can become highly charged court proceedings.

Bill Dobson, vice president of Binary Engineering, of Holden, MA, has consulted to assess cause and effect in litigation involving the collapse of an offshore oil platform (where several lives were lost), damage to machine parts causing injury to workers, and automobile accident reconstruction. "In most cases," he says, "we're called in to perform stress

Down in the hole: ME Professor Raymond R. Hagglund '56 gets an unusual ride to inspect the remains of a restaurant explosion in Derby, CT, which left six people dead. This kind of on-site fact gathering is often the first step in expert witnesses' involvement in litigation that can take them back to the laboratory before they make a trip to the courtroom.

ME Professor Allan H. Hoffman '64: "Opposing lawyers try to catch you with your guard down, and after four or five questions they attempt to vanquish you."

analysis on failed parts, assess the appropriateness of designs and materials, or, in auto accidents, to determine whether failed parts on the vehicle caused or resulted from the crash."

Alan K. Wolfe '81, is a partner in the firm, which also consults to industry on design and materials processing.

WPI faculty and alumni members representing nearly every discipline of science and engineering have been drawn to expert testimony. Many become involved through personal recommendations of a colleague. Others find their way to court testimony through their publications, their involvement with professional societies or their past expert witnessing.

WPI's name itself, says Staples, often leads lawyers or insurance companies to seek experts from the faculty. Staples has worked on cases involving consumer machinery such as home workshop tools, table saws, chain saws and lawn mowers.

Mechanical Engineering Professor Raymond R. Hagglund '56, perhaps the most experienced of WPI's expert witnesses, introduced Chemistry Professor Alfred A. Scala to service as an expert witness. Hagglund says he learned of a case for which a chemistry expert would be needed, so he called the lawyer's attention to Scala's qualifications.

Roy F. Bourgault '42, professor emeritus of mechanical engineering, agrees that the paths to giving expert testimony are many, saying, "An insurance company or a lawyer or an individual or a manufacturing company may come to me, perhaps as a result of having heard of me somewhere else." An insurer in Springfield, MA, for instance, learned of Bourgault's skills, and Bourgault has since assisted the company with 15 or 20 cases.

Ronald R. Biederman, professor of mechanical engineering and head of WPI's Materials Science Program, says he believes engineers are likely to encounter expert testimony at some point in their careers. "By one way or another, people become aware of your expertise. Occasionally, you can't avoid such testimony. It just seems to come to you." A variety of cases concerning materials analysis of product failure have come across Biederman's desk through his 15 years of expert testimony, including cases on grinding wheels and small mechanical components.

Years of experience in structural engineering and surveying, as well as word of mouth, led Civil Engineering Professor Frank D. DeFalco '58 to serve as an expert on cases involving building designs, building collapses and land disputes.

Likewise, Electrical Engineering Professor Alexander E. Emanuel's background and experience resulted in his involvement with testimony in cases questioning electrical wiring principles. And Helen G. Vassallo, professor of management and biology, gained an expert's reputation in part through publication of a textbook on anesthetics.

Although he offers the views of an expert, Daniel L. David '72 says he normally doesn't testify in legal cases as an "expert witness." As technical services manager of Saab-Scania of America, Inc., West Haven, CT, he is the sole U.S. resource for Saab in cases involving government or personal litigation against the Swedish auto maker. "As a company resource, the court and the jury view me as highly biased," he acknowledges, "so we involve independent experts in most of our cases."

If a plaintiff wants someone from Saab deposed or sues for personal damages, "I protect the company's interests," he says, but adds, "Since we encounter only about a dozen cases against the company each year, and all but a couple of these are settled out of court, relatively few reach a jury decision."

In fact, he says, product-related litigation is only a small part of his responsibilities at Saab, which include evaluating product problems that are reported by dealers, producing service literature, and testing products before production for compliance with U.S. government regulations.

"Our engineers in Sweden," he notes, "pay particular attention to the regulatory demands of U.S.-bound automobiles, since the environment here is *far* more litigious than in Europe."

William Denison

ME Professor Carlton W. "Spike" Staples '58: "Lawyers are always seeking the help of experts from WPI. This involvement can have a big impact on your reputation."

Michael Carroll

ME Professor Ronald R. Biederman: "I stay away from cases in which I can't make a clear professional judgment based on fact."

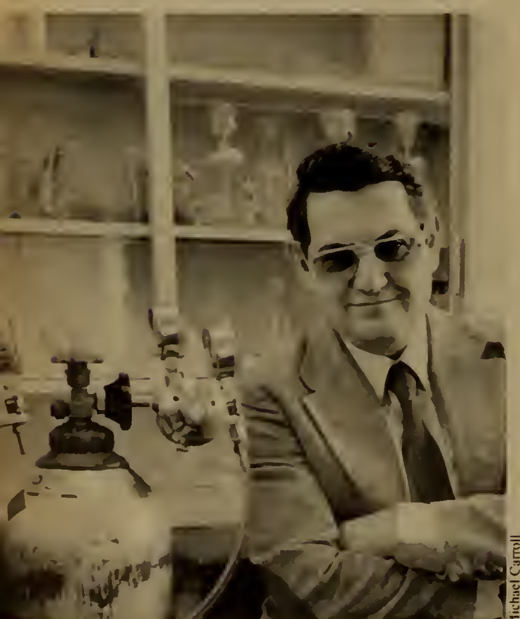
Once the task of constructing and strengthening the case begins, the normal procedure for the insurance company's lawyers or the individual litigant is to recruit the experts needed to build the case.

The work involved for the expert varies from case to case, says Bourgault. Sometimes, the witness considered for testimony may have to perform extensive laboratory testing. In other situations, involvement could mean engaging in documentation analysis or examination of a design.

Once asked for an expert opinion on a technical situation, the consultant must decide whether or not to pursue the litigation. This decision involves careful scrutiny of the situation and an analytic judgment concerning whether or not the case can be won.

"In my experience," says Dobson, "about half the time our clients are wrong, so the cases never get to court. I wouldn't let a 'bad' case get that far," he adds. "And I don't hesitate to give the attorney my opinion on our prospects for success."

"My approach is to call it as I see it," says Ron Biederman. "I don't get involved with those cases in which I cannot clearly make a professional judgment based on fact." Alex Emanuel says he selects his cases in a similar manner. The number of cases available for faculty to work on, he says, allows, and sometimes requires, such selectivity.



Michael Carroll

EE Professor Alexander E. Emanuel: "The demand for expert witnesses, together with the diversity of cases, often causes us to be selective in choosing where and when we get involved."

Michael Carroll

CE Professor Frank D. DeFalco '58: "Witnessing can call for lots of footwork to locate and evaluate documents or locations involved in the case."

Sometimes, says Dobson, cases call for expertise which he and his company cannot supply directly. "We've gone to faculty members such as Alex Emanuel and Jon Barnett in firesafety studies when we need specialists in fields other than materials engineering."

Often, expert involvement calls for a great deal of locating and evaluating product blueprints, patterns and designs. Before a case can be developed, according to Frank DeFalco, written evaluations must be completed. "We have to locate full documentation," he says, "and models of the product in question must be examined to determine the validity of the case."

After an initial assessment of the legal situation, the expert's research and testing may begin in earnest to determine more facts about the case. Bourgault's cases often involve a failure analysis. For Emanuel, initial investigative work could include careful evaluation of circuit boards. DeFalco might begin by examining maps and blueprints.

Sometimes the legal authorities possess most of the evidence and documentation necessary before the expert is consulted.

One time, for example, Al Hoffman, who serves as chairman of the Board of Health in Sterling, MA, was called to examine a public health case. The attorney, who already possessed background on the case, did not realize that the information in hand had great technical significance. Consequently, Hoffman says, "The lawyer presented me the full documentation needed to build an airtight case." In this situation witness Hoffman synthesized already existing factual information into an argument that could ultimately lead to settlement.

Regardless of how much information is provided initially, an expert's technical report can have significant bearing on the litigation.

Technical reports, says Bourgault, can include the expert's research, analyses of the situation, testing results on components, and other evidence to support the case. Many cases are settled out of court solely on the basis of such technical reports.

In addition, witnesses may be asked to respond to questions in the form of a written deposition. In effect, a deposition involves extensive questioning of a witness, under oath, out of court on the material in the technical report he or she has prepared. Every word of this interrogation is recorded, and the transcript is as powerful as live courtroom testimony.

If the expert has done a thorough job, and the facts are presented in a way that

TIPS FOR WITNESSES

1. **TELL THE TRUTH.** If you tell the truth and tell it accurately, nobody can cross you up.
2. **DON'T GUESS.** If you don't know, say you don't know.
3. **DON'T MEMORIZE** what you are going to say.
4. **UNDERSTAND THE QUESTION** before you attempt to give an answer. If you don't understand the question, ask the lawyer to repeat it.
5. **TAKE YOUR TIME.** Although you can't be rushed into answering, taking too much time on each question may lead the jury to think you are making up an answer.

Kenneth McDonnell

Management and Biology Professor Helen G. Vassallo '82: "On my very first trip to the witness stand, the judge restricted my testimony to clinical pharmacology of local anesthetics because I don't hold an M.D.—just a Ph.D. and an M.B.A."

would leave little question of liability, Bourgault adds, the technical report could lead to an out-of-court settlement. Once this technical report is completed, he says, "The job is done."

Not surprisingly, expert testimony often involves close association with attorneys. By assisting the attorneys in comprehending the technical subtleties of a case, experts can make the most of their examinations. Interactions characterized by many questions and attention to technical detail strengthen the case built by technical expertise and legal knowledge.

Witnesses can help lawyers in planning courtroom strategies, as well, most experts agree. With knowledge about the scientific aspects of a case, they are able to point attorneys to vulnerable areas in the opposition's argument. Likewise, the competence of lawyers in the arena of the courtroom can assist the expert in preparing for cross-examination.

Most interactions that occur between expert and lawyer involve explanation of the technical aspects of a case. In order to understand the spectrum of the case, Bourgault maintains, the lawyer must first know the scientific facts of the case inside and out. And since most lawyers have little experience in dealing with the technical components of each case they encounter, experts often find themselves in a teaching role.

Bourgault's experiences have confirmed the importance of this role. "Lawyers sometimes have a different perspective of what is important and what's not," he says, "especially when it comes to technical information."

Bill Dobson agrees: "Engineers and lawyers often think *very* differently about the same question."

Expert consultants also seek to discover weaknesses in their side's views of the case. Through such discovery, the lawyer and the expert can prepare additional supportive materials if acting as defendant, or else settle the case out of court if serving as plaintiff.

The technical expert, says Hoffman, might also develop for the attorney questions that ought to be asked of the opposition. Once lawyers understand the technical subtleties of the case, he says, they can form stronger arguments.

"To be really effective, you have to understand where the other side is coming from," says Hoffman. Just as the defendant tries to anticipate what the plaintiff will say, the plaintiff must also

6. **STICK TO FACTS.** No hearsay, nor your conclusions, nor opinions. You usually can't testify about what someone else told you.

7. **DON'T BE TOO FINAL.** Don't say "That's all of the conversation," or "That's all I remember happening." It may be that after more thought or another question you will remember and want to say something important.

8. **GIVE A POSITIVE ANSWER IF YOU CAN.** Avoid saying, "I think," "I believe," "in my opinion" and "I guess." If you are asked about details which you don't remember, just say that you don't remember them. But don't let the cross-examiner get you in the trap of answering question after question with "I don't know," or "I don't remember."

9. **DON'T VOLUNTEER.** Answer directly and simply only the question asked you, and then stop. Do not volunteer information not actually asked for.

10. **CORRECT MISTAKES.** If your answer was wrong, correct it immediately.

11. **BEWARE OF QUESTIONS INVOLVING DISTANCES AND TIME.** If you make an estimate make sure that everyone understands that you are estimating and make certain your estimates are reasonable.

12. **SPEAK UP.** Talk loud enough so that everybody can hear you. Speak clearly and distinctly. Keep your hands away from your mouth.

13. **YOU'RE ON YOUR OWN.** Don't look at the lawyer, or the judge, for help when you're on the stand.

14. **DON'T ARGUE.** Don't fence or argue with the lawyer on the other side. He has a right to question you, and if you give him smart talk or evasive answers you will make a bad impression.

15. **DON'T LOSE YOUR TEMPER** no matter how hard you are pressed.

16. **BE COURTEOUS.** This is one of the best ways to make a good impression on the court and the jury. Be sure to answer "Yes, ma'am" and "No, sir" and to address the judge as "Your Honor."

17. **DON'T DENY DISCUSSING CASE.** If asked if you have talked to the lawyer on your side, or to an investigator, admit it freely. Remember, you're sworn to tell the truth.

18. **DON'T BE AFRAID** to look the jury members in the eyes while telling the story. Jurors are naturally sympathetic to witnesses and want to hear what they have to say. Eye contact helps to establish credibility.

19. **DRESS PROPERLY.** A court of law demands respect.

20. **WAIT UNTIL THE JUDGE HAS RULED** on any question about which an objection has been made. You may never have to answer the question if the judge sustains your attorney's objection.

be prepared for the questions coming from the defendant. "I ask myself, 'If I were the technical expert working for the other side, which issues would I bring out?' "

Roy Bourgault's experiences on the witness stand indicate that the interactions between attorneys and expert witnesses usually lead to mutual respect between the two professionals. "The lawyers for the people you are working for are very kind to you. They protect you while you're on the stand. That's their job—to not allow the other side to run over their witnesses."

Interactions with opposing attorneys, says Ron Biederman, can be less pleasant. "Some treat you very well—but others are terrible."

"Most lawyers," Bourgault adds, "are pretty careful, especially in front of a jury. They don't want the jury to think they're mistreating a witness. If you have a witness with some standing in the community—a doctor, an engineer—the lawyers don't want the jury to think they are trampling on them.

"On the other hand," he adds, "if the opposition perceives that technical experts are in trouble—and don't understand that they're digging a deeper and deeper hole for themselves—the lawyers will ask *very* pointed, embarrassing questions. They put on an act. They reflect how shocked and surprised they are that you seem in their eyes to be so ignorant."

Every expert who approaches the witness stand, says Helen Vassallo, is subject to a careful review of his or her credentials. For example mechanical engineers working on a case involving a power lawn mower might be asked if they have ever designed such a device. Standard engineering principles governing lawn mowers can be applied to other engineering projects. But the opposing lawyers, attempting to strengthen their case, will question credentials extensively in an effort to disqualify an expert.

Vassallo, for example, confronted a challenge to her professional credentials on her first trip to the courtroom. "The plaintiff's attorney did not want me qualified as an expert because I don't hold an M.D. The judge indicated that my testimony would be restricted to clinical pharmacology of local anesthetics, in which I could be considered an expert although not medically qualified."

Bourgault agrees that attorneys try to limit how much experts can contribute.

Michael Carroll

ME Professor Emeritus Roy F. Bourgault '42: "The opposition lawyers don't like to be seen as harrassing you on the witness stand. Still, your own lawyers often have to protect you from being trampled."

"The side you are working for tries to give you the broadest possible latitude," he says. "All the while, the other side will try to limit how far you can go."

While on the witness stand, experts are accountable for everything they have ever written or testified to. Witnesses, in turn, must be careful not to volunteer information that would back them into a corner or to speculate on what could have caused particular scientific difficulties. As Biederman says, "You have to tell it like it is. It is like taking the oral part of the Competency Exam. You can't bluff your way through it."

According to Frank DeFalco, the expert's influence over the jury can depend on how well the jury understands the technological aspects of the case. The expert's testimony, he says, must balance technical jargon and clear explanation. The jury must be convinced that although the matter in question is often not easily understood, it is usually governed by simple principles. Visual aids can help, says DeFalco.

As the case proceeds, the jury deliberates, considers all experts' views, and finally gives its verdict. Naturally, verdicts emerging from cases that include expert testimony meet with a wide range of sentiments from the experts. Most say, for example, that the emotions surrounding a personal injury case can camouflage the scientific facts, and that the amount of information conveyed during the witness's examination can easily influence the jury's viewpoint.

What is more, many of the jury's verdicts might appear accurate if one considers that the information discussed in the courtroom is the only information the jury considers. Consequently, if a witness is prevented from contributing a good deal of information, an "inaccurate" verdict may result.

Although Ron Biederman has served as an expert witness for nearly 20 years, he maintains that expert testimony forms only a small portion of his professional activities. For others who may be involved with more than one case at a time, serving as an expert constitutes more of their professional involvement.

Bill Dobson says that about half of Binary Engineering's business comes from expert consulting, but he adds that he knows of no more than a dozen colleagues elsewhere who do litigation work for a living.

The court is not alone in deriving benefits from the testimony of WPI faculty members. Roy Bourgault, whose legal work has spanned two decades, developed a course in analysis of defects and failures which examines topics that would confront an expert in mechanical engineering. And Emanuel and Hoffman, among others, have advised IQP teams studying engineering analysis and liability.

WPI's faculty members find expert testimony to be, in many cases, lucrative work. According to Bourgault, "We charge lawyers a fair amount of money—not as much as the lawyers themselves charge, but we're not working for five dollars an hour either."

Regardless of the extent of the scientific analysis or the amount of energy devoted to the project, says Bourgault, court work is not necessarily conclusive. Many times expert testimony uncovers flaws in product design and safety. But, he adds, "Sometimes you can't come to a plausible answer. You have to settle for a probable answer."

Linda Blackmar '86, a humanities-technology major, wrote this story as part of her Major Qualifying Project, in which she completed an anthology of her own and others' technical writing. The anthology pieces ranged from highly technical works to purely literary stories containing a technical element.

WPI CLASS NOTES

1923

Ralph White and **Fred Pickwick, Jr., '22** decided it would be interesting to hold a reunion of the 1919-1920 and 1920-1921 New England championship basketball team from WPI. Both were regulars on the team and are the only surviving members. Pickwick, who lives in Grand Junction, CO, and White, who resides in Keene, NH, got together last summer in Maine to feast on steamed clams and lobster.

White writes, "Neither one of us had seen classmates for years, and we hadn't seen each other for over 60. We had a great time talking about the good old days."

Pickwick is a member of Phi Sigma Kappa and White belongs to ATO. Both are members of Skull. Says White, following their reunion, "We promised to carry on a lively correspondence."

1926

Reunion June 5-8, 1986

1930

Word has been received that Betty Center, the widow of class president, **Eugene Center**, passed away on January 23, 1985.

1931

Reunion June 5-8, 1986

1933

We hear from **Ed Allen** that he and his wife, Earlene, are planning to move to Westboro, MA, to a new retirement home called "The Willows." Although they will be giving up an 11-room house situtated amidst 18 acres of flora and fauna and squeezing into three rooms, Ed says, "I'm already practicing how to grow old gracefully, helped by gentle wifely admonitions 'to just try a little harder, dear!'" Ed faithfully attends Tech Old-Timers' meetings.

Ethan "Charlie" Bassett is in good health and residing in Longmeadow, MA. After his official retirement from Electronic Coils Inc., he ran his own business from his home. At his wife's request, his home activities are now confined to hobbies, including clock repair and renovation. The Bassetts have two daughters and two granddaughters.

Al Bicknell, a retired chemist from the S.D. Warren Co., lives with his wife in Westbrook, ME, near Portland. He says they have a quiet life playing the various golf courses in their area in the summer and bowling and playing contract bridge in the winter.

Bob Blake has been retired for almost a decade from 43 years of service as senior electrical engineer with New York State Electrical & Gas Corp. He keeps busy helping in the county historian's office, delivering Meals-On-Wheels, and golfing and bowling with friends. Occasionally, he leaves his residence in Binghamton, NY, and returns to his "old home country" in New Hampshire.

It's amazing how many of our classmates are healthy and still employed: **Tom Decker** for one. He continues as a sales manager for the County Photo Compositing Corp. of Jefferson, MA. Tom and his wife, Helen, reside in Holden, MA. We see them often at TOT meetings.

John Dwyer has been named by our class vice president, **Ed Johnson**, to represent the class on the WPI Alumni Council. He will fill the post vacated by **Norm Clark**, whose years of service in that capacity we much appreciate.

Another class member who is still working is **Bob Ferguson**, a Worcester native, who is putting his talents to use with the real estate firm, Century 21. He and his wife, Eileen, have eight children and 12 grandchildren, "And believe it or not, they were all home for Christmas!"

We had the opportunity to talk with **John Keefe**, whose colorful and successful business career ended with retirement after 14 years as city manager for Modesto, CA. While he was in the Modesto post, the city won the "All American City" award. During World War II, he served as an army major. Later, he held engineering or manager's positions in Northampton, MA, and Annapolis, MD, and in California at Palm Springs, Bruno and Modesto. Although he has had three serious operations, he is currently in good health and enjoying an active life.

Recently, the **William Slagles** of West Medford, MA, celebrated their golden wedding anniversary at a reception hosted by their children at the Lexington Inn. They were married on December 7, 1935, in their hometown of Stamford, CT. Until his retirement, Bill was chief of northeast flood studies for the U.S. Army Corps of Engineers. He had also been chief of enforcement for the Division of Water Pollution Control of the Massachusetts Department of Natural Resources. He is currently president of the Royall House Association in Medford and clerk of the Congregational Church of West Medford. Mrs. Slagle, the former Harriet Ferris, serves on the boards of directors of the Lawrence Memorial Hospital Auxiliary and of the Royall House Association. She is also active in many church, social and charitable organizations in the area.

Al Brownlee, Class Secretary

1935

Carl Bergstrom spent most of his career with Wyman-Gordon Co. of Worcester, a leading manufacturer of aircraft forgings. After starting out as a metallurgical trainee, he later managed various laboratory departments concerned with the acceptance testing of raw materials, heat treatment and product testing. Eventually, he became chief metallurgist of the Worcester plant, as well as of the larger Grafton facility. Prior to retirement, he was involved in quality control management for both plants.

The **Walter Blaus** have a new 34-foot

O'Day auxiliary sloop which they use as their vacation home. They belong to three yacht clubs, with Walter being the past commodore of two. During the past 20 years, they have traveled to Europe, North Africa, the Far East and Hawaii. Walter belongs to the U.S. Power Squadron, the Lions Club, Mystic Seaport (CT) River Foundation, the Middlesex County Historical Society, Navy League and the Greater Middlesex Preservation Trust. He is director emeritus of the local Farmer's and Mechanics Savings Bank. In 1979, he retired from Wallace Silversmiths in Wallingford, CT. He writes, "My last major accomplishment with Wallace was the layout and supervision of the plant relocation."

Karl Bohaker works part time as a consultant for Struther-Dunn, a relay and electronic control manufacturer in New Jersey. In 1978, he retired as director of business development at AMF Electrical Products Group, Alexandria, VA. Earlier posts were with Factory Insurance Association, Sigma Instruments and Fisher-Pierce Co. At one time, he was an independent manufacturers' representative in the mid-Atlantic states. His hobbies include woodworking and radio-controlled model boats.

B. Austin Coates, a retired, 40-year employee at Heald Machine Co. (supervisor of methods engineering), now raises dogs, collects stamps, gardens and spends time restoring his 200-year-old house. He belongs to the Masons, the Eastern Star and ASME.

Ted Cole, of Holden, MA, continues as vice president of engineering and R&D at Parker Metal Corp. Earlier, he had been with Bauer Brothers, Norton Co., F.H. Cole (wooden box manufacturer) and Atlas Tack Corporation. His hobbies currently include golf, tennis, gardening, travel and music. He has been active with his church, and he's also served on the Governor's Executive Advisory Committee on Education. A former member of TAPPI, and a registered professional engineer, he is a past president of the Worcester Better Business Bureau.

Edward Cove and his wife, Theresa, enjoy traveling throughout the U.S. and abroad. Edward also likes bowling, swimming and spectator sports. He worked for 39 years for New England Telephone & Telegraph Co., retiring as a testroom supervisor.

John Coyle writes from his home in Palm Beach Gardens, FL, that he loves to swim and likes sports cars, playing bridge and listening to good music. From 1938 to 1964, he worked on the development of aircraft engines. After retiring from the USAF at Wright Field, he became an engineer and technical writer for Pratt & Whitney. In 1975, he retired—for the second time.

Edward Cronin currently is active playing golf, woodworking and refinishing furniture. For 44 years prior to his retirement, he was with GE in Pittsfield, MA, which he served as a senior design engineer. In 1955, he received the firm's Managerial Award. He developed eight patents while with the company.

C. Marshall Dann, a WPI trustee since 1974, is a former president of the American Patent Law Association, and is active with the American Bar Association, and the International Patent & Trademark Association. In 1976, he received the Goddard Award from WPI for outstanding professional achievement. He received the Jefferson Medal of the New Jersey Patent Law Association and the 1978 Distinguished Achievement Award of the Government Patent Lawyers Association. Since 1977, he has been associated with the Philadelphia firm of Dann, Dorfman, Herrell & Skillman. Earlier, he had been the U.S. Commissioner of Patents, and chief patent counsel for Du Pont, where he had been employed for 38 years. He belongs to the Mayflower Society and plans to do some genealogical research in the future.

Phillip Dean is a charter member of the Waterbury (CT) Chapter of the Society for the Preservation & Encouragement of Barbershop Quartet Singing in America. He once constructed a 25-foot sloop which the family still sails off Long Island. One of his involvements has been with the local BSA Scoutmaster's Troop Committee. He is a member of the U.S. Power Squadron, the Branford (CT) Yacht Club and the Masons. A member of the IEEE and the AIEE, he served on the program committee for the New England Electric Council. He also belongs to the Goodspeed Opera House Foundation. During his career, he was with Connecticut Light & Power and Northeast Utilities Service Co. He was involved in joint design with other utilities in the first 345-KV lines in the state.

Joseph Glasser, a WPI trustee, serves on the board of advisors in the department of management at WPI. He is also a trustee of Bon Secours Hospital, Methuen, MA, and Andover (MA) Memorial Library and a corporator-trustee of Lawrence (MA) Savings Bank. He is a director of the Lawrence Boys Club, as well as a corporator of Lawrence General Hospital. Currently, he is a management consultant and director of the Center for Business and Industry, Northern Essex Community College, Haverhill, MA. In 1979, he retired as corporate vice president of Raytheon Co., Andover. From 1935 to 1945, he was superintendent of F.W. Sickles Co. (General Instrument), Chicopee, MA. He holds an honorary doctorate from the University of Lowell, an Outstanding Civilian Service Medal from the U.S. Army and the Goddard Award from WPI for outstanding professional achievement.

Raymond Granger, of West Boylston, MA, started his own construction company in 1939. At first the firm built gas stations and then branched out and specialized in high-rise buildings, schools, hospitals and college buildings. AT WPI his company made additions to the EE labs, to Morgan Hall, Harrington Gym and alterations to Boynton Hall. It was also concerned with several dormitories. Ray is a co-founder of the Worcester Building Contractors' Association, past president of the Associated General Contractors of Massachusetts, a registered professional engineer and a member of ASCE.

Currently, **Jack Healy** of Newburyport, MA, is engaged in managing investment real estate holdings. He has been president of the local YMCA, the historical and maritime societies, and a board member for the local hospital and savings bank, as well as commander of the American Legion. A descendant of the original settlers in Newbury, MA (1635), he worked on the committee planning the celebration of the 350th anniversary of the town. He is a 32nd degree Mason and a Shriner. During his career, he worked for 33 years for Liberty Mutual Insurance Co., being assigned for 12 years to Avis Rent-A-Car Systems as a consultant. He had eight years of active duty with the U.S. Army and 27 years with the reserves.

In 1972, **Eugene Henning** retired as a project engineer from the Quality and Reliability Assurance Laboratory at Marshall Space Flight Center, NASA, Huntsville, AL. Previously, he had been with the Army Ballistic Missile Agency in Huntsville and with the Fire Control Branch, Bureau of Ships, Navy Dept., Wilmington, DE. He belongs to AIAA, Sigma Xi, NARFE, AARP and the Press Club. Hobbies include hiking and traveling.

John Howes's interests include horse shows, trail rides, golf, motorcycling, building ship models, grandfather clocks, gardening and travel. From 1950 to 1975, he was manager and treasurer of Woods Pond Cranberry Co., a 39-acre family business. From 1936 to 1981, he was a self-employed cranberry grower. He is the former director of New England Cranberry Sales, a member of the Grower Advisory Committee for Ocean Spray and treasurer of the Cranberry Highway Horsemen's Association. He has been a member of the board of trustees or a director for two Middleboro (MA) banks.

Leonard Humphrey, Jr. spent his entire career, from 1936 to 1976, with Buffalo Forge Co., first in Buffalo, NY, then in Washington, DC. He worked with various Navy and commercial shipyards in the West Coast, Gulf Coast and Great Lakes areas and on the Eastern Seaboard supplying and servicing company equipment. Much of his spare time was spent in Scouting. In 1950, he was honored with the Silver Beaver Award. In 1963, he successfully ran for a seat on the Board of Managers of Chevy Chase (MD) Village, and remained on the Board until 1983. Since then, he has been village engineer working on street lighting, drainage and renovation of the village hall. Active in WPI alumni affairs, he has held local chapter offices and served on the Alumni Fund Board. In 1980, he received the Herbert F. Taylor Award from WPI for service to the college.

Joseph Johnson, Jr. has been an active amateur radio operator for 53 years. He writes, "Current interest is talking to old friends around the world." Other pastimes are genealogical research, historical house research and the restoration of his 200-year-old house. He belongs to the National Association of Naval Technical Supervisors, the American Radio Relay League, the Quarter Century Wireless Association and the Potomac Valley Radio Club. He holds two superior accomplishment awards from the New York Naval Shipyard and numerous commendations for work done on various naval vessels, as well as letters of appreciation from the Commander-in-Chief of the Pakistan Navy. In 1973, he retired from the Naval Ship Systems Command, Washington, DC. Previously, he was with the New York Naval Shipyard, Brooklyn, NY, Buffalo Niagara Electric Co., and New York Power and Light Corp. He is a former officer with the New York and

He Still Has A Nose For News!

Clark Goodchild '40

According to the *WPI Alumni Directory*, Clark Goodchild '40 is a mechanical engineer. True enough. But ever since junior high school, Goodchild has also been something else: a die-hard writer.

"When you get right down to it," Goodchild observes, "writing is a lot like an addiction. Hard to break an enjoyable habit."

Goodchild, who retired four years ago from Emhart's USM Machinery Division after 42 years, is still hard at work at his avocation. He continues to edit USM's *Quarter Century News*, a publication for employees and retirees with more than 25 years of service. He also contributes to *Beverly Today*, USM's employee newsletter.

Hard put to describe the appeal that writing holds for him, Goodchild says simply that he enjoys talking with people and learning about their backgrounds. "It's fun to see your efforts in print. Occasionaly embarrassing when there's a goof!"

In actual practice, writing comes easily to him. He doesn't suffer writer's block. "But I still have run-ins with spelling and style," he admits.

Goodchild's technical background sets him apart from many writers. At WPI, he edited the former *Tech News*. During his school days, he also wrote for his hometown daily, the *Springfield* (MA) *Union and Daily News*, earning 15 cents per column inch.

In the unlikely event that Goodchild should become bored with writing, he has lots of other interests to fall back on, like photography, origami (Japanese paper-folding) and space exploration study. He also enjoys his 1931 Ford, Apple computer and ham radio (KAIACM). When not serving as a hospital volunteer, he is host at the Beverly High School Photovoltaic Visitors Center.

"I'm probably best suited to writing, however," he says. In the tradition of the true journalist, he explains, "I'm the lousiest organizer you ever saw. I never finish anything, never file anything and never throw anything away!"

Washington chapters of the Alumni Association.

Paul Krantz was the first president of the Citizens' "Plan E" Society of Worcester, and the organizer of a successful petition drive and campaign for the council manager form of government in Worcester. Among his interests are furniture construction, Boy Scout work and boat building. He retired as Northeast regional sales manager from Kropp Forge Co., Chicago, in 1978. Other employers had been Berwick Forge, Berwick, PA, Wyman Gordon and Pratt & Whitney Aircraft.

Ted Latour, who walks five miles daily, is active with his political party in Las Vegas, NV. He has served as district captain and as a member of the Clark County Central Committee. In addition, he has assisted several national and state candidates. He retired from Du Pont as senior chemist for R&D following 38 years of service after transferring from Richmond to Buffalo to Birmingham to Buffalo to Seaford, DE, and to Kinston, NC. A member of Tau Beta Pi, he also belongs to Sigma Xi and ACS. He holds gold and bronze medals for race-walking in the local Senior Olympics. Ted and his wife, Irene, have six sons.

Roger Lawton of Mystic, CT, has a 600-acre tree farm in Athol, MA. Although he currently is active with gardening, world travel, carpentry and swimming, he formerly crewed the Bermuda Yacht Race twice, and served as commander of the U.S. Power Squadron and as commodore of the Ram Island Yacht Club. Over the years, he and his family have done considerable boating, sailing and cruising from their summer home in Gloucester (MA) and from Mystic. Every year, he enjoys a golf vacation in Stuart, FL (Indian River Plantation). In 1977, he took early retirement from General Dynamics-Electric Boat. Other posts had been with Davis Standard Division of Crompton & Knowles, Rodney Hunt and U.S. Steel's Federal Shipbuilding & Drydock Co.

Harold LeDuc plays regularly in a duplicate bridge club and golfs in the summer. He does most of his home maintenance from gardening, to painting to reroofing, as well as furniture repairing. Besides concerts and plays, he and his wife, Emily, enjoy trips abroad. Since 1975, he has worked "more or less independently" in the Brockville, Ontario, Canada, area as a financial consultant and manager for several small businesses. Previously, he was with an oil-fired home and water heating equipment manufacturer. In 1970, he was appointed to the board of the firm's Canadian affiliate as financial director. From 1944 to 1956, he was plant manager with a management consulting firm specializing in textiles. He has an MBA from Western New England College and has lectured at several American Management Association seminars. Currently, he is treasurer of his local YMCA/YWCA.

Les Libby holds nine patents and has had five articles published. A member of Sigma Xi, he is also a senior life member of IEEE. Sports cars, amateur radio, radio-electronics, tennis and music are his interests. Since 1968, he has served as an independent consultant. Among his earlier employers were Varian, Lockheed Aerospace, Carad Corp., Sierra Electronic Corp., Kay Electric, ITT Labs and RCA. Les and his wife, Grace, reside in Los Altos Hills, CA. They have two daughters.

Gordon Lincoln is a past president of the Northern California Chapter of the Alumni Association and former member of the Society of Manufacturing Engineers. Because of the loss of sight of one eye in 1973, he had to give up his hobbies of tennis, golf, bowling and woodworking. "To compensate I've taken up baking and turn out a mean loaf of sourdough French bread!" Gordon spent 18 years with Morse Twist Drill and 12 with Union Twist Drill as a cutting tool engineer. He managed Morse's San Francisco sales district, after which he managed Union's San Francisco sales district. He retired to Redding, CA, in 1971, where he worked at a local hospital until final retirement in 1977.

Evan Luce, who joined Norton Co., Worcester, in 1935, retired from the company in 1972 as a senior project engineer. From 1940 to 1955, he was water commissioner for the West Boylston (MA) Water District. A registered professional engineer in Massachusetts, he has had technical articles published in several magazines including *Stone Industry*, and the Norton publication *Grits and Grinds*. Currently, he and his wife, Mary, reside in Wells, ME, where he participates in church and historical work. He is also active with the Masons and the Shriners. Hobbies include golf, fishing, gardening, cooking and philately.

George Makela spent 37 years with the Corps of Engineers working on water resources projects while stationed in Boston, Little Rock, AR, Bismark, ND, Dallas, TX, and Washington, DC. He retired in 1972, but is now concerned with a project for his son at the Houston office of a Dallas engineering firm. A life member of ASCE and a member of SAME, he received a meritorious civilian service medal from the Corps of Engineers. He enjoys fishing in the Gulf of Mexico, working with home computers and printers, and woodworking.

Ted McKinley was concerned with research, chemistry and metallurgy at Du Pont from 1935 to 1979. He is now interested in the development of new flowers by mutations induced by large dosages of high energy X-rays. He has 75 varieties of specimen hollies. Listed in both "Who's Who in America," and "Who's Who in the World," he has served on the National Materials Advisory Board, as chairman of Division I, ASTM, as chief of the U.S. Delegation to AGARD-NATO, and as president of the Electrochemical Society.

Tom McNulty, a retired vice president of manufacturing at Emhart Corporation's hardware plant, Berlin, CT, was at one time a member of several committees concerned with standards for doors and hardware for commercial construction. His committees' recommendations were accepted by the Federal Bureau of Standards. Prior to joining Emhart in 1947, Tom was with the U.S. Navy. Travel and golf are among his current hobbies.

Richard Merriam was a 39-year employee of Stanley Works, New Britain, CT, from which he retired as controller of the plant engineering division in 1978. Previously, he had been plant manager of the strapping systems division. He writes, "My most gratifying non-employment accomplishment involved the supervision of construction of an educational wing for Christ Lutheran Church in Middletown (CT)." Besides playing golf, he works around the yard and the house.

One of **Howard Nordlund**'s interests is assisting Asian refugees. He also remodels houses, sails, fishes and is involved with the Masons, the Elks, photography and the Coast Guard Auxiliary. He holds two community service awards and the Western Insurance Information Service Award. He is a Commander, USNR (Ret.). From 1946 to 1973, he was with Safeco Insurance Co., Seattle, WA, where he was manager of the loss control department. Other employers were Liberty Mutual Insurance Co., New England Telephone and Telegraph, and Rockefeller Center Inc.

Verner Olson retired in 1978 as production superintendent of Du Pont's Toledo (OH) plant following 41 years with the company. Some of his previous posts were technical supervisor, sales development supervisor and research chemist. He now golfs, fishes, listens to music, travels, enjoys sports and is involved with community affairs and adult Sunday school classes. A member of Sigma Xi, he has also belonged to the Chamber of Commerce, Rotary (former local president), and to the council of his Lutheran Church. He has served on various United Way and church committees, often as chairman.

Charles Puffer, who was employed as first standards engineer at Chapman Valve Mfg. Co., now finds time for golf, gardening, house maintenance and investing. He serves as chairman of the Big Alum Lake Environmental Committee. The Puffers currently reside in Osprey, FL, and Big Alum Lake, Fiskdale, MA.

Emerson Robinson, a registered professional engineer in Massachusetts and Rhode Island, belongs to ASME, WES, PES, MSPE, NSPE and the Wire Association. A member of the Aleppo Temple, he has served as past master of the local Grange, the Odd Fellows and the Masons. In 1979, he retired from Wanskuck Co./New England Butt Division, Providence, RI, where he had been employed since 1935. During his career, he rose from engineering draftsman to chief engineer. He writes, "We were the largest manufacturer of braiders of all types: textile agers and knitting machinery, wire machinery for the manufacture of copper and aluminum power cables used in transmission lines and the communications industry, and centerless grinders." In retirement he enjoys boating, fishing, bowling and traveling.

Victor Sepavich, who holds more than 50 patents, was with Crompton & Knowles from 1936 until his retirement in 1978. He retired as director of research, a post which sent him on numerous assignments throughout Europe. His primary concern was machinery for making all types of fabrics. He now enjoys golf, photography, bridge and gardening. He has been active with ASME and IEEE serving as a committee member and division chairman.

David Smyth continues as executive vice president and part-owner of Peck Spring Company, Plainville, CT. He and his brother founded Screw Machine Products in 1948. In 1950, the firm was absorbed by Peck Spring, and Smyth still remains with the closely held company. He has been president of the New England Spring Manufacturers' Association, and a director of the national Spring Manufacturers' Institute. Several of his articles have been published in magazines. For many years, he has served as secretary of the Waterbury (CT) Chamber of Commerce. Photography and raising show dogs (Cocker Spaniels) have been his hobbies. For years he has served his church as a vestryman and warden.

Frederick Swan, Jr. restores antique furniture and builds miniature antique furniture. He keeps busy with the Boy Scouts, the Boys' Club, Unitarian Church and conservation work. Also, golf, "RV-ing," traveling (often with **Jack Healy**), gin rummy and bridge. He says he belongs to too many organizations to list! Formerly, he was with Buffalo Forge Co., Farrar & Trafts Inc., Sylvania, and Fisher Price Toys.

Gordon Swift, who is interested in genealogy, has traced his family back 11 generations. For 35 years, he has been active with Rotary, having served his local club as president and secretary. Other activities are cross-country skiing, gardening, and summering at the family cottage on Highland Lake in Goshen, MA. Since 1967, he has been a partner-owner in two retail shops: Empsall's Sport Shop and Laura Girard Shop (ladies sportswear, equipment, etc.) in Northampton, MA. Earlier, he had been with Crompton & Knowles, Brown Bag Filling Machine Co. and Prophylactic Brush Co.

Robert Taylor continues to do consulting. He retired from Buffalo Forge in 1975. Although he formed his own company in 1965, he still was associated in sales and service with Buffalo Forge until his retirement. He likes boating and runs his "small Hatteras." He gives travel talks which he illustrates with his own photographs. Every year, he wins a couple of trophies for skeet and trap shooting. He was the first president of the local chapter of the American Society of Heating and Ventilating Engineers, and is a life member of ASHRAE. The past commander of the Mohawk Power Squadron, he is also past commodore of the Tri-City Yacht Club. He is a Paul Harris Fellow of the Albany (NY) Rotary Club.

1936

Reunion **June 5–8, 1986**

1937

In November, **Henry Dearborn** retired as a patent attorney with Texaco Development Corporation, White Plains, NY.

1941

Reunion **June 5–8, 1986**

K. Blair Benson is the editor in chief of the 1,478-page *Television Engineering Handbook* recently published by McGraw-Hill. Written by some of the leading experts in the field, the handbook includes technical information and provides the know-how which engineers need to design, operate and maintain every type of television equipment in current use. The book explains the latest techniques and hardware being employed in television engineering, and provides a comprehensive discussion of the basic theories of light, vision and information that underlie the technology.

Dr. **A. Ranger Curran,** a professor and chairman of the Management Department at Keene (NH) State College, participated in the 1985 International Discoveries Symposium entitled "Laws of Nature and Human Conduct: Specificities and Unifying Themes" last October in Brussels, Belgium. He attended the 1982 symposium in Columbus, OH, the 1983 symposium in London, England, and the 1984 symposium in Melbourne, Australia. Organized by the Solvay Institutes for Physics and Chemistry and sponsored by the Honda Foundation, the Brussels conference was designed to study the impact of the new developments of nonlinear dynamics in mathematical physics. Seventy-five experts throughout the world were invited to discuss various aspects of technology and cultural interaction. Curran received his master's degree from the Air Force Institute of Technology and his doctorate from the University of Georgia.

Leonard White, president and treasurer of the R.H. White Construction Co., and a WPI trustee, delivered the fall commencement address at WPI. He is the founder and former chairman of the President's Advisory Council at WPI. For seven years, he served as a member of the WPI Alumni Fund Board. In 1981, he received the Herbert F. Taylor Award for outstanding service to the college.

1942

Robert Searles writes, "After 37 years in the Ready Mix Concrete business, I've sold out and retired."

1944

Earl Harris, president of Rodney Hunt Company, was recently elected to a three-year term on the board of trustees of Historic Deerfield in Massachusetts. The 33-year-old museum of early American history and the decorative arts operates 12 historic houses as museums open to public tours. Historic Deerfield also offers public lectures and education programs and operates the Deerfield Inn. Harris, a resident of Greenfield, MA, attended Dartmouth, the University of West Virginia, and MIT, as well as WPI. Currently, he serves as director of Blue Shield of Massachusetts, a trustee of the Orange Savings Bank, a member of the World Business Council and a director of the National Association of Manufacturers.

1945

Warren Morgan, project coordinator of the bulk systems division at the Jervis B. Webb Company, was co-author of "Lignite—A Different Experience for Coal-Burning Utilities," which appeared in the November issue of *Public Utilities Fortnightly*. At Webb he is responsible for coordinating proposal preparation and serves as the primary in-house contact on major contracts. He has had more than thirty years of experience in the engineering field, with an extensive background in the bulk-material handling area of power generation.

1946

Reunion June 5–8, 1986

Edward Pendleton exhibited work at the 30th Annual Exhibit and Sale of Wesleyan Potters held in December in Middletown, CT. A professional engineer, Pendleton learned his cabinet making skills from his grandfather.

1947

Dan Lewis was recently named director of technical services for the American Public Power Association. APPA is a small trade association located in Washington, DC, representing the publicly-owned electric utilities in the U.S., as opposed to the corporate or investor-owned utilities. Lewis was formerly special assistant to the director of the Office of Electric Power Regulation at the Federal Energy Regulatory Commission.

In his new post, he is responsible for all APPA technical programs in support of legislative and regulatory issues. He will oversee association services in the areas of the environment, rates, generation, transmission, distribution, energy use and research and development. From 1972 to 1974, he directed the National Power Survey, a comprehensive study of the status and prospects of the U.S. electric power industry. In 1975, he was named assistant to the FERC chief engineer, and in 1976, he became special assistant to the director of the Office of Electric Power Regulation.

Before joining the FERC, Lewis worked for Control Data Corporation, where he provided technical support for applications of large-scale computers. He was also a system engineering analyst for GE.

Lewis continues to sing in his church and is on the golf course when time and weather permit. He keeps up with astronomy and says, "I've seen Comet Halley approaching from afar, and expect to be in the southern Caribbean for a better view in the spring."

1948

George Allen continues as guidance counselor at East Hartford (CT) High School.

Robert Dieterle, former manager of purchases at Northeast Utilities, recently retired.

Prof. **Ken Scott** of WPI's Mechanical Engineering Department moderated a technical session, "Computer-Aided Design in Engineering Education," at the 63rd annual fall conference of the New England Section of ASEE. He also presented his paper, "Integrating a Turnkey CAD System into an Undergraduate Engineering Program."

1949

Walt Dick writes that in 1984 when the Bell System was broken up by the government, he moved from Pittsburgh to Arlington, VA, in order to help set up the new Bell Atlantic Regional Holding Company. His job was to handle the negotiation of new interconnection arrangements with the plethora of new long distance telephone carriers. "As a result, my wife lived in Arlington, but during the year I was in New Jersey, New York, Pennsylvania, Maryland, Georgia, Illinois, Colorado, California, Texas, New Mexico, Missouri, West Virginia and Massachusetts, rather than in Virginia." By the end of year, he retired to Bradenton, FL, just shy of 40 years with the company.

1951

Reunion June 5–8, 1986

1953

Charles DeChand was recently elected president of Bloomfield (CT) Access Television (BATV). Long interested in video, he has produced and taped several on seasonal religious music, and has begun a documentary series on "Houses of Worship" in the local area. He instituted live coverage of the Board of Education's bi-monthly meetings.

A scientist, Charlie has worked at Combustion Engineering since 1958, the year he received his doctoral degree from Yale. In addition to his BATV commitments, he is active in the Bloomfield Methodist Church as long-time treasurer and committee member. He is also involved with the Connecticut Aeronautical Historical Association, working in the museum library.

Jack Gearin has been named director of AT&T's Manufacturing Development Center in Princeton, NJ. He supervises the design and manufacture of prototype automatic machinery and test systems. He also directs the Center's production of special purpose, proprietary machinery and test equipment. During Jack's 30-year career with AT&T, he has held engineering and managerial assignments in Merrimack Valley, MA, Newark, NJ, and Cockeysville, MD. Before his recent promotion, he supervised engineering operations at the company's Indianapolis works. He holds an MBA from Northeastern.

1956

Reunion June 5–8, 1986

1957

Adrian Atkins, P.E., continues as manager of engineering specialties at Aetna Life & Casualty. He joined Aetna in 1966 following five years' service in project and chief engineer posts with several Connecticut construction firms. He is past chairman of the AIA Construction Committee, and served as a first lieutenant with the U.S. Army Corps of Engineers following graduation from WPI. He has an MSCE from UConn.

1958

C. Stewart Gentsch has been appointed president and general manager of Stanley Tools—U.S., New Britain, CT. With the firm since 1982, he had served as plant operations manager with responsibility for several plants. In 1984, he was named vice president of manufacturing, with responsibility for all of Stanley's U.S. hand tools plants. Earlier, he was president and general manager for a division of Rexnord. He was also a director of the local United Way, a director and past president of Junior Achievement, a director of Associated Industries of Massachusetts, and had held posts in other professional and community organizations. He attended the Carnegie-Mellon Advanced Management Program.

William McLeod, Jr. is now production and engineering manager for Borden & Remington Corporation, Fall River, MA.

Robert Wolff, president of Blackstone Valley Electric Co., has been elected a vice president of EUA Service Corp., Boston. He will maintain liaisons with suppliers of electricity to the EUA System and assume a prominent role in EUA's New England power pool activities. Prior to joining Blackstone Valley Electric in 1983, he managed several key engineering, purchasing and operations areas at Consolidated Edison Co., New York. For five years, he was power delivery editor of *Electrical World*, a McGraw-Hill publication. A professional engineer, he is a member of IEEE. He served three years as a U.S. Navy engineering officer.

1959

Dr. **Joseph Bronzino** wrote "Clinical Engineering Internships: A Regional Hospital-Based Approach," which appeared in September's *Journal of Clinical Engineering*. Joe continues as chairman of the Engineering Department at Trinity College, Hartford, CT.

1961

Reunion June 5–8, 1986

Lee Hackett has been named to the Board of Trustees of St. Johnsbury (VT) Academy. He is president of the American Appraisal Company, the world's largest appraisal firm with annual sales in excess of $40 million. The company is a division of American Appraisal Associates Inc., which Hackett serves as a vice president of operations and a director. Lee, who holds an MBA from the University of Chicago, is also an officer in the U.S. Army Reserve. In his spare time, he sails as often as possible on Lake Michigan.

1962

MARRIED: Kenneth Krikorian and Dianne Chakarian in Osterville, MA, on July 27, 1985. A school adjustment counselor in Cambridge, she graduated from Anna Maria College and has a master's degree in education from Antioch University, Yellow Springs, OH. He holds a master's degree from Yale and did advance studies at Johns Hopkins. Currently, he is a senior member of the physics-math faculty at Quinsigamond Community College, Worcester.

Ronald Baruzzi has been named a "Distinguished Member of the Professional Staff" by Bell Communications Research, Network Planning Center. He was one of 37 employees out of 8,000 to receive the award.

Bob Wilder recently began a new career as innkeeper at the Inn at Weston in Weston, VT. Bob and Jeanne have purchased the inn, which will be in operation for the 1986 season. The Wilders returned to the U.S. in the summer of 1985 after two years in London, England, where Bob managed the European branch for the consulting firm of Nolan, Norton & Company. After a few months back on the travel circuit, they decided to take the plunge and pursue a long-time dream. Weston is a small town (Pop. 508) in the Stratton-Bromley area, which boasts its own summer playhouse. Says Bob, "It's a long way from EE101 to running a country inn in the Green Mountains. Drop by, and we'll let you know if it's as good as Bob Newhart makes it out to be!"

1963

Gary Adams, a faculty member at Thames Valley State Technical College, was recently promoted to professor by the Board of Trustees for the Connecticut State Technology Colleges. He began his teaching career at Thames Valley in 1966. He has served on several college committees and is currently the department chairperson for mathematics and science, as well as a member of the Corporation of the Norwich Free Academy. The environment is another active interest.

George Eldridge, P.E. is chief electrical engineer for United Illuminating in New Haven, CT.

Last fall, Prof. **Allen Hoffman** of the ME Department at WPI, ran one segment of the Annual Cape Cod Relay, an 81-mile race from Plymouth Rock to Provincetown. He is a member of The WPI Footpounders, who finished 34th out of 200 teams at the Cape race. They covered the 81 miles in 8 hours, 15 minutes. In November, Al was part of a three-member WPI team which came in first at the Finnish-American Social Club 4-mile road race held in Shrewsbury. He was also first in his age group in the Shrewsbury race.

David Nordin works for Peerless Nuclear Corp., Stamford, CT.

Ronald Pueschel is now with Canaan Computer, Trumbull, CT.

Warren Standley has recently returned to the Washington, DC, area after a two-year assignment in Massachusetts, where he was in charge of starting up a TRW field office near Boston. As a department manager in Virginia, he is currently in charge of 40 computer scientists who are involved in database management, computer data security and applications programming for a variety of defense-related customers.

1964

MARRIED: Stephen Wilcox and Pauline Schwensen in October in Longmeadow, MA. Pauline graduated from Hobart and William Smith College, Geneva, NY, and has a master's degree from the University of Buffalo School of Social Work. She is with Strong Memorial Hospital in Rochester. Stephen, who has a master's degree from WPI, is employed at Kodak in Rochester.

Allen Case, Jr. has been appointed a liaison scientist at the General Electric Research and Development Center, in Schenectady, NY. In his new post, he will be responsible for promoting technology transfer between the Center and GE's Factory Automation Products Division, Drive Systems Operations, Automation Controls Operations, Calma Company, Semiconductor Business Division, GE Financial Services and GE Supply Company Business Division. He is also responsible for recognizing the technical needs of these components and keeping lines of communication open with researchers at the Center. Allen joined the R&D Center in 1970 as a systems engineer in the Mechanical Equipment Branch.

Along with other colleagues, he won two awards presented by *Research and Development Magazine* for the development of an assembly robot (1981) and a vision-guided welding robot system (1984). He holds four U.S. patents in sensors and robotic control, and has co-authored several technical publications on robotics. The holder of two degrees from WPI, he is a member of ASME and the Robotics Institute of America.

Prof. **Robert Peura**, director of the biomedical engineering program at WPI, was re-elected secretary-treasurer at the Engineering in Medicine and Biology Society meeting held in Chicago on September 27. He was also elected vice president of financial and long-range planning.

1965

Stephen Cloues was named PACT "consultant of the year" at a recent meeting of the Southern Baptist Home Mission Board during its annual conference at the Ridgecrest (NC) Baptist Conference Center. PACT (Project: Assistance for Churches in Transitional Communities) is a Home Mission Board effort to help church ministries evaluate their programs and communities in order to be more effective in public outreach and ministry.

Cloues began serving as a church extension and planning consultant in Birmingham in 1978 and was appointed by the Home Mission Board in 1984. Last year, he conducted 15 PACT consultations with churches. Two of the Birmingham churches received the PACT "church of the year award."

In January, Cloues was named associate director of associational and cooperative missions for the Alabama Baptist Convention. In his new role in Montgomery, he will provide technical assistance in the Mega Focus process in metropolitan areas, help in urban mission and associational strategy planning, address needs of transitional churches, and gather census data on church program organizations. He will also conduct association studies, work with missions development committees, give leadership to experimental ministries and work with Sunday School departments in identifying sites for new churches and missions.

Besides WPI, Cloues holds degrees from Georgia Institute of Technology and Southwestern Baptist Theological Seminary. He served as a construction batallion officer in the U.S. Navy, as associate regional planning director in Columbia, SC., and as a seminary student summer missionary. He is married and has two teenage daughters.

1966

Reunion June 5–8, 1986

1967

Dr. **Richard Gutkowski** was an invited participant in an international expert group meeting on the subject of timber construction held in Vienna, Austria, in December, and organized by the United Nations Industrial Development Organization (UNIDO). The purpose of the meeting was to draw together the experience of a small group of experts to discuss ways and means of increasing the use of timber construction in developing countries. Dr. Gutkowski was one of some 20 experts whose conclusions and recommendations were presented to the Secretariat. He described the initiative to reintroduce timber bridges in the U.S. He also assessed the potential for their fabrication and use in developing countries. He chaired the ASCE's committee on timber bridges for six years and presently chairs the administrative committee on bridges.

Dr. Gutkowski, an associate professor in the Department of Civil Engineering at Colorado State University in Fort Collins, returned in September from an eight-month sabbatical leave in Western Europe. During that time, he was an invited professor at the Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland (Swiss Federal Institute of Technology). He worked on structural wood research within the IBOIS (Institute for Wood Construction) at the EPFL.

1968

Bob Gemmer has accepted a position as project manager with the Gas Research Institute, Chicago.

Robert Horansky has been named director of the Data Processing Department of The Travelers Companies in Hartford, CT. The department operates a nationwide computer-communications network of more than 15,000 terminals that access more than 2,000 on-line data bases located in five computer complexes. Before joining The Travelers in 1984, Horansky worked for Northeast Utilities, where he was responsible for the management of technical support and telecommunications software. He is married, has two children, and lives in Wethersfield, CT.

C. David Larson holds the post of international product manager at A.W. Chesterson in Stoneham, MA.

Kenneth Roberts has been appointed vice president and regional general manager for the eastern region of the Shipping Container Division, Container Corporation of America (CCA) in Chicago. Previously, he had been vice president of planning and public policy for CCA, and vice president of administration for W.F. Hall Printing Company, a subsidiary of Mobil, which he had also served in managerial assignments. He holds an MBA in operations management from the University of Rochester (NY).

Dr. **E. Wayne Turnblom** is currently director of marketing planning for the Bio-Products Division of Eastman Kodak Company, Rochester, NY.

1969

BORN: to Cheryl Weisman-Cohen and **Michael Cohen** a son, Benjamin Seth, on September 11, 1985. Benjamin joins his sister, Whitney Sara, who is 4. The family lives in Needham Heights, MA.

John Poblocki was recently named senior vice president in charge of acquisitions at Mutual Benefit Financial Service Co., Providence, RI. Before joining the company in 1983 as vice president of product development, he was executive vice president of Kates Properties Inc. Earlier, he was director of planning and development for the City of Woonsocket, RI. He has a master's degree from URI.

1970

William Coblenz is now a senior scientist with the High Performance Ceramics Division of Norton Company, in Northboro, MA.

David Emery, former First District Congressman from Maine and current deputy director of the Arms Control and Disarmament Agency in Washington, DC, has visited 27 countries on arms-control business during the last two years. He has authority in the area of multilateral affairs and serves as the agency's primary representative in the ongoing review of nuclear testing and related treaties. He has received public service awards from the American Freedom Foundation, the National Federation of Independent Businesses and other national organizations. David and his wife, Carol, are building a home of their own design in Tenants Harbor, ME.

Edward Mason is director of logistics for Cummins Engine Company in Brazil. He is responsible for manufacturing, materials, importation and exportation and systems for a $100 million diesel engine business, which has a world-wide customer base. He belongs to the American Society of Brazil and is a Fellow of the American Production and Inventory Control Society.

Frank Meoli holds the post of president of Eastern Fire Door Co. Inc., New Haven, CT. With the company since 1971, he is now in charge of long and short-term decisions relative to company policies, purchasing, personnel and product lines. He is active with the Cub Scouts and the local soccer program.

Alan Miller is an account executive with sales responsibility in the Boston area for Cullinet Software Inc. of Braintree. Earlier, he held various sales positions with IBM for 14 years. He belongs to the Woodland Golf Club and enjoys skiing.

Gregory Moberg works as a project engineer for Eastman Kodak in Rochester, NY. He is concerned with advanced development and pre-production design in the area of consumer electronics and magnetic video recording. Since finishing graduate school, he has worked in both the R&D labs and advanced development at Kodak. He is a ruling elder of the Reformed Presbyterian Church.

Paulo Su works as an engineer in customer service with DEC.

1971

Reunion September 20, 1986

Allen Downs continues with DataProducts in Milford, NH. When he recently worked on a project in San Jose, CA, he visited with **John Pratt** and **Dave Pratt '69** in San Francisco. Dave, John and Vi Pratt were in San Francisco at a computer show demonstrating "Computereyes," the first product of Dave's new company, Digital Vision. Allen writes that John has moved from Connecticut to Massachusetts to work with Dave.

Thomas Mirarchi has been promoted to the new post of director of process technologies for USCI Division, C.R. Bard, Billerica, MA. He joined the division in 1984 as development engineering manager, following several years as manager of manufacturing engineering for American Optical Corporation. A registered professional engineer in Massachuetts, he has an MBA from RPI.

Vincent Pace has become associated with Dann, Dorfman, Herrell and Skillman, a Philadelphia law firm specializing in patent, trademark and copyright law. He has an MSEE from Drexel University and a doctor of law degree from Temple University. Before joining the firm, he served as a patent attorney at the Naval Air Development Center in Warminster, PA, and at the Naval Research Laboratories in Washington, DC.

Richard Teitelman serves as manager of customer training at Sperry Computer Systems. He holds an MBA from Fairleigh Dickinson University.

Bob Trachimowicz is now resident engineer for Ebasco Constructors Inc., Houston, TX.

David Winer has been appointed vice president of engineering at Lion Precision Corp., North Billerica, MA. He joined the firm only recently as director of engineering. Earlier, he was employed as principal engineer at Orion Research, where he directed the development of several major products. He had also served Orion as reliability manager and senior engineer. A member of IEEE and AMA, he holds a master's degree from Northeastern and an MBA from Boston College.

1972

John Cuth has been named superintendent of building maintenance at Northern Michigan University. Previously, he was supervisor of facilities for a year and a half for the County of Marquette. From 1982 to 1984, he was a mechanical engineer at K.I. Sawyer Air Force Base. He is a licensed professional engineer in Michigan.

Brian Savilonis, associate professor of mechanical engineering at WPI, was part of a three-member WPI team which won the Finnish-American Social Club 4-mile road race held in Shrewsbury in November.

Nickolas Denetracopoulos is with the Nuclear Engineering Department at National Technical University, Athens, Greece.

1973

Dr. **David Hubbell**, now out of the Navy, is currently at the Case Western Medical Center in Cleveland, OH, where he teaches medical students, conducts research and has a small practice in the Center hospital.

Sippican Ocean Systems has named **Steve Iannotti** senior manufacturing engineer. He will be responsible for the design and development of new products and equipment. A member of the Society of Plastics Engineers, he received an ASME from Central New England College and a BSME from WPI. He and his wife, Donna, and their four sons reside in East Sandwich, MA.

Robert Schultz, public works director for the last two years in Foster, RI, recently left to become public works director in Lincoln, RI. In 1975, he was program engineer for Alyeska Pipeline Service Co., Fairbanks, Alaska, and worked on the construction of a road from Fairbanks to Prudhoe Bay. From 1976 to 1981, he was project engineer for civil construction for the Alaska International Construction Co., which built the Fairbanks sewer system, a highway, two airports and other major projects. Currently, he is broker and owner of Meetinghouse Realty of Providence, and co-owner, vice president and secretary of the Riverpoint Tool Co., also in Providence. Schultz studied arctic engineering at the University of Alaska. He and his wife, Vickie, have two children and reside in Foster.

Bob Steinberg is a naval architect with the U.S. Navy, U.S. Chief of Naval Operations, Washington, DC.

1974

MARRIED: Gary Gastiger and Linda Goulet on September 20, 1985, in Groton, CT. Linda graduated from the University of Connecticut and is with Electric Boat. Gary is with Stone & Webster.

In November, **Edward Dlugosz** participated in the Sixth Superfund Conference in Washington, DC. His paper, "The California Ranking System," was selected for presentation at the National Conference and Exhibition on the Management of Uncontrolled Hazardous Waste Sites.

Dr. **Bruce Johansen** has been awarded the Herbert F. Alter Chair of Engineering Science for 1985-1986 at Ohio Northern University, Ada, OH. Johansen holds an MD from the University of Pittsburgh, and a doctorate from WPI. He is chairman of the Department of Electrical Engineering at Ohio Northern University, as well as a professor of electrical engineering. He joined the faculty there in 1967.

Russ Naber holds the post of section head of food product development at Procter & Gamble Co., Cincinnati. He has an MBA from Xavier University.

Mort Williams is currently with Vision Ease in Fort Lauderdale, FL.

1975

MARRIED: Jeffrey Lacko and Pamela Jaquith on October 5, 1985, in Rockville, CT. Pamela attended Manchester Community

Remember the Boston Navy Yard? Now It's a Crystal Palace!

If you visit the Charlestown Navy Yard next September, you probably won't recognize it. By then the venerable Boston landmark will have metamorphosed into a $60 million office park. The park's showcase will be a crystal palace built around a garden.

Says Dean Stratouly '74 CE, vice president of The Congress Group, real estate developers for the project, the gardens will be connected to three buildings containing 965,000 square feet of office space. "The overall plan," he adds, "will combine an Italian palazzo and a Rockefeller Center idea with ice in the winter and a reflecting pool in the summer." The complex will also house a restaurant.

The revitalized Navy Yard, to be known as Constitution Park, is expected to increase tourism in the area and provide more than 3,000 permanent jobs.

During the past few years, Dean

Stratouly '74, vice president The Congress Group

has been involved in numerous projects which are changing the face of Boston. "I deal with the financing, design and construction aspects," he says. "Our company develops sites, purchases land and buildings and hires architects, engineers and construction companies. We rehab older buildings or build new ones—whatever the project calls for."

Dean and his partner, Edward Barry, Jr., president of The Congress Group, have 28 permanent employees, and provide jobs for 1,500 other employees outside of their immediate group.

"We recently completed three projects and have four more on the boards," he says. "We have $196 million in on-going construction with $350 million coming up in the near future. We do everything on speculation. At the beginning of every project all of our net worth is at risk."

Prior to joining the Congress Group, Dean, who also holds an MBA from Central Michigan University, worked for Stone & Webster and Babcock & Wilcox. For a time he was vice president of operations for an architectural engineering firm in Boston.

In June, Dean plans to take a break from his 15-hour a day schedule and participate in the annual Newport to Bermuda yacht race. "I've crewed for others for years," he reports. "This time it's going to be different. I'm going to captain my own boat!"

College and is a manager with the Hartford Insurance Group in Windsor. Jeff serves as project supervisor of data processing with the Hartford Insurance Group in Hartford.

John and **Ginny Giordano FitzPatrick,** their daughter, Cara, and son, Joseph, write "we have adopted a baby girl." Linda Marie was born in Bogota, Colombia, on September 9, 1985.

John Gabranski was recently named a partner in the Springfield, MA, office of Coopers & Lybrand, an accounting, tax and consulting firm, which he joined in 1978. He currently serves clients in the retail, health care, higher education and manufacturing fields. Previously, he was a dean and instructor for the firm's retailing industry training course for new staff members. He wrote a chapter of the *Retail Accounting Handbook* published by the National Retail Management Association. A director of the Pioneer Valley chapter of the American Red Cross and of Springfield School Volunteers Inc., he holds a master's degree from Columbia University.

Bob Simon was recently named marketing manager for Baron-Blakeslee Inc., a new acquisition of Allied Corporation. The firm manufactures industrial degreasing and defluxing equipment and serves as a distributor of degreasing solvents.

Stephen Wojciak writes, "Completed first marathon at the Worcester/Norton 100 Marathon in October."

1976

Reunion September 20, 1986

MARRIED: Donald Moore to Carol Washington in Worcester on September 14, 1985. Carol graduated from Wellesley College and has a master's degree from Johns Hopkins University. Donald is with Prime Computer Company. . . . **David Vogt** and Susan Brodeur in Nashua, NH, on September 15, 1985. She graduated from Franklin Pierce College and is an R&D administrator for Sanders Associates in Merrimack. He serves as actuarial director of loss reserves and special studies at American Universal Insurance Group in Providence, RI.

BORN: to Diana and **Rob Roy** a daughter, Elizabeth, on November 19, 1985 . . . . to Reggie and **Mary Polanik Sherman** a son, Brian, on September 18, 1985. Brian has a three-year-old sister, Alison. Mary is currently working part time as an instructor at Central New England College.

Capt. **Daniel Brock,** former fire chief in Southboro, MA, was recently named fire captain in Cohasset, MA. He has worked on the Southboro force since the age of 17, first as a call firefighter and then as a permanent firefighter. Four years ago, he was appointed captain. Currently, he is working for his master's degree in fire protection engineering at WPI.

Bob D'Orazio serves as manager of applications engineering at Amerigas Division of UGI in Dallas, TX. He has an MS from Rice University.

Last October, **Paul Grogan** ran a segment of the Annual Cape Cod Relay with The WPI Footpounders, who came in 34th out of a field of 200 teams. They covered the 81 miles from Plymouth Rock to Provincetown in 8 hours, 15 minutes. Paul serves as a senior air pollution control engineer for the Massachusetts Department of Environmental Quality Engineering in Boston.

Constance Kuzmier has been elected a member of the Institute of Management Consultants and has been named a certified management consultant. The certification signifies that an individual consulting practitioner meets the Institute's strict standards of technical competence, professional experience and ethical conduct. Constance is a senior consultant with Rath & Strong Inc., Lexington, MA. Her practice includes development and implementation of management systems, productivity improvement programs, computerized manufacturing and control systems and Just-In-Time setup reduction. She also belongs to the Institute of Industrial Engineers.

Arthur Stryer, a senior engineer with Raytheon, has held previous posts in design engineering with DEC and Data General. He has an MBA from Northeastern and is currently attending the WPI evening program working for his MSEE. He holds a patent for a phase-locked loop design.

Steven Tuckerman has been named the town planner for Southington, CT. Earlier, he had been town planner in Coventry and East Hampton. He has a master's degree in regional planning from UMass.

Dr. **Edward Whittaker** was co-author of "Quantum-Limited Laser Frequency-Modulation Spectroscopy," which appeared in the September issue of the *Journal of the Optical Society of America.* He received his PhD from Columbia in 1982, and spent two years as a visiting scientist at IBM's San Jose Research Laboratory. Currently, he is an assistant professor at Stevens Institute of Technology, Hoboken, NJ.

1977

MARRIED: Brian Barnoski and Jill Stempek in Hoosick Falls, NY, on September 7, 1985. Jill attended Bay Path Junior College and is a medical assistant. Brian is a chemical engineer in Winterport, ME.

BORN: to Joan (Tarantula O.D.) and **Herb Schiller** their first child, Elizabeth Ann Schiller, on November 21, 1985. Joan graduated from the Pennsylvania College of Optometry in 1983 and works as an optometrist in Somerset County, NJ. Herb, who is looking forward to attending an executive MBA program in the fall, is with Foremost Mfg. Co. of Union, NJ.

1978

MARRIED: U.S. Army Captain **Gerald Baird, Jr.** and Carol Spence on September 4, 1985, in Lake Hopatcong, NJ. Carol graduated from County College of Morris in Randolph, NJ. Gerald is currently attending MIT. . . . **Kathryn Dearden** and Dennis Simmons on August 24, 1985, in Victor, NY. Kathryn is with Mobil Chemical Co. in Macedon, NY. Dennis, a graduate of Victor High School, is self employed.

Bill Kelm has been promoted to director of engineering for Espey Huston/Structural, Mechanical & Electrical Engineers, engineers and environmental consultants, in Austin, TX. He has been the subsidiary's structural department manager since 1983. Earlier, he was primarily active in designing bridges, commercial office buildings and water and wastewater facilities.

Wayne Noss, who resides in Boston, is now with Cognex in Newton, MA. He writes, "Am a systems hacker at Cognex and loving it!"

Douglas Thompson, an engineer and supervisor of WPI's Instructional Media Center, has been named technical advisor for the Cable Television Advisory Committee in Northbridge, MA.

Wes Wheeler continues as a senior engineer at Exxon Research & Engineering in Florham Park, NJ.

1979

MARRIED: John Brennan and Claire Crane in Newton, MA, on October 12, 1985. She graduated from Lasalle Jr. College and Wheelock College in Boston and is assistant director of the Groton (CT) Senior Center. He has a master's degree in business from the University of New Haven and is a production supervisor for Pfizer Inc., Groton.

BORN: to Deborah and **Donald Larson** a son, Daniel, on June 13, 1985. Donald received his MBA from The Wharton School, University of Pennsylvania, and is currently a product marketing engineer for Intel Corporation in Folson, CA.

Joe Carrolo holds the post of sales support manager for Hewlett-Packard in Andover, MA.

Robert Hart has joined The Disney Channel, Burbank, CA, as director of business development. He is responsible for marketing and sales development in new markets as well as corporate tie-ins for the channel. Previously, he was marketing manager for Cornell Dubilier Electronics in Santa Monica, CA, where he was responsible for the on-going marketing and sales development activities for the highly diversified manufacturer of electronic components.

In addition, he has served as western regional sales manager for Artel Communications, a Massachusetts firm engaged in the manufacture of fiber optics, where he developed sales with aerospace and defense contractors, government and military agencies, and process control developers. Earlier, he was assistant project director with Cordoba Corporation, as well as sales engineer with The Trane Company. He holds an MBA from the UCLA Graduate School of Management. The Disney Channel is a subsidiary of Walt Disney Productions.

Air Force Captain **Steve Kanevski** has participated in Maple Flag XVI, an exercise involving U.S. Air Force, Air National Guard, and Air Force Reserve, as well as

Winning Tactics By Gregory VanHouten

When it comes to Caesar's conquests, the American Revolution and the Arab-Israeli Wars, Gregory VanHouten '79ME knows far more than most of his comtemporaries. And he uses board wargames to challenge high school students to learn more about history.

Last year, his enthusiasm led him to organize the Simsbury (CT) High School Historical Simulations Club. Now every Friday afternoon the club carries out strategies in campaigns ranging from Roman times into the future.

"I belonged to a similar group when I was in high school," he says. "and I continued my interest while I was at WPI." Most of the games that the Simsbury High club play come from the VanHouten collection. The games can take from one to 200 hours to complete with from one to eight players involved.

"Most games require the use of maps," VanHouten explains. "Through actual historical situations the kids learn a lot about different countries. Players try to do as well or better than the historical commander did," VanHouten continues. "They know what resources they have to work with and how much time they have to accomplish their objectives. The person who makes the most of his or her assets wins."

"Tactics II" is regarded as the basic teaching game with more difficult games such as "Diplomacy," "Squad Leader" and "Up Front" topping the popularity charts. VanHouten cautions that beginners need coaching and shouldn't play at the wrong level.

VanHouten, who recently moved his family to Florida where he's working as an aerospace engineer on naval helicopters, is currently playing a Napoleonic game with participants from the U.S., Canada, Britain, France, Holland and Hong Kong: "It's been going on for 18 months." He has also developed his own wargame which he hopes to market, and has started a historical simulations club at Gulf Breeze High School.

Greg writes, "My professional experiences in Nicaragua and with the multi-national force in Beirut, Lebanon, have greatly enhanced my conviction that people can learn a great deal about history, people and places, as well as have a good time, through the playing of historical simulations."

Canadian air crews, staged at Canadian Forces Base Cold Lake, Alberta, Canada. The exercise was designed to enhance the crews' combat capability in a densely wooded area resembling the central European plains. Kanevski is an instructor of weapons systems operations with the 391st Tactical Fighter Squadron at Mountain Home AFB, Idaho.

Randy Wheeler holds the post of White House technical manager for Grid Systems of Vienna, VA. He is located in San Ramon, CA.

1980

MARRIED: Peter Sharpe to Norean Radke on October 12, 1985, in Yorktown Heights, NY. Norean, who holds degrees from Mount Holyoke College and the University of North Carolina, is currently studying for her PhD in systems engineering at the University of Virginia. Peter, an account executive with Siecor Corporation, Stamford, CT, holds an MS from the University of Virginia. . . . **Scott Wade** and Kathleen Wrenner in Endicott, NY, on August 31, 1985. Kathleen graduated from York College and Bryn Mawr School of Social Work and Social Research. She is a social worker at Kennedy-Donovan Center, Foxboro, MA. Scott works for Texas Instruments Inc., Attleboro, MA.

BORN: to **Paul** and **Deborah Johnson Doherty '81** their first child, a daughter, Laurel Ann, on July 16, 1985. . . . to Judith Gemma-Sjostedt and **John Sjostedt** their third child, Daniel William, on December 5, 1985. Peter is now three and Jennifer is two. Daniel's maternal grandfather is **Rowland Gemma '79 SIM**. His aunt is **Jackie Gemma '83 MA**. John continues as a research laboratory supervisor with Du Pont's Washington works facility in West Virginia.

Margaret Davis is now a material control analyst for Honeywell in Newton, MA.

Capt. **David Paciorkowski** has completed the Air Force Institute of Technology program, receiving a master's degree in electrical engineering. Located at Wright-Patterson AFB, OH, AFIT provides accredited graduate-level resident education for selected Air Force members in the sciences, engineering, technology, management and related fields.

Capt. **Robert Vozzola** has graduated from the Squadron Officer School at Maxwell AFB, AL. He is slated to serve with the 1912th Information Systems Support Group at Langley AFB, VA.

Lisa Wylie is currently a staff member in information systems at AT&T Technologies in North Andover, MA. She received her MSCS from Kansas State University through a program sponsored by AT&T called "Summer-on-Campus," which she started four years ago.

Ali Zahedi serves as cost engineer at Pacific Bell in San Ramon, CA.

1981

Reunion September 20, 1986

MARRIED: Elaine D'Iorio and **Michael Baginski** recently in Danvers, MA. She graduated from Marian Court Junior College and works for GE in Lynn, MA. He is with Travis Associates of Burlington, MA. . . . **Eleanor Cromwick** and Thomas Kelly III in Washington, DC, on October 12, 1985. Eleanor is an estimating engineer at Turner Construction Co., Detroit. Tom, a graduate of Canisius College, Buffalo, NY, has a master's degree from the University of Missouri at Columbia and an MS in management from the Sloan School of Management at MIT, where he was named a Sloan Fellow. He served three years in the U.S. Army and was recently director with the U.S. Army Artificial Intelligence Center at the Pentagon. Currently, he holds the post of director of technical planning for Ford Aerospace in Detroit. . . . **Gary Godek** and Patricia Miller in Longmeadow, MA, recently. Patricia, a graduate of Westfield State College, is a junior high school mathematics teacher in Somers, CT. Gary serves as a project engineer for Hamilton Standard in Windsor Locks, CT.

MARRIED: Barry Jackson to Kathleen Spencer in Peterborough, NH, on November 23, 1985. She graduated from Bonny Eagle High School, Standish, ME. Currently, she serves as a surgical assistant with Breakfast Hill Oral Surgeons in Rye. He is a mechanical engineer. . . . **Thomas Johnson III** and Cynthia Lee on October 5, 1985, in West Chester, PA. Cynthia, a senior customer representative for Du Pont, Wilmington, DE, graduated from Virginia Polytechnic Institute and State University, Blacksburg. After studying at WPI, Tom became a student of architecture at the University of Pennsylvania. He is self employed as a cabinetmaker and designer with Johnson Woodworks. . . . **Richard Passaro** to Robbin Ann Sawicki in Hyannis, MA, on October 5, 1985. Robbin, a dental assistant, graduated from Becker Junior College. Richard is an electrical engineer. . . . **Gary Styskal** and Marcia Ryan in Woburn, MA. Marcia graduated from Northeastern University and Katharine Gibbs School. Gary is an electrical engineer. . . . **William Waller** and **Sandra Paille '82** in Amherst, MA, on October 12, 1985. He is an astronomy PhD candidate at UMass, Amherst.

William Carlson was the coauthor of "Algorithmic Performance of Dataflow Multiprocessors," which appeared in the December issue of the magazine, *Computer.* He is a doctoral student in electrical engineering at Purdue University. His current research interests include multiprocessors, dataflow computering techniques and performance evaluation of new computer systems. A student member of the IEEE Computer Society, he holds an MSEE from Purdue.

Tom Clark works for Stratus Computer Inc., Marlboro, MA.

Bob Daley serves as a standards engineer for Sikorsky in Stratford, CT. His wife, Susanne, is a merchandise manager for Brian Alden, Clinton, CT.

Craig Dempsey has completed a two-year assignment as shift supervisor for GE's Knolls Atomic Power Laboratory in Windsor, CT. He was recently promoted to senior field engineer. He will represent GE at the Pearl Harbor Naval Shipyard in support of nuclear powered attack submarines.

Ethan Foster serves as lead programmer/analyst at Harvard Medical School, Boston.

Lt. **Mark Malenbaum**, USAF, was promoted to captain in October. Stationed at the Los Angeles AFB in El Segundo, CA, he is currently a project engineer on the Consolidated Space Operation Center being built in Colorado Springs. He has a master's degree from Chandler College, El Segundo, CA.

1982

MARRIED: Paul Lindenfelzer III and Sandra Delmolino on November 9, 1985, in West Stockbridge, MA. Sandra graduated from Becker Jr. College. She is a receptionist and secretary at GE, where Paul is an engineer. Last May, he received his MSEE from RPI. . . . **Wilson Powell** and **Sonia Adrianowycz '83** on October 12, 1985, in Ansonia, CT. She holds a degree in chemical engineering. He is a software engineer with Raytheon Company. . . . **Wolfgang Strobel** and Karen Nickolas in New Britain, CT, on September 22, 1985. Karen graduated from Central Connecticut State University. . . . **Christopher Wraight** and Katherine Higgins in East Lyme, CT, on November 29, 1985. Katherine, who graduated from Lesley College, Cambridge, MA, is employed by CIGNA Corp., Boston. Chris works for AT&T Information Systems, Morristown, NJ.

Richard Bolstridge has transferred from Applicon in Burlington, MA, to Flopetrol Johnston, a division of Schlumberger Ltd. in Houston, TX.

David Freitas is with Marshall Contractors in Rumford, RI.

James Kaemmerlen serves as a mechanical engineer with BIF in West Warwick, RI.

Daniel O'Laughlin holds the post of systems engineer at RCA Corporation in Camden, NJ.

Prof. **Helen Vassallo** of WPI's Management Department, was awarded honorable mention for Outstanding Advisor of the Year at the Phi Sigma Sigma national convention held in August in Columbia, MD. She conducted a workshop on Communication and Cohesion at the convention. Her article, "The Pharmacology of Local Anesthetics," was included in the Continuing Education Seminar Series, Department of Anesthesia, Academic Health Science Center, University of Medicine and Dentistry of New Jersey, Rutgers Medical School.

1983

MARRIED: Brian Perkins and **Susan Kirkman '84** in Otter River, MA, on July 20, 1985. Besides WPI, Susan graduated from the John Robert Powers Modeling School. She is a civil engineer with the Massachusetts Department of Public Works. Brian is an electrical engineer with Raytheon Co., Wayland, MA. . . . **Paul Perron** and Brenda Boucher on September 21, 1985, in Westboro, MA. Brenda graduated from Quinsigamond Community College, Worcester. Paul serves as an analytical engineer at Pratt and Whitney Aircraft in East Hartford, CT. . . . **Christos Ross** and **Meggan McGuiness** on September 22, 1985. Meggan is a radiological engineer for GE-Knolls Atomic Power Laboratory, Schenectady, NY. Christos works for GE in Utica, NY. . . . **Daniel Statile** and Debra Noel in Bristol, CT, on October 12, 1985. Debra, a secretary, graduated from Becker Jr. College. Dan has an MS from RPI and is a nuclear engineer at Westinghouse.

Steve Bednarz serves as a project engineer at Pratt & Whitney Aircraft in West Palm Beach, FL.

Colin Craig, now with Pratt & Whitney, is also pursuing a master's degree at the University of Connecticut.

Brian Fuller has been promoted to the rank of first lieutenant in the U.S. Air Force. He is a mechanical engineer with the 2835th Electronic Systems Division at Hanscom AFB, MA.

Mark Millay continues with GTE in Westboro, MA.

Mark Mungeam works for Classic Golf Course Builders, Palmetto, FL.

Nicholas Ortyl is principal engineer for Colt Industries, Chandler-Evans Division, West Hartford, CT.

Sean Suckling, who has an MBA from RPI, is a jet engine mechanic at Griffiss AFB, Rome, NY.

Eric Tuvesson works as a hardware engineer II at Wang Labs in Lowell, MA.

1984

MARRIED: David Anderson and **Mary Foley** in Franklin, MA, on November 9, 1985. Mary is with AT&T Network Systems and David with Teradyne Corp. . . . **Richard Hajec, Jr.** to Lori Turner in Shelburne Falls, MA, on October 12, 1985. Lori graduated from Becker Jr. College and is with Epsilon Data Management in Burlington, MA. Richard works for AT&T Technologies, North Andover, MA. . . . **G. Christopher Heyl** and **Lisa LaChance** on October 19, 1985, in Cumberland, RI. Lisa is with Barden Corp., Danbury, CT, and Chris with Colt Industries, West Hartford, CT. . . . **Jean Salek** and David Camp in Clifton, NJ, on September 8, 1985. David graduated from Georgia Tech, Atlanta. Both are process engineers for Chevron Research Co., Richmond, CA.

Lt. **Brian Coleman,** U.S.A., a medical specialist, is currently assigned to duty with the U.S. Military Community Activity, Pirmasens, West Germany.

Paul R. Graham, Jr. has been appointed associate field engineer by New England Power Service Co., Worcester. Previously, he was assistant field engineer.

Kurt Krusinski continues with AT&T Bell Laboratories, Holmdel, NJ.

Patty Martone has been working as a sales engineer for Hewlett-Packard in Andover, MA, for more than a year and a half.

2/Lt. **Rolfe Parsloe** has graduated from U.S. Air Force pilot training, and has received his silver wings at Mather AFB, CA. He is scheduled to serve at Castle AFB, CA.

1985

MARRIED: Thomas Arseneault and Mary Shea in Norwich, CT, on September 7, 1985. Mary, an assistant buyer at Quill & Press Stationers, Acton, MA, graduated from Bay Path Jr. College. Tom is with RCA Government Systems in Burlington, MA. . . . **Gary Capitanio** and Ronda Will on October 5, 1985, in Torrington, CT. She graduated from Torrington High School and is with McCann's Downtown Army and Navy Store. Gary serves as a project manager at Interior Technology of Torrington. . . . **John Cole** and **Catherine Marinelli** in Southbridge, MA, on September 7, 1985. Catherine is a management intern with Consolidated Edison, New York City. John works for Hamilton Standard, Windsor Locks, CT. . . . **Theodore Fazioli** and Carol Asermely on October 5, 1985, in Central Falls, RI. Carol, a graduate of the Community College of Rhode Island, is employed by a law firm. Ted is with Hewlett-Packard Co., Santa Clara, CA.

MARRIED: Richard Hilow to Ginger Isaacs in Auburn, MA, on August 24, 1985. An electrical assembler, Ginger graduated from Auburn High School. Richard serves as a design engineer at Harris Graphics Corp., Dover, NH. . . . **Stephen Horan** and Deborah Hanna in Worcester on August 23, 1985. Deborah, an RN at the University of Massachusetts Medical Center, graduated from Southeastern Massachusetts University. Stephen teaches computer science and coaches football at Worcester Academy. . . . **Manuel Irujo** and Carrie Goss in Newburyport, MA, on June 22, 1985. She graduated from Framingham State and is attending

Augusta College in Georgia, where she is majoring in secondary English. He is supervisor of waste management operations at Du Pont in Aiken, SC.

MARRIED: **Wayne Lovington** and Karen Ruggiero in Connecticut on October 19, 1985. Karen, a radiation therapist technician at Yale-New Haven Hospital, graduated from South Central Community College. Wayne is a materials engineer, surface analysis, at the U.S. Army Materials and Mechanics Research Center, Watertown, MA. . . . **Christopher Papile** and **Susan Decoteau** in Worcester on August 10, 1985. Susan is a chemical engineer. Christopher is a graduate student in chemical engineering at the University of Delaware, Newark. . . . **Michael Sullivan** and Kathleen Iovene on August 23, 1985, in Cheshire, CT. A manager for Jordan Marsh Co., Kathleen holds a BA in economics from Holy Cross College. Michael is an industrial engineer for Parker Bros. of Salem, MA. . . . **David Williams** and **Patricia Coghlin** in Shrewsbury, MA, on August 24, 1985. Tricia is a mathematician at Alphatech in Burlington, MA. David is a mechanical engineer for Bernard Danti Inc., Woburn, MA.

Michael Abladian is employed by Raytheon.

Licinio Alves has joined Naval Underwater Systems Center in Newport, RI.

Gloria Andrews, who holds an MSCE from WPI, serves as a civil engineer with the U.S. Army Corps of Engineers in Waltham, MA.

Daniel Baird is a site engineer for Francis Harvey & Sons Inc., Worcester.

Rich Caloggero, Jr. works for the U.S. Army Materials and Mechanics Research Center, Watertown, MA.

Carolyn Cannon, who has her MSEE from WPI, continues as a first-year student in the MD/PhD program at The University of Texas Health Science Center at Houston.

Mark Cioffi works as a senior engineer for Luminescent Systems Inc., Lebanon, NH.

Derek Doughty is a technical specialist for E-Systems Inc., St. Petersburg, FL.

Katherine Driscoll works as an environmental engineer for Metcalf & Eddy, Wakefield, MA.

Robert Gibbons serves as quality control manufacturing engineer in the equipment division at Raytheon in Waltham, MA.

Larry Haith is a research associate with Creative Biomolecules in Hopkinton, MA.

Bruce Harley works as a design engineer for Capitol Circuits Corp., Allston, MA.

Lt. **Michael Hobson** is a flight test engineer with the U.S. Air Force, Edwards AFB, CA.

Denise Johnston, who continues as a project engineer (mechanical) at Weyerhaeuser in Longview, WA, is also employed as an aerobic dance and nautilus instructor for the Family Fitness Center in Vancouver.

2/Lt. **Daniel Kennedy** is an air defense control officer with the U.S. Marine Corps at Camp Pendleton, CA.

Robert Kunemund serves as a patent examiner with the U.S. Patent and Trademark Office, Arlington, VA.

Mark LaCasse holds the post of senior project member of the technical staff at RCA in Burlington, MA. He has an MSEE from WPI.

Daniel Laprade is on a two-year assignment in Nepal with the Peace Corps.

Richard Levy, who has a PhD from WPI, an MA from Clark University and a BA from Colby College, is a consulting scientist for Millipore Corp., Bedford, MA.

Wayne Lipson continues as a graduate student at WPI.

Edward Mackey is with Raytheon Company.

Robert MacLeod, Jr. who recently graduated from OTS at Lackland AFB, TX, now holds the post of second lieutenant with the U.S. Air Force, Scott AFB, Belleville, IL. The 12-week course held at Lackland AFB trained selected college graduates to apply communicative skills, professional knowledge, leadership and management in positions of responsibility.

Alan Macomber serves as a project engineer at United Technologies' Hamilton Standard Division in Windsor Locks, CT.

David Madamba works for Hamilton Standard.

Kelly Madden has joined Raytheon.

Kevin Madden works for Craig Systems Inc.

Rajiv Maheshwary is now with Mitsubishi Semiconductor of America Inc.

Paul Maier has accepted a post at Hamilton Standard.

Mark Malagodi is at the University of Utah.

Zeke Mannel serves as a process engineer at Corning Glass Works, Corning, NY.

John Marczewski works as an assistant field engineer at Massachusetts Electric Co. in Hopedale, MA.

Stephen Mariano is with the U.S. Army Materials & Mechanics Research Center, Watertown, MA.

Gregg Marcus has accepted a position with Raytheon.

Roland Martin is currently a systems programmer with Pratt & Whitney Aircraft, East Hartford, CT.

Scott McAuliffe has joined Stratus Computer.

David McCarthy works for New Seabury Corporation.

Deidre McCarthy is with Hamilton Standard.

Kelly McGurl has been employed by MITRE Corporation, Bedford, MA, where she is a member of the technical staff.

Patricia McSherry is with Raytheon Company.

Andrew Melnyk has been employed by LTV Aerospace.

James Melvin has joined Digital Equipment Corporation.

William Michaud works for Zenith.

Don Mikan works for IBM in Poughkeepsie, NY.

Robert Minicucci is with the Massachusetts Department of Public Works.

James Mirabile is an ensign with the U.S. Navy.

Rosario Mollica is a grad student at the University of Michigan.

Michael Mongilio works as a junior engineer for Westinghouse Electric Corporation in Baltimore, MD.

Joseph Mooney has joined Target Industries, East Windsor, CT.

David Moriarty serves as a microwave systems engineer at Motorola Communications and Electronics Inc. in Glen Rock, NJ.

Brian Morrison is a senior design and development engineer at Raytheon in Sudbury, MA. He has his MSEE from WPI and a BS from the University of Maine.

Sondra Morrissey has joined Augat Altair International in Mount Clemens, MI.

Jim Morton has been employed as a software engineer by Applix Corporation.

Frederick Moseley is enrolled in the master of science program in transportation at the University of Pennsylvania.

Paul Mulroney works for Boston Gas.

Neal Murphy has joined GTE Government Systems Corporation, Westboro, MA.

James Murray, Jr. is now a design engineer with the U.S. Government/Army Counter Measures Research Lab. in Fort Belvoir, VA.

James Nadeau has been employed by TRW.

Michael Narkis is with the U.S. Air Force.

Neal Neslusan has been employed by Raytheon.

Raymond Newmark has joined Apollo Computer, Chelmsford, MA, as a major accounts systems analyst.

Louis Nicholls, now with Mitsubishi Semiconductor of America Inc., is currently an assembly engineer trainee for the firm in Japan, where he will be located for nearly two years.

Joe Nikosey, Jr. now works at Auguat.

Eric Noack is with G.L. Tool & Manufacturing Co.

Virginia Noddin has been employed by the U.S. Government/Army Corps of Engineers, Vicksburg, MS. She writes that she is taking night classes, working on her master's degree.

Marek Nowak has been employed as a materials engineer by GE in Lynn, MA.

Maureen O'Brien is with GE Datel, Mansfield, MA, where she is a thin film process engineer.

Judith O'Coin works for Arthur Andersen & Company, Hartford, CT, as a management information consultant.

Tom O'Donnell has joined GTE, Needham Heights, MA.

Charles Owen has been employed by Digital Equipment Corporation.

Robert Pacecca works as an associate engineer for General Dynamics-Electric Boat, Groton, CT.

John Packer is now with Off Shore Engineering.

Angela Padavano is currently attending the master's program in fire protection engineering at WPI full time.

Francisco Palacios, who has his MBA from WPI, works as manager of instruments and controls at Riley Stoker in Worcester.

John Palczynski, Jr. is now with Digital Equipment Corporation.

Harold Paraghamian holds the post of supervisor of project engineering at Norton Co. in Worcester. He has a BS from Northeastern and an MBA from WPI.

Kathy Parker works for the Naval Underwater Systems Center.

Richard Parsons works for Turner Construction Co., Boston, MA, as a field engineer.

Benjamin Paul is a graduate student at MIT.

Thomas Pelnik is studying at the University of Rhode Island.

Luigi Peluso works as a product design engineer at Torrington Company in Connecticut.

Charles Penta works at New Seabury Corporation.

Eric Peterson now works for Augat Inc., Attleboro, MA.

Roy Peterson has accepted a post at Raytheon Company's Submarine Signal Division in Portsmouth, RI.

Michael Petkewich has joined Dennison Manufacturing Company. He works in Framingham, MA.

Ann Pettit works for AT&T Technologies.

Elizabeth Phalen is currently employed at Digital Equipment Corporation.

Alan Phipps has joined Nelmor Co., North Uxbridge, MA.

Martin Pierce works as a mechanical design engineer at Pratt & Whitney Aircraft, West Palm Beach, FL.

Liza Pierro works for RCA.

Robert Pierson is now employed by General Electric.

Steven Pinkerton has joined the Dynapert Division of Emhart Corporation in Beverly, MA.

Daniel Pitkowsky works as a sales engineer for GE in Jacksonville, FL.

Robert Pizzano has been employed by MITRE Corporation, Bedford, MA, as a member of the technical staff.

Walter Plante continues as a teaching assistant at WPI.

James Polewaczyk works as a field engineer for Hewlett-Packard, Lexington, MA.

Robert Power works for General Dynamics-Electric Boat.

Mark Primmer serves an ensign in the U.S. Navy, Naval Aviation Schools Command, Pensacola, FL. Last summer, he was assigned to temporary duty at the Pentagon. Currently, he is training to be a naval flight officer.

Anne Provencher works for Procter & Gamble.

Edward Quigley is an associate engineer at General Dynamics-Electric Boat in Groton, CT.

Michael Raspuzzi works for Digital Equipment Corporation.

Brent Reedstrom is with Allied Chemical.

Ellen Regan has joined Stone & Webster Engineering Corporation.

James Richard has been employed by GCA.

Virginia Roach holds the post of civil (environmental) engineer at Camp Dresser & McKee Inc., Boston.

Franz Roesner works as a product representative for Siemens-Allis Inc., Atlanta, GA.

Steven Rogers is with Pratt & Whitney Division.

Jorge Ros has joined Intel.

Stephen Roughan is with Raytheon Company.

Kenneth St. Hilaire works for Transcom Electronics.

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Mail to: Editor, *WPI Journal*, Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA 01609.

Marc Sanfacon is employed by Data General.

John Scacciotti has joined General Electric as a sales engineer in Elmonte, CA.

Rochelle Scala has been employed by Computervision.

Laura Mackertich Scanlon is now with Paul Carroll Associates in Boston.

John Scannell works as a transportation engineer at BSC Engineering in Boston.

Scott Schaefer is DEC systems manager with Access Technology Inc., South Natick, MA.

Victor Schubert is a graduate student at Southern Methodist University.

Brian Sears has been employed by Pratt & Whitney.

Ronald Sedergren works for GE.

Michael Shea works for Con-Edison.

Nikhil Shah has been named a project engineer in the Admiral Division of Magic Chef.

David Sheehan is concerned with semiconductor sales at Texas Instruments, Dallas, TX. He is also directing his energies toward the development of a professional lacrosse league.

Joseph Simonelli has joined GTE-Communication Systems Division, Natick, MA.

Mark Skinner is employed by General Electric.

Air Force 2/Lt. **Gary Smith** has arrived for duty with the 71st Student Squadron. He is currently stationed at Vance Air Force Base in OK.

Jeffrey Smith works for New England Power Service.

John Snow has been employed by General Electric. He currently works at the Lynn, MA, facility.

Peter Spinney has accepted a post with the Research and Development department at Raytheon Company. He works in Northboro, MA.

Mark Stanley is currently employed as an industrial engineer at Princess House, North Dighton, MA.

Russell Staples has been employed as a quality assurance engineer at Jamesbury Corp., Worcester. He has an MBA from WPI and a BS from Tufts.

Frank Statkus holds the post of engineering manager at IC Testing Inc., Sudbury, MA. Besides degrees from Worcester Junior College and Northeastern, he has an MS in management from WPI. Previously, he was employed at Data General, RCA, Raytheon and Fenwal Inc. He and his wife, Patricia, have three children.

Craig Stearns is an associate engineer in design and development at Raytheon in Andover, MA.

Scott Stefanov has been commissioned a second lieutenant in the United States Air Force upon graduation from Officer Training School at Lackland AFB, Texas. He is currently stationed at Wright-Patterson AFB in Ohio, where he is an avionics systems engineer.

Jeffrey Stevens works for Raytheon Company.

Susan Stidsen has accepted a post with Pratt & Whitney.

Nancy Stone is a graduate student in chemistry at Brown.

Robert Stoodt holds the post of mechanical engineer at Naval Underwater Systems Center, New London, CT.

Kirsten Storm works for Westinghouse Electric, Monroeville, PA, as a manufacturing controls engineer in the apparatus division.

Jonathan Story has been named as production engineer at Union Carbide/Molecular Sieve in Chickasaw, AL.

Michael Strzepa works for Digital Equipment Corporation.

Patrick Tacelli has joined Pratt & Whitney.

David Tahajian is employed by Raytheon Company.

Olaniyi Taiwo is at RPI.

David Tardito is currently employed at Raytheon, Marlboro, MA, as an associate electrical engineer.

Kathy Taylor has joined Procter & Gamble, Quincy, MA, as manufacturing manager.

Lloyd Tepper works for GE's Knolls Atomic Laboratory in Schenectady, NY.

Craig Therrien works for General Electric.

Barbara Thissell works for Barnes and Jarnis Inc., Boston.

Jean "J.P." Thomsin is studying for a master's in theoretical and applied mechanics at Cornell University.

Shaun Tine works for Grace Heights-Mukonoso II in Japan. He writes, "Love Japan. People are great!"

R. Christopher Trimper works for Raytheon Company.

Barry Tripp is an associate engineer with Raytheon in Bedford, MA.

Hank Valcour serves as a cryogenic test technician at Koch Process Systems in Westboro, MA.

John Voccio is doing graduate work at MIT.

Scott Wahlstrom has joined Dennison Manufacturing, Framingham, MA, where he is a project engineer.

David Wall has accepted a post as a software engineer with Digital Equipment in Marlboro, MA.

Maureen Walsh works as a production control supervisor for General Electric in Everett, MA.

Matthew Wasielewski has joined Westinghouse.

Richard Weed serves as an environmental process engineer at C.T. Main Corporation in Boston.

Dan Weinshenker is a field recruiter with Business Executives for National Security, Louisville, CO.

Fran Weiss has been employed as a systems engineer by Corning Glass Works, Corning, NY.

Paul Westgate is at Purdue University.

Scott Wheaton works as a development engineer at Engelhard Corporation in Edison, NJ.

Stephen Wheaton is a systems programmer with Beckman Laboratory Automation Operations in Waldwick, NJ.

David Wheeler has joined General Dynamics-Electric Boat, North Kingstown, RI. He is currently employed in construction management.

Scott Wheeler works for GTE-Communication Systems in Needham Heights, MA.

Warren Wheeler has accepted a post at Raytheon.

2/Lt. **Mark White** has graduated from the U.S. Army engineer officer basic course at Fort Belvoir, VA.

Beth Whiteside is a graduate student at Boston College.

2/Lt. **Jonathan Williams** has completed a signal officer basic course at the U.S. Army Signal School in Fort Gordon, GA. He received instruction in military leadership and tactics, tactical and radio communications systems and communications center operations. He is now stationed with the San Francisco MT Detachment at the Presidio of San Francisco in California.

Charles Wright is on the technical staff at TRW Inc., Redondo Beach, CA.

Paul Wyman has joined D.W. Clark and Company, East Bridgewater, MA, as a quality control engineer.

Kuo-Kai Yang, who has his MS in chemical engineering from WPI, serves as a project manager for W.S. Yuan in Taiwan.

Arra Yeghiayan is now with GenRad.

Chue-San Yoo continues as a graduate student in chemical engineering at WPI.

Thomas Zaccari works for Kaman Avidyne.

David Zaterka has joined Mitsubishi. He writes, "I expect to be in Japan until June 1987."

Michael Zizza is with the United States Army.

Douglas Zuklie has joined AVCO Lycoming Division.

School of Industrial Management

Robert Blackmar '72, director of productivity services at Norton Co., Worcester, spoke on employee incentives at a meeting of the Milford/Amherst, NH, Chamber of Commerce in November. With Norton for 25 years, during the past 10 he has been responsible for incentive, work measurement and productivity improvement programs at the firm. He is the author of many articles on productivity and has been a guest speaker at Harvard Business School's Graduate Program. He is a graduate of Alfred University. . . . **Paul Henderson '78** has been named vice president of operations of Pennsylvania Gas and Water Co. (PG&W). He joins the company after having served as director of distribution and engineering for Commonwealth Gas Co., Southboro, MA. The past chairman of the construction and maintenance committee of the New England Gas Association, he holds an associate degree in mechanical engineering and a BS in industrial engineering from Northeastern University. The Hendersons, who reside in the Back Mountain area of northeastern Pennsylvania, have a son, Brian, and a daughter, Deborah.

Natural Science Program

Sr. **Louise Lataille '70** has been named principal of St. Laurent School, a parochial school in Meriden, CT. She holds a BA in mathematics from Anna Maria College and is currently working on her master's degree in Christian leadership from Boston College. Prior to going to Meriden, she had taught middle school students during the day and adults in the evening in a rural community in Vermont. Earlier, she had taught in several towns in Massachusetts. During her leisure time, Sr. Louise enjoys bicycle riding, playing the guitar and singing.

COMPLETED CAREERS

Roger M. Lovell '18 died at his home in Greenfield, MA, on October 7, 1985, at the age of 88. He was born in West Boylston, MA, on March 25, 1897, and graduated as a civil engineer from WPI.

A registered professional engineer, he was with New England Power Co. for 42 years, retiring in 1963 as manager of real estate. After retirement, he was employed for several years by Gordon Ainsworth Associates of South Deerfield, MA.

Mr. Lovell was past national president of the American Right-of-Way Association. He belonged to the Congregational Church and Sigma Phi Epsilon. During World War I, he served with the U.S. Army.

Howard A. McConville '19 died in Schenectady, NY, on September 22, 1985, at the age of 91. A graduate chemist, he was a native of

Florence, MA.

In 1965, he retired as a chemist for General Electric following 25 years of service. Earlier, he had worked for Rolls Royce in Springfield, MA, for several years.

He belonged to the General Electric Quarter Century Club and St. Thomas the Apostle Church. He was a past president of the Schenectady County Historical Society and the Dutch Settlers of Albany. For a number of years, he was involved with the Boy Scouts of America in the Schenectady area.

Roland A. Crane '25 of Los Osos, CA, died on October 13, 1985. A native of East Longmeadow, MA, he was born on November 30, 1901.

Following his graduation as an electrical engineer, he worked for Electrical Research Products and the Radiation Laboratory at the University of California at Berkeley. For many years, he was a service inspector with Altec Service Co. in San Francisco. He belonged to ATO and had served as president of the Northern California Chapter of the Alumni Association. He was an Army veteran (Corps of Engineers) of World War II.

David J. Minott '25 of West Allenhurst, NJ, died November 11, 1985.

He was born on March 10, 1902, in Portland, ME. In 1925, he received his B.S.E.E. from WPI. For many years, he was with the U.S. Army Electronics Command, from which he was retired. He was a member of Theta Chi Fraternity and the father of **John Minott '57**.

Edmund J. McGarrell '26 died at his home in Knoxville, TN, on September 5, 1985. He was born in Worcester on Jan. 4, 1903.

After graduating as an electrical engineer, he moved to Elmira, NY, where he worked for many years with the New York State Electric and Gas Corporation. He later became general manager of J. Scott Baldwin Refrigeration and Air Conditioning Co. in Elmira. In 1968, he retired as a senior designer at the Newport News Shipbuilding and Dry Dock Co. in Virginia. A licensed professional engineer, for a time he taught at Pennsylvania State University.

Mr. McGarrell was a former member of the legislative committee of the Retired Men's Club of Virginia.

Harry E. Stratton '26 of Peterborough, NH, passed away last November. He was born on December 13, 1901, in Fitchburg, MA, and later studied civil engineering at WPI.

During his career, he was with Wm. P. Ray, C.E., McCauliff Quarry Co., Seaboard Quarries Inc., Stone Mountain Granite Corp., Rollstone Granite Co. and Haskell Granite Co. In 1939, he joined H.E. Fletcher Co., West Chelmsford, MA, from which he retired as plant engineer. He belonged to Sigma Phi Epsilon.

George B. Emerson '32, a retired marine engineer, died at his home in Sarasota, FL, on November 11, 1985, at the age of 76. He was born in Columbia, MO, and received his BSME from WPI.

In 1947–1948 he attended the Oakridge School of Reactor Technology. During his career, he was with the Bethlehem Shipbuilding Corp., Quincy, MA, the Monsanto Chemical Corp. and the Bureau of Ships (Navy Department) in Washington, DC, where he was principal engineer.

A member of the American Society of Naval Engineers and the Society of Professional Engineers, he helped to develop the world's first nuclear submarine, *Nautilus*.

C. Bradford Newell '33 died November 8, 1985, in Memorial Hospital, Worcester, at the age of 73. A Worcester native, he studied mechanical engineering at WPI, where he was a member of Theta Chi.

Mr. Newell was president and treasurer of Howard Products, a sheet-metal fabrication firm in Worcester, which he founded in 1948. He retired in 1976. Previously, he was a production manager at the former Heywood Boot & Shoe Company in Worcester for 15 years.

He served on the chancel committee of the First Baptist Church. In Holden, he was a member of the Dawson School building committee, a former director of the Grove Cemetery Corp. and the Holden Hospital Corp.

Robert B. Gurry '34 died September 11, 1985, in Oakdale (MA) Nursing Home at the age of 74. He was born in Portland, ME.

For many years, he was a claims manager for Merchants Mutual Insurance Company, from which he retired ten years ago. He was a senior warden of his local Episcopal Church, a past master of the Masons in East Douglas, MA, and a member of the Worcester Art Museum, where he was a security guard and docent. Other interests were the Holden (MA) Senior Citizens group and the Boy Scouts.

John A. Crane '36, a retired advertising consultant, died suddenly on October 30, 1985, at Framingham (MA) Union Hospital. He was born in Framingham and was a graduate mechanical engineer.

He was a former business manager of the *Framingham News*, which later became the *South Middlesex News*, from 1957 to 1971. More recently he was employed as an advertising consultant for the *Milford Daily News* before retiring in 1983. Earlier posts were with Air Conditioning Engineering Co., Curran & Burton Inc., Geo. T. Stevens Co. and Worcester Stamped Metal Co.

At one time associated with the Framingham Historical District Commission, he was also a member of the local Congregational Church. He belonged to Sigma Phi Epsilon.

John J. O'Donnell '36 recently died in Worcester at the University of Massachusetts Hospital. He was 71, a graduate electrical engineer and a native of Worcester.

Prior to retiring in 1971, he had been a sales engineer for 33 years with Johns-Manville Corp. in New York City. He had also been associated with Postal Telegraph in New York, Arter Grinding Machine Co., Worcester, and Underground Products, Detroit.

Active with alumni affairs, he had served as president of the New York chapter of the Alumni Association, as well as having been a member of the Alumni Council, a contact man for the Alumni Fund, a member of the Committee on Students, chairman of the Nominating Committee, class agent, and a captain in the Capital Gifts Campaign. He was a member of the Poly Club and IEEE.

Joseph A. Stead '36, a retired chief structural engineer of Riley Stoker Corp., Worcester, died October 25, 1985. He was born in Millbury, MA, on May 17, 1915.

After receiving his BSCE, he graduated from the School of Industrial Management in 1960. From 1936 to 1939, he was a designer with U.S. Steel Corporation (American Steel & Wire Co.). In 1939, he joined Riley Stoker's structural steel department as a structural engineer. In 1948, he was named assistant chief structural engineer. In 1966, he was promoted to chief structural engineer of Riley Stoker Corp. He retired in 1978 after 39 years with the company.

Mr. Stead, who had served as class agent, belonged to the Tech Old-Timers and Theta Chi. A registered professional engineer in Massachusetts, he was registered in Texas and Indiana as well. He was a member of the American Institute of Steel Construction. From 1950 to 1956, he was a member and chairman of the board of selectmen of the Town of Millbury, where he had also served on the board of registrars. He belonged to the Millbury Federated Church and the Golden Age Club, and had been a member of the Millbury Historical Society. He was a former cubmaster for the local Scouts.

A. Hallier Johnson '37 of Chesapeake City, MD, died on January 22, 1986, in Christiana Hospital at the age of 70. He was born in Hopedale, MA, and received his BSME from WPI.

He joined Du Pont directly after graduation, remaining with the firm for 34 years. In 1972, he retired from the design division at Louviers.

Mr. Johnson, who was a member of Sigma Xi, also belonged to the Wilmington Power Squadron (past commander and life member) and the Elk River Yacht Club, Elkton, MD, which he served as past commodore.

John V. Quinn '41 died at his home in Framingham, MA, on August 28, 1985, at the age of 65. He was a native of Worcester.

A mechanical engineer, for 14 years he was the cost engineer manager in the equipment division laboratory at Raytheon Co. in Wayland, MA. Previously, he was manager of military products operations at General Instrument Corp., Chicopee, MA, and plant manager for Raytheon in Waltham. Other posts were manufacturing manager at Norden Co., Norwalk, CT, operations manager at Bendix Corp., Towson, MD., and superintendent of manufacturing at Leland-Gifford in Worcester.

In 1953, he graduated from WPI's School of Industrial Management. He was a member of Phi Kappa Theta.

John L. Perkins III, '43, of Old Saybrook, CT, passed away at his home on November 4, 1985. He was born in New York City on February 8, 1920.

During World War II, he enlisted in the

Army Air Corps, serving as a first lieutenant. He was a flight instructor at Bryant Field in Texas.

After the war, he became vice president of sales at B.F. Perkins and Sons, now a division of Standard International. He also worked for The Torrington Co. in Chicago and Peoria, IL. At the time of his retirement, he was forecasting manager of the Torrington needle bearing division.

Mr. Perkins belonged to the Society of Automotive Engineers, the International Oceanographic Association, the Menunketesuch Yacht Club and the Quinnepiac Club of New Haven, as well as the Hartford, Old Saybrook and Mystic Power Squadrons.

J. Francis Sullivan '43 of Holyoke, MA, died on September 20, 1985. He was born on Oct. 4, 1921, in Worcester, and later graduated from WPI as a chemical engineer.

For many years, he was with Plastic Coating Corp., Holyoke, MA, which he had served as purchasing agent. Later, he was manager of purchasing at Scott Graphics, Holyoke. He was a member of SAE, the American Chemical Society and the AIChE.

James W. Knight '46 of Longmeadow, MA, passed away recently. A native of Buffalo, NY, he was born on March 29, 1913, and later studied chemistry at WPI.

During his career, he was with Springfield Federal Land Bank, New England Telephone & Telegraph Co., and Downing Taylor Co. For a number of years, he was a self-employed broker in the insurance and investments business. He graduated from Indiana University and took evening courses at Northeastern University. He was a U.S. Army veteran, and a member of the Masons, Scottish Rite Bodies and the Shrine in Springfield, MA. He belonged to Lambda Chi Alpha.

Sherwood S. Vermilya '46 and his wife, Marquerite, of East Hartford, CT, were killed in an auto accident last September. He was born in College Point, NY, on Aug. 18, 1924, and studied civil engineering at WPI.

He was president of United Appraisal Company, East Hartford, CT. Earlier, he had been a field supervisor for J.M. Cleminshaw Co., Appraisal Engineers, and an industrial appraiser and partner in the L.E. Thomas Co., Cleveland, OH. He belonged to SAE and the Elks. In World War II, he served with the U.S. Navy.

Robert W. Cook '49 died in Cape Cod Hospital, Hyannis, MA, on October 5, 1985, at the age of 61. The Boston native received his BSME from WPI.

From 1949 to 1958, he served as sales engineer for the Boston office of Minneapolis Honeywell. From 1958 to 1974, he was the New England Division sales manager for Gould Inc., an electronics manufacturing firm located in Cleveland, OH. During World War II, he was a second lieutenant and fighter pilot with the Army Air Corps.

George Crompton III, '49, of Chapoquoit Island, West Falmouth, MA, died December 17, 1985, at Falmouth Hospital following a long illness. The Worcester native was 64.

After attending Harvard University for a year, Mr. Crompton was drafted into the U.S. Army during World War II. As a corporal with an anti-aircraft battery, he took part in the Battle of the Bulge and the crossing of the Rhine River at Remagen. He was also at the Elbe in 1945, where the Allies met the Russians. In 1949, he received his B.S. in chemistry from WPI, and in 1951, his MS.

As a chemical engineer for Uniroyal Company of Naugatuck, CT, he went to the Malay Peninsula early in the 1960s. Later, he worked for Atlas Buchron Tire in Detroit and the Lord Chemical Company in Ohio. He was also chief chemist for Barry Controls, Watertown, MA. He belonged to Sigma Xi.

Tejinder C. Singh '50 of Bombay, India, died in a fatal car accident on August 29, 1985. A native of Rawalpindi, India, he was born on April 14, 1927.

Following graduation as a chemical engineer, he was with Koppers Co. Inc. for a year. After working for a year at Power Gas Corporation (U.K.), he joined Burman Shell, which he served as terminal manager in Bombay. At the time of his death, he was general manager of Bharat Petroleum Corp. in Bombay. He belonged to Pi Delta Epsilon and the AIChE.

S. Charles Kaplan '55SIM died September 12, 1985, at the University of Massachusetts Medical Center in Worcester. He was 73 and a native of Framingham, MA.

For 43 years, he was with H.H. Brown Shoe Company in Worcester. He retired three years ago as quality assurance superintendent. In the 1930s, he toured New England with the Dennison Company basketball team.

Mr. Kaplan, who belonged to Shaarai Torah Sons of Abraham Synagogue East, was a contributing member to the Jewish Home for the Aged.

Richard G. Edwards '59 died at Strong Memorial Hospital in Rochester, NY, on November 27, 1985, at the age of 50. Born in South Weymouth, MA, he was a graduate civil engineer.

He was a former supervisor for the Town of Nassau, NY, and a sales representative for the Ward Cabin Manufacturing Co. In addition, he had been employed as a civil engineer by the State Department of Transportation in Albany from 1959 until 1979, when he assumed the post of regional traffic engineer for Region 6 of the department.

During the Korean War, he served in the U.S. Army Signal Corps. He was a member of the local American Legion, the New York State Association of Highway Engineers, Sigma Phi Epsilon and the Poly Club.

George R. Barney '60 died September 30, 1985, in Nashua, NH. He was born in Whitefield, NH, on August 8, 1938.

He was a graduate of Wentworth Institute and had studied at WPI and the University of Rochester in New York. Early in his career, he was with Xerox Corp. At the time of his death, he was an engineer with Kollsman Instruments Co., Merrimack, NH. He belonged to the Nashua Lodge of Elks, had served on the Amherst Planning Board and was a communicant of St. Patrick's in Milford. He was a U.S. Army veteran.

Justin J. Kelley '63MNS, a Worcester native and chemistry teacher at Doherty High School, Worcester, died in November.

With the Worcester school system for 30 years, he retired in 1981. He had also taught science at Worcester Memorial Hospital School of Nursing.

Mr. Kelley graduated from Holy Cross College in 1950 and received a master's degree in education from Clark University in 1957. He belonged to the Education Association of Worcester and the MA Teachers Association.

Joan M. Shea '64MNS, a science educator, died December 7, 1985, at the Dana Farber Cancer Institute in Boston, following a long illness. She was born in Worcester and graduated from Our Lady of the Elms College in Chicopee, MA.

During her career, she worked at Cutler Laboratories in California and the Worcester Foundation for Experimental Biology, prior to teaching science at Millbury (MA) High School. She taught at Barnstable (MA) High School for many years, becoming the head of the school's science department.

She belonged to the Massachusetts Teachers Association, the National Education Association and the Barnstable County Education Association. She was a communicant of St. Pius X Church, South Yarmouth, MA.

Robert H. Jacoby '65, sales manager for Electro-Flex Heat Inc., died August 13, 1985, in Hartford, CT. He was 42, a native of Bridgeport, CT, and a graduate mechanical engineer.

Prior to joining Electro-Flex, Bloomfield, CT, he was a sales engineer with Superior Plating Co. in Fairfield. He served as an Air Force captain in Vietnam and was active in South Windsor (CT) youth baseball, hockey, football and soccer. He belonged to Phi Sigma Kappa.

Ernest Poulias '78, a native of Worcester, died October 16, 1985, in Hartford (CT) Hospital at the age of 30.

After receiving his BSME, he worked for Boston Digital in Hopkinton, MA. For the past five years, he was a manufacturing engineer at Combustion Engineering in Windsor, CT. He was a member of the Greek Orthodox Church.

Wilber C. Rathbun '85 died at the Park View Nursing Home, Providence, RI, on October 21, 1985. He was 22 and a Providence native.

A former electrical engineering student at WPI, he had worked part time in drafting and design for Matrix Inc., East Providence, for two years. Previously, he worked for Newport Creamery in Warwick, RI, and Worcester. He belonged to the Baptist Church.

Correction In the *WPI Journal* obituary of Harry P. Storke (February 1986), we mistakenly named Dr. Edmund T. Cranch as President Storke's successor. Dr. George W. Hazzard succeeded President Storke in 1969. Dr. Cranch succeeded Dr. Hazzard in 1978. Our apologies to all concerned.

THE LAST WORD

on the State of the WPI *Journal*

In 1987, the WPI *Journal* will be 90 years old. That's more than 400 times that news of WPI and its people has left Boynton Hill bound for all corners of the globe. In fact, at last count we are sending the magazine to readers in 74 nations. India ranks first in number of foreign readers, with Taiwan a distant second.

The August 1986 issue will part ways with one element of the magazine that has been a tradition for years and years. Here's what we plan, and why.

Commencing with the August issue, Class Notes, Completed Careers (obituaries) and News from the Hill will no longer appear in the *Journal*. How then, you may ask, will I get to read what I—and most other alumni—normally turn to first in the *Journal:* news of our collegemates?

Fear not. Eliminating that news altogether is the last thing we'd ever consider. But we think we've come up with a better solution for publishing the growing volume of class notes and campus news generated by all of you.

In July 1986, we plan to launch a new publication—a tabloid. Why? Because currently Ruth Trask, our alumni information editor, produces far more class notes—in both breadth and depth—than the *Journal* can now or in the future accommodate. As a result, for several years we've been struggling to lessen the backlog of class notes we've wanted to publish, but for which we simply haven't had the space.

The tabloid will enable us to expand our alumni news coverage. There will be more news and photos of more alumni. We'll be adding to the short profiles now offered throughout the pages of the *Journal* class notes section. We'll also be publishing much more in the way of campus news; faculty, student and staff profiles; alumni, campus and sports calendars; and the countless odds and ends that characterize, enrich and recall the WPI experience for all of us.

In short, the tabloid will provide a continuing, expanded chronicle of the WPI community for the benefit of alumni, parents and friends, as well as the current campus community, selected members of the media and other individuals.

But what of the *Journal,* you may be wondering. In the past few years, we've made a major effort to improve both the content and the visual appeal of the magazine. We've added pages, enabling us to paint with a finer brush a portrait of the initiatives, and the people behind them, that make WPI what it is today.

If you like what you've been reading in the *Journal*, we think you will be pleased with the "new" magazine. Removing alumni notes, obituaries and campus news from the *Journal* will simply provide more pages for the kinds of stories you've said in readership surveys you'd like to see. Each piece will reach you quarterly, to keep news and views current.

One other development to report: In conjunction with the changes I've described, WPI will conclude publication of *Newsbriefs*, the quarterly newsletter of the college. Much of the content of *Newsbriefs* will appear in the tabloid in expanded form: faculty and staff appointments and promotions, student project profiles and news of the campus community.

Both the Alumni Publications Committee and the Executive Committee of the Alumni Association endorse these changes. My thanks especially to William J. Firla '60, Publications Committee chair, and the Committee members for their time, efforts and encouragement on behalf of our plans.

We view these changes as an integrated opportunity to *enhance* our ability to communicate to WPI's many publics the news of an organization and its people that are constantly on the move, a dynamic community of 16,500 alumni and more than 6,000 students, faculty and staff that is helping society reach for the next frontiers of science, engineering and management.

We're excited about all this, and we look forward to sending the first issues of our "new" quarterlies later this summer.

Meanwhile, why not use the coupon on page 57, joining so many of your classmates who regularly apprise us of what's new with them. You'll be in *great* company!

Kenneth McDonnell

Kenneth L. McDonnell
Editor

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1 · 9 · 8 · 6

J · U · N · E · 5 – 8

1926, '31, '36, '41, '46, '51, '56, '61, '66

Institute Day, June 7, Theme—
BIOTECHNOLOGY:
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WPI Journal

WORCESTER POLYTECHNIC INSTITUTE

AUGUST 1986

A MESSAGE FROM THE EDITOR

At the Inauguration of her husband as 13th President of WPI on May 10, Jean Strauss receives a bouquet of roses from Jeanne Benjamin, representing the Class of 1986.

The Inauguration

Inaugurations are not everyday occurrences on college campuses. Prior to the investiture of Jon C. Strauss as WPI's 13th president on May 10, we hadn't witnessed an inauguration since 1978, when Edmund T. Cranch took the oath of office. And it was another nine years before that that George W. Hazzard was inducted as eleventh president.

So an investiture is a major event for the entire campus and the extended WPI community. For besides the pomp, circumstance, and celebration of the occasion, the event offers us a moment to reflect on the importance of the college president as defender and preserver of a mission and a way of life that is today threatened as never before.

We call upon our college presidents to wear a growing number of hats. One is that of financial acrobats, balancing a multitude of budgets and behaving like Wall Street tycoons while serving as their institutions' key breadwinners.

At a college the size of WPI, my fund-raising friends tell me, everyone wants to see the president. Straight to the top. So the president must also don the hat of the institution's front-line spokesperson. He or she must fill the role with tact, in public and in private, and be still more tactful as traffic cop, referring some visitors to the "proper channels."

I once saw Edmund Cranch field a phone call from an irate neighbor of a fraternity after the main switchboard had closed on Friday afternoon. Hanging up, I heard him mutter, in good humor, to no one in particular, "They never told me about *this* part of the job."

Then there's the celebrity hat. One Drury Lane is as much a place for gracious entertaining as it is the residence of the presidential family. In their first year at WPI, now completed, Jon and Jean Strauss have become acquainted with hundreds of alumni, friends, faculty, and staff members and their spouses over luncheon, dinner, and hors d'oeuvres at One Drury Lane. Nothing unusual here. It goes with the territory.

Meanwhile, back on campus, we expect the president's mortarboard to fit with nary a lock of hair askew. He or she ought to both set the academic agenda for the institution and be ready to articulate and defend the priorities of this mission before all who would seek to enfeeble it.

In short, it would appear that the president must be all things to all people. But with a mere 24 hours in the day with which to perform the miracles expected of him, it's a wonder anyone would want the job at all—let alone excel in it. It ain't for the money, any college prexy will assure you.

But a handful of institutions are fortunate—or clever—enough to attract presidents who seem to respond to the challenge of the job with the vigor of thoroughbreds, persons who *have* developed the capacity at least to appear to be all things to all people.

Yet it's been neither fortune nor sleight of hand that has enabled WPI to remain a member of this elite group of institutions: capable of attracting the leadership and vision we found in George Hazzard, in Edmund Cranch—and now in Jon Strauss. These matches and those before them—between the personal character of the president and the heritage of a great institution—are by no means accidental. They are earned, by both sides.

A Word About the *Journal*

No, your copy of the *Journal* is not missing pages—at least not pages that might contain Class Notes. As we announced in the May issue, we have simply moved Class Notes and obituaries—not to somewhere else in the magazine, but to a new publication, to a tabloid we are calling *The Wire.*

We assume that by now you have received your copy of *The Wire.* If not, we'll be a little embarrassed but more than eager to send you a copy. Published quarterly, *The Wire* contains lots more news of alumni than we could sardine into the *Journal,* plus more news from the Hill, profiles, special features, campus and alumni calendars, sports, and opinion, as well as alumni and president's annual reports. And more.

Meanwhile, we have given the *Journal* a minor facelifting. We hope you notice and like the changes—both in this magazine and in launching *The Wire.* Please, let us hear from you—your opinions, your news, or just to say hello. And thank you for your support and encouragement.

Kenneth McDonnell

Kenneth L. McDonnell
Editor

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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, Hartwick College, Johns Hopkins University, Villanova University, Western Maryland College, Worcester Polytechnic Institute) and appear in the respective alumni magazines of those institutions. Second class postage paid at Worcester, MA, and additional mailing offices.
Staff of the Alumni Magazine Consortium: Editor, Mary Ruth Yoe • Wrap Designer and Production Coordinator, Amy Doudiken • Assistant Editor, Leslie Brunetta • Core Designer, Allen Carroll.
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Acknowledgments: Typesetting, BG Composition, Inc.; Printing, American Press, Inc.

 Address correspondence to the Editor, The WPI Journal, Worcester Polytechnic Institute, Worcester, MA 01609. Telephone (617) 793-5609. Postmaster: If undeliverable please send form 3579 to the address above. Do not return publication.

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Cover: In an Atwater Kent laboratory, Professor Peter Green and Stephen J. Oullette '86 discuss the design of a sensing mount for the yet-to-walk Mobil Robot, one program under way by the WPI Artificial Intelligence Research Group. Story on page 10. Photo by Michael Carroll.

Ten Months Late—but, Oh!

"You may be assured that your trust will not be misplaced."

With these words, Jon Calvert Strauss accepted the charge of Howard G. Freeman '40, trustee chairman, to serve as 13th president of WPI.

It had been 121 years on May 10—Charter Day and the Inauguration—since the Institute's Charter from the Commonwealth of Massachusetts had been recorded in the secretary of state's office, creating the school known in 1865 as the Worcester County Free Institute of Industrial Science.

And as President Strauss noted in his inaugural address (text begins on page 4), he had already served more than 10 months as president. The reason for an inauguration this late, he quipped, might have been to give the trustees and the faculty opportunity for second thoughts. "If there are second thoughts now," he said, "we'll have to schedule a *de*nauguration."

It's difficult to imagine a more splendid day for one of WPI's most memorable events. Not known for its predictability in the spring, the weather was ideal—crisp sunshine with temperatures around 70.

The investiture was a family affair, since it capped a three-month tour by Jon and Jean Strauss to acquaint themselves with hundreds of alumni in some 20 cities nationwide. In fact, a healthy proportion of the 500 attendees to the inaugural ceremony were Worcester County alumni, who had been invited to the Inauguration—in a sense, their event on the tour.

In his address to his attentive Alden Memorial audience, Strauss echoed the words of WPI's sixth president, Ralph Earle: "The state of the college is excellent, but of course it can never be even satisfactory, for if we stop progressing or changing, we will atrophy."

Today, in the sciences and engineering, Strauss said, with the half-life of technical knowledge less than five years, it is even more imperative in 1986 than it was 50 years ago that WPI continue to evolve in order to avoid the atrophy which President Earle so prudently cautioned against. He went on to outline a strategy for moving WPI toward the 21st century.

The day-long Charter Day and Inauguration began with a symposium in the morning. Richard H. Gallagher, vice president and dean of the faculty, moderated as three experts addressed the many issues contained in the relationship between "Scholarship and Technology."

Sharing the Alden Memorial stage with Gallagher were Joan T. Bok, chairman of New England Electric System; J. Wesley Robb, professor of religion at the University of Southern California; and David S. Saxon, chairman of the Corporation of Massachusetts Institute of Technology. After individually addressing the audience on an element of the larger topic, the trio fielded lively and at times provocative questions from each other and from members of the audience. (Excerpts from each panelist's address appear on page 7.)

Following a relaxing luncheon in Harrington Auditorium for the hundreds of invited guests, the assemblage returned to Alden Memorial for the balance of the business at hand.

They were greeted by a trumpet fanfare, performed by the WPI Brass Choir, under the baton of Douglas G. Weeks. This served also as the cue for the stage party, trustees, faculty members, and visiting representatives of other academic institutions to make final adjustments to their regalia in preparation for the colorful academic procession. Led by honorary marshal David Cyganski, associate professor of electrical engineering, the procession handsomely replayed the centuries-old tradition honored around the world.

J. Wesley Robb, who in

What an Inauguration.

Photos by Robert S. Arnold

Jon and Jean Strauss emerge from the investiture to a throng of well-wishers.

June 1985 had presided at the wedding of Jon and Jean Strauss, offered the invocation. Following the National Anthem, James P. Hanlan, associate professor of history, gave perspective to the Charter Day observance with an address on the early days at WPI and how those times helped create the WPI of today. (See the text of Professor Hanlan's talk on page 8.)

Greetings and expressions of good wishes to the Strausses were next, from Kevin J. Szeredy '87, Student Government president; from Paul W. Bayliss '60, Alumni Association president; and from John B. Anderson, Mayor of Worcester. The greetings of Messrs. Bayliss and Anderson appear on pages 3 and 9.

Following a musical interlude by the combined Men's Chorus and Women's Chorale, under the direction of Professor Louis J. Curran and Malama Robins, respectively, and accompanied by the Brass Choir, Jean Strauss offered her thoughts on "The Fabric of the Community." The reflections on WPI and Worcester by this transplanted native Californian were revealing both of her sensitivity and of her enthusiasm for her adopted community.

Presiding over the investiture was Howard G. Freeman '40, chairman of the Board of Trustees. Assisting were Helen G. Vassallo, associate professor of management and of biology and biotechnology, who presented to Dr. Strauss the Charter of WPI; and Paul W. Davis, professor of mathematical sciences, who placed the ceremonial medallion over Strauss' head, signifying the presidency of the Institute. Also seated on the stage were Presidents Emeriti Edmund T. Cranch, Strauss' immediate predecessor; and George W. Hazzard, who served from 1969-78; as well as Dean Richard H. Gallagher.

After Dr. Strauss' inaugural message and a second musical interlude, Reverend John E. Brooks, S.J., president of the College of the Holy Cross, gave the benediction. Then, in reverse order to the procession, the stage party and gowned members of the audience marched out of the hall, much as they had entered earlier, but now with a sense that, once again, the circle had been completed.

As the day drew to a close, a reception at the lovely Higgins House property offered to all in attendance the opportunity to bid Jon and Jean Strauss personal best wishes for the months and years ahead.

The late afternoon sunshine of that day in May—ideal not only meteorologically but in the spirit of the event as well—through the tall pines and hardwoods of the Higgins House lawn brought to a festive conclusion one of WPI's most momentous events in a long time, and one that WPI's first—and extended—families will not likely soon forget.

Greetings

From Paul W. Bayliss '60, President, WPI Alumni Association

Dr. and Mrs. Strauss, Distinguished Guests, Trustees, Faculty, Students, Fellow Alumni, and Friends. I'm honored to represent the more than 16,000 alumni whom you, Jon, have placed such emphasis on addressing.

Shortly after you got here, you joined the President's Advisory Council. (I guess we couldn't keep the president out of the President's Advisory Council, but we did appreciate the money.)

You also joined us in addressing the Alumni Council and were elected to honorary membership in the Alumni Association. And you undertook an extensive tour of the country, visiting more than 20 cities to meet with alumni, reaching from Boston to Los Angeles, from San Francisco to Tampa.

It was my pleasure to participate with you in a portion of that tour. During that tour I heard you challenge us to take pride in the excellence of this institution, which is our common heritage, and to be vocal and active in expressing that pride.

I want to assure you that your challenge will not go unheeded. I pledge the support of the Alumni Association in working for the betterment of the college, its faculty, students, and alumni.

Therefore, on behalf of the Alumni Association, I extend to you our welcome, our best wishes for your continued success, and our thanks for placing such importance on the words, "the WPI family."

Scholarship:
The Vital Link

The Inaugural Address of Dr. Jon C. Strauss

Chairman Freeman, trustees, distinguished guests, alumni, faculty, students, friends, and particularly my two predecessors Ed Cranch and George Hazzard—thank you for joining Jean and me on this important day for us and for WPI.

Ladies and gentlemen, today I will develop the thesis that enhancement of scholarship will be the vital link in moving Worcester Polytechnic Institute from being known in engineering circles as a very good school to being recognized nationally for the excellence of our teaching, our scholarship, and our graduates.

It seems almost anticlimatic to be inaugurated today as the 13th president of WPI after having already served in that capacity for more than 10 months. Jean and I have now participated in a year's worth of trustee meetings, have recruited a new class, have led one graduation and are about to lead another, and we have seniority over 25 percent of the students and some 10 percent of the faculty. Why then an inauguration now?

Early on, as the trustees, my senior faculty colleagues, and I discussed how best to make the inauguration meaningful and effective, we decided that we needed a different model. All too often college inaugurations are characterized by crowds of representatives from other institutions garbed in academic regalia, caught up with the pomp and circumstance of the occasion, but with little understanding of the institution and the reason for the ceremony.

We felt that this inauguration should be different; it should celebrate WPI for what it is and what it can, and will, become. Moreover, it should be a celebration for those who have a direct stake in WPI: our trustees, faculty, students, alumni, friends, and the direct academic community.

Recognizing that many of these members of the extended WPI family would not be able to attend a celebration in Worcester, we scheduled the inauguration in late spring to provide sufficient time for Jean and me, as well as key members of my staff, to travel across the country carrying the inaugural message to our extended family. The spirit of our celebration today has been shared from San Francisco to Washington, DC, from Tampa to Detroit, with alumni from the Class of 1918 to the Class of 1985, and with many friends, parents, corporations, and foundations. The only thing missing in these many meetings was our academic regalia. And, of course, the free lunch.

Another reason for scheduling the inauguration this late in the year might also have been to give the trustees and faculty opportunity for second thoughts. Not surprisingly, they didn't share that notion with me. Regardless, we appear to have passed that hurdle. If there are second thoughts now, we'll have to schedule a "denauguration."

In addition to the inauguration, today we celebrate the 121st anniversary of the signing of our charter. It was just after the Civil War that our founders established WPI, then the Worcester County Free Institute of Industrial Science. The school was created to serve the needs of a rapidly growing Worcester with particular emphasis on Worcester industry. This emphasis was captured in the German phrase in our coat of arms: *Lehr und Kunst*—Learning and the Skilled Arts and embodied in the original Two Towers—Boynton Hall for academics and Washburn Shops for practical learning.

The "Two Towers" tradition has, of course, evolved over the years, adapting to changes in both society and technology. Both the United States and the world of today are vastly different from the years of Reconstruction when WPI was conceived. Even though our civilization has been transformed, WPI today is still characterized by a strong academic program closely aligned to the real work of the world. Our unique, project-oriented undergraduate curriculum, the WPI Plan, prepares young men and women for careers of leadership in engineering, science, and management with an effectiveness only aspired to by peer institutions. Moreover, our faculty and students still test the relevance of their academic work not only with Worcester industry, but with the real problems of industry and society the world over.

The Nobel Laureate, Albert Camus, once noted, "An achievement is a bondage. It binds one to a greater achievement."

WPI, too, is bound to its past achievements. The standards of the college today present exciting challenges for the future. And, as we build upon the achievements of the past and present, *scholarship* will be our vital link.

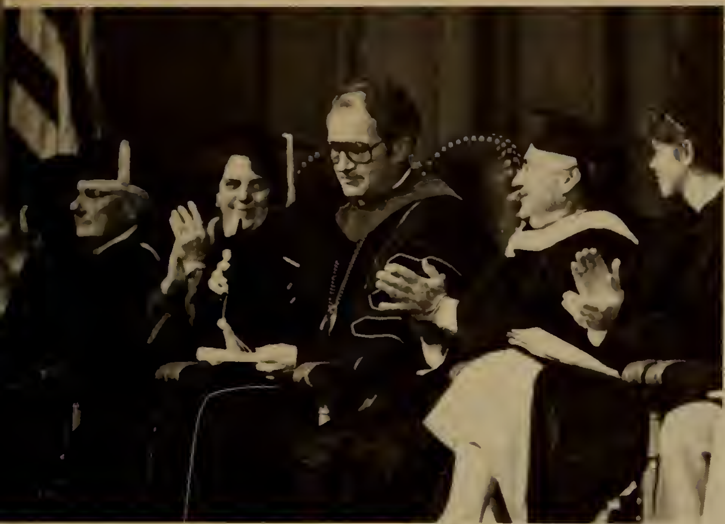
When I mention scholarship, many will assume that I am looking to a WPI modeled after such research universities as MIT, Harvard, and Stanford. While such an outcome would hardly be undesirable—that is, after all, pretty exciting company—that is not the future that I or our faculty envision for WPI. Rather, we see our primary emphasis continuing to be the enhancement of our extraordinary undergraduate program.

However, to do that well, our faculty must be excited about the world of ideas and convey that excitement in their teaching. To teach well, one must love to learn. Faculty transmit that love of learning, that excitement for ideas, in every interaction with students. That love of learning and that development of ideas, their presentation to others verbally and in writing, and their defense before one's peers is what I mean by scholarship.

I am indebted to my colleagues, Joan T. Bok, chair of New England Electric System and president of the Harvard Board of Overseers; David S. Saxon, chairman of MIT; and J. Wesley Robb, professor of religion at the University of Southern California, for joining us this morning and sharing their views on scholarship. You will find them to be in accord with my message this afternoon. (See page 7.)

It is the mission of a college to create and disseminate knowledge, and the faculty is the backbone of that mission. Enhancing the environment for scholarship at WPI is the foundation of our strategies for the future.

This thrust for renewal and advancement is, of course, nothing new. In 1935, Ralph Earle, WPI's sixth president, captured an important element of my message today when he noted, "The state of the college is excellent, but of course it can never be even satisfactory, for if we stop progressing or changing, we will atrophy."



WPI's 13th president following his inaugural address.

As in 1935, the state of the college in 1986 is indeed excellent as demonstrated by the following observations:

• Our curriculum, the WPI Plan, is recognized as one of the most innovative and appropriate of any, with particular kudos for the articulateness, communication and problem-solving skills, and confidence of our graduates.

• Our faculty members come from first-rate institutions, have demonstrated excellence in teaching, and are improving their recognition for scholarship and research.

• Our students are independent, well-motivated, and score very well on national scholastic tests.

• Our staff is loyal and hard-working.

• Our alumni are generous of both their time and their financial support and are justifiably proud of their alma mater.

• Our trustees are excellent stewards of the college both as a corporation and as a living institution.

• Local and national foundations and corporations as well as many individuals are very generous in their support of the college.

• Our physical plant is first-rate. Many of the buildings are old, but all have been renovated and maintained to the most modern standards.

• Our finances are in very good shape: borrowing is low, and the endowment of almost $70 million is quite respectable for a college of our size.

However, with the half-life of engineering knowledge now estimated to be less than five years, it is far more imperative in 1986 than it was in 1935 that we not consider this status to be satisfactory. To avoid the atrophy of which President Earle warned, Dick Gallagher, our dean of faculty, and I are working with the deans, department heads, and faculty to develop our strategies for excellence for the future WPI. These strategies are not final, and, of course, in the spirit of President Earle, they never will be; they must continue to evolve.

Five key strategies, which should work for us for some time, are as follows:

Identify existing strengths.

The WPI Plan is a major strength. The curriculum is outcome oriented by design; and the outcomes—our graduates—are absolutely first rate. The Plan stresses the importance of quality teaching, and our faculty has responded to that challenge.

In a recent study, the American Management Society found that American industry was seeking graduates with the abilities to:

Appreciate cultural differences,
Organize work into doable tasks,
Relate ideas from different areas,
Work in teams to solve problems, and
Maintain currency into the future.

Interestingly, when one looks at not only the objectives of the WPI Plan but also its actual accomplishments, one could not find an educational protocol better designed to develop these abilities. Moreover, there are many areas of excellent scholarship at WPI today, at least one in each department and several in some. Without meaning to be exhaustive, a list would have to include the following areas of excellence, so worthy of acknowledgment:

- Gene structure and function in biology
- Non-invasive sensors and physiological modeling in biomedical engineering
- Catalysis and biochemistry in chemical engineering
- Photochemistry and spectroscopy in chemistry
- Construction management in civil engineering
- Artificial Intelligence in computer science
- Image processing and power systems in electrical engineering
- Analytic design in fire protection engineering
- History, music, and ethics in humanities
- Information systems and manufacturing in management
- Robotics in manufacturing engineering
- Applied mathematics in mathematical sciences
- Computational mechanics, fluid dynamics, laser holography, and materials in mechanical engineering
- Optics in physics
- Policy analysis in social science

What's particularly exciting is that in those areas we are absolutely first rate.

Reinforce existing strengths with resources.

Stanford University refers to such areas of strength as "Steeples of Excellence." Stanford's rise to preeminence following World War II was based on a strategy of identifying these "Steeples of Excellence," building on those peaks with additional faculty and resources, and then filling in the valleys between peaks starting where the synergy was greatest. This strategy worked well for Stanford. It will work even better at WPI.

Encourage faculty to improve personal scholarship.

The faculty members who comprise the areas of excellence I have mentioned all have active personal scholarship, here oriented toward research. Many other of our faculty, not as well known for research, also have active scholarship oriented in many instances toward professional practice and education. We may not all be sponsored researchers, but as members of the academic community we all should be scholars. Scholarship, in whatever is our major interest, is our common ground; it is what binds us together.

James Freedman, president of the University of Iowa, recently captured the excitement of scholarship when, writing in the *Chronicle of Higher Education,* he stated,

"The reward that animates every scholar is the joy of discovery—the satisfaction of finding out what no one else

knows and of making that knowledge available to others. At the heart of that joy is the sublime delight of getting something absolutely, unmistakably right. *That is the joy that laboratory scientists feel when they devise an experiment that not only works the first time, but that can also be flawlessly replicated and verified by others. That is the joy that mathematicians feel when they know that their colleagues will recognize their theorems and proofs as* 'elegant.'

"Presidents as well as professors must understand that the measure of the scholar's thought is the source of a university's vitality and the standard by which it must judge itself."

Improve student recruiting.

WPI offers an excellent education, with demonstrable outcomes at a competitive price. Prospective students and their families recognize this well for we have just recruited the largest and most talented freshman class in our history. However, the number of high school graduates is going to decline by more than 40 percent during the next decade in the Northeast (more than 20 percent nationally). Consequently, we at WPI must increase dramatically our market share in order to maintain enrollment and to continue to enhance student quality.

This strategy of increasing market share is unassailable until one finds that the strategy of virtually every other of the 3,500 colleges and universities in this country is exactly the same. Obviously, we can't all succeed. WPI, however, has a unique advantage—the WPI Plan. The Plan is not for everyone. To succeed, students must be independent, self-motivated, and industrious. For those, however, WPI is exactly right.

To provide perspective on this enrollment challenge, as well as to develop specific strategies for the future, I have recently chartered an enrollment task force with representation from the trustees, the faculty, the students, and the alumni bodies. This task force is now considering strategies to assure that our product is specified properly, delivered superbly, packaged appropriately, and presented to the right audience. Part of these strategies will surely involve greater participation by faculty, alumni, and students in student recruiting; for no one can present the excitement—and advantages—of WPI as well as those who are involved directly. As this work continues, I am confident that WPI will join that small group of select, high quality institutions that weathers this demographic storm with the desired enrollments of increasing quality.

Improve our recognition.

WPI, like Worcester—our home and partial namesake—is not as well-known as our quality deserves. We have here something of a "chicken and egg" situation. To secure the resources we need to develop the programs and recruit the faculty and students necessary to maintain and enhance our reputation for quality, we need to be better recognized.

We believe that with your help and the proper implementation of the strategies I've outlined, we can break what appears to be a closed loop and turn it into an expanding spiral of greater quality, leading to greater recognition, leading to greater resources, and so on. It is the case that individuals, foundations, and corporations do not give to abject need; rather they invest in projects they consider to be relevant, performed by people and institutions they recognize and respect. Recognition, in all its facets, is a key element of our future strategies. But, recognition begins at home! Others will not recognize our quality for what it is, and will become, until we do so ourselves. We all have a stake in the outcome and a major role to play in improving our recognition.

We are about to embark on a major fund drive to raise the resources necessary to implement the strategies for excellence that I have outlined here today. While today is not the time for fund raising, we hope and expect that all members of the WPI family will join us in this effort to make WPI all that it can be.

Here we are, talking once again about change as we so often seem to do in higher education. One thing that is so exciting about our profession, however, is that the more we adapt to the changing needs of society, the more we stay the same. This observation is well supported by noting that of the 66 institutions in the western world that have survived in essentially their same form since the time of the Reformation in 1530, 62 are universities. The other four are the Catholic Church, the Lutheran Church, and the Parliaments of Iceland and the Isle of Man.

These are demanding, yet exciting, times for WPI. When WPI was chartered 121 years ago, Alexander Bullock, then governor of the Commonwealth, noted, "This school comes to us at the right time." Being "right" in 1865 was but a precursor for being "very right" in 1986. Our ability to ignite new enthusiasm for scholarship will be the link to insuring our being "even more right" for the future.

John Naisbitt, author of *Megatrends*, notes, "The old Taoist formula for leadership was to find the parade and get in front of it."

In what I have shared with you today, you will note my strong personal affinity for this formula for leadership. You, members of the extended WPI family, make up an exciting "parade" toward an exciting and productive future for WPI. It is Jean's and my pleasure and privilege that you have asked us to "get in front of this parade."

Therefore, Chairman Freeman and fellow trustees, it should come as no great surprise that I formally accept the charge you have given to me.

You may be assured that your trust will not be misplaced.

***The combined choral and brass choir groups performing Handel's* Let Thy Hand Be Strengthened.**

Three Voices Unite

Charter Day's Inauguration was more than an investiture. At a Saturday morning symposium, with Richard H. Gallagher, vice president and dean of the faculty, moderating, three experts brought their experience and views to bear on the issues surrounding the topic, "Scholarship and Technology."

Before opening the discussion to questions from the standing-room-only Alden Memorial audience, each panelist addressed a portion of the larger theme. Here are excerpts from that forum.

Symposium participants (L. to R.) were moderator Richard H. Gallagher, vice president and dean of the faculty; and panelists David S. Saxon, chairman of the Corporation, Massachusetts Institute of Technology; Joan T. Bok, chairman, New England Electric System; and J. Wesley Robb, professor of religion, University of Southern California.

Is scholarship relevant to today's industry? *Joan T. Bok, chairman, New England Electric System.*
Scholarship is indeed relevant to the needs of industry. For industry to fulfill its role of providing goods and services—and doing so in a way that we hope will make a profit—industry needs the development and application of new technologies, and the people who can understand and use these new technologies in socially feasible ways. Our universities, in turn, have a role in preparing students for these roles; and academe needs enlightened, socially-aware faculties.

In my industry, for example, we are faced with solving problems in an imperfect world. We need problem solvers who have an appreciation of nontechnical issues—of history, culture, the political aspects of society, and of the humanities. Although the mission and cultural environments of academe and industry may differ, our common purpose is the same: to serve our fellow man.

It is scholarship at our engineering and science institutions that will largely determine the technological advances on which industry will capitalize in tomorrow's world. It is here, too, that the bright, creative men and women must be prepared to deal with technological issues in the broad social context.

Are scholarship and technology compatible?
J. Wesley Robb, professor of religion, University of Southern California.
Unless there *is* compatibility, technology can be a negative force, especially if it stands alone without the moral insight, understanding, and sensitivity that the scholarly temper should bring to the applied sciences.

So little in the educational process addresses where we fit into the nature of things. Too often, this assessment is left to the conventional and often unexamined beliefs we have been conditioned to accept.

I am convinced that what modern persons need is an attitude that respects other disciplines and approaches to knowledge. This involves what Einstein once called a "holy curiosity," which is always seeking a more enriching and complete understanding of ourselves as human beings.

Is scholarship necessary in today's technological education? *David S. Saxon, chairman of the Corporation, Massachusetts Institute of Technology.*
Today, science is our great intellectual adventure. No educated person can afford to be ignorant of the character and limits of science. Yet scientific and technological illiteracy is so pervasive that the great majority of otherwise intelligent, educated, inquisitive people are quite unable to bring informed judgment to bear on almost any question connected with science and technology. Most rely instead on the testimony and assertions of others. If this pervasive illiteracy is to be addressed, it places clear and heavy responsibility on the kind of education our liberal arts colleges and comprehensive universities offer students.

I am more than a little uneasy at the prospect of a future which could depend on experts too narrowly trained, on mere technicians, on people who are less broadly educated than they are capable of being, on those who don't understand that knowledge must be tempered by wisdom, on those who believe that all problems have solutions.

The best scientific and technological preparation is broad, not narrow, and certainly not merely vocational. Over the half century that lies ahead for today's students of science and engineering, their knowledge of the arts, philosophy, and history will prove more valuable than the purely vocationally oriented courses in differential equations or computer science which these students are too often advised to take.

WPI's requirement that each student complete a Sufficiency in the humanities is well designed to overcome the attitude too prevalent in science and engineering that nonscientific thinking is somehow second rate or inferior.

Charter Day:
WPI at the Beginning

An Inaugural message from James P. Hanlan, Associate Professor of History

One hundred twenty-one years ago today—on May 10, 1865—the institution that we know as WPI came into existence when the school's Charter from the Commonwealth of Massachusetts was recorded in the secretary of state's office. The Charter had previously been passed by the House on May 6 and passed by the Senate and signed by the governor on May 9. That Charter, which will today be both physically and symbolically entrusted to Jon Strauss, authorized the establishment of

an institution to aid in the advancement, development, and practical application of science in connection with arts, agriculture, manufactures, mercantile business, and . . . other kindred branches of practical education.

WPI was then known as the Worcester County Free Institute of Industrial Science. As the name implied, tuition was free to residents of Worcester County. Others paid $60 per year. The institution was begun as a result of the generous offer of John Boynton, who set aside $100,000 to establish a school in which young people could acquire understanding of the "principles of science applicable to mechanics, manufacturers, and farmers."

Boynton's offer had one significant string attached. He required that the citizens of Worcester provide land and a building for the new school. The citizens of Worcester did so, raising initially $63,000 to get the school off the ground and followed that fund-raising effort with many others over the years—usually spearheaded by prominent Worcester citizens, many of whose names we see on buildings around the campus.

John Boynton's vision was that of the traditional academy with stress on the scientific. His vision was not shared by Ichabod Washburn, a prominent local manufacturer who saw the value of schooling but stressed the practical application of learning.

As construction proceeded on the granite building that would come to bear Boynton's name, an adjacent building went up, paid for entirely by Ichabod Washburn and constructed of strong, common-sense brick. Washburn's building would be designed for shops to assure the inclusion in the curriculum of the practical learning that Washburn so valued. These two buildings would come to symbolize the school's recognition of both the theoretical and the practical aspects of education.

By 1868, the two buildings were completed, and the Worcester County Free Institute of Industrial Science was ready to accept its first class. The trustees had hired Charles O. Thompson as the first president—they called him principal—and a fledgling faculty had been recruited. Advertisements were placed, and young men aged 14 to 21 were invited to take entrance examinations in mathematics, geography, and the history of the United States. As a result of these examinations, 32 young men were admitted to study mechanical engineering, civil engineering, physics, chemistry, drawing, French, German, and English.

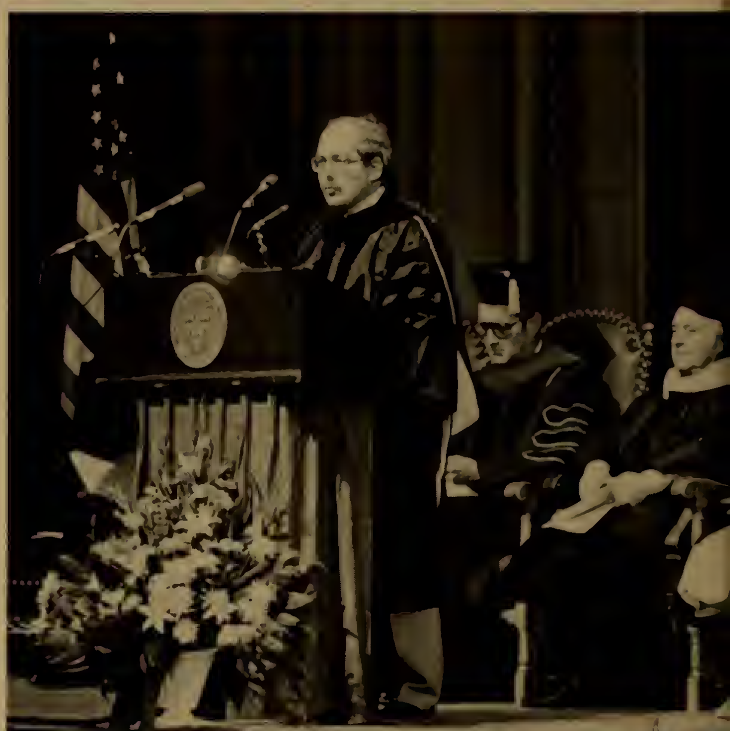
To Charles Thompson and his faculty fell the task of instruction. There are two ways to view the tasks facing Thompson. The optimist's view holds that Thompson, who himself carried a full teaching load as professor of chemistry, undertook an ambitious and energetic program with a faculty of four capable men and one equally capable woman.

I must admit, however, that not all historians are optimists. One pessimistic view described Thompson as aided only by his sister-in-law, a young instructor (and "young" was not intended as a complimentary term here), and a part-time artist. If this particular historian meant to cast aspersions with the term "young," I shall leave it up to you what was intended by the term "artist."

As WPI's first president, Charles Thompson did his job well under difficult circumstances. There were never sufficient funds, the faculty was overworked, and the equipment and library facilities were sorely lacking. Curiously enough, there is no record that Thompson complained about or apologized for anything—with one exception. He did express disappointment that inadequate facilities did not allow for the admission of women. Thompson promised to admit both sexes "as soon as possible." But, as we all know, it would be over 100 years before WPI would admit women.

The trustees made sure that Thompson and his faculty did their jobs. On what we are told was an unbearably hot day in July of 1871, the new school held its first graduation ceremony. A future WPI president whom I shall decline to name tells us that 15 young men "suffered through the interminable tortures of a graduation exercise which lasted all day."

The morning was taken up with each graduate reading his entire senior thesis at a program to which the public was invited. Each young man was then publicly examined by com-



History Professor James P. Hanlan recounts WPI's beginnings.

mittees of the Board of Trustees who also saw to it that the first graduates were put through, and I quote the same future president here, "other proper and exacting ordeals to prove beyond a shadow of a doubt that each was fully qualified for his degree."

When WPI came into existence the United States was, as described by one prominent historian, "a second-rate industrial country with industrial production considerably less than that of England and probably less than that of France and Germany as well." By 1890 U.S. industrial production would almost equal that of England, France, and Germany combined. Only slightly more than 1.5 percent of college-aged young people attended college when WPI began, and there were, indeed, only 563 colleges in the country.

Worcester, in 1865, was a community of 30,000 people poised on the edge of a great expansive growth. It was served by seven railroads and had a broad and varied industrial base. Worcester was, or would become, a city of some importance in the production of wire, in manufacture of machinery, in the machine tool industry, in carpet weaving, in abrasives, and in a variety of other industrial fields.

By the time Charles Thompson left WPI in 1882, both the college and the city had prospered. The college would boast a faculty of eight professors, two assistants, and a number of lecturers varying between one and 11. The mechanical engineering program had grown to a three-and-a-half-year program, and the school boasted of four classes totaling 123 students. Five hundred twelve students had attended the school under its first president, and 207 had graduated. The college catalog had grown to 69 pages and, as college catalogs are wont to do, included accounts of many esoteric aspects of college life. My own two particular favorites are the sample entrance exam question: "Name the nouns in this sentence and state the case of each"; and an advertisement for the products of the Washburn Shops which offered "the patented improved adjustable [lecture] stand" which was proclaimed as "substantial, ornamental, convenient, and cheap." And, I might add, still in use.

The college catalog for the year Thompson left WPI gives us some idea of the extent to which the Institute's first president succeeded. Some of the school's graduates, we are told, had gone to graduate school, some had become senior engineers, some had become plant foremen, some had become partners in business firms. More than 95 percent of the school's graduates were actively engaged in the occupations or professions for which they had been educated.

There remained, and would remain for many years, some tension between the ideal of Boynton and the ideal of Washburn—that is, between the theoretical and the practical. The catalog tells us that the school was a place where the best tradition of the academy and the best tradition of the shop combined: "The academy inspires its intelligence into the work of the shop, and the shop, with eyes open to the improvements of productive industries, prevents the monastic dreams and shortness of vision that sometimes paralyze the profound learning of a college."

By the turn of the century, the school had become known as WPI and had enjoyed considerable growth in educational sophistication as well as in numbers of faculty and students. There was no longer a backhanded apology for the purely academic aspect of learning. The senior theses of 1900 give some idea of the growing respect for scholarship and learning. Senior theses ranged from the highly technical ("Oxidation of Sulfides to Sulfates by Oxygen and Metallic Oxides," by a chemistry student, and "The Dielectric Strength of Oils Under High Potential Stress," by an EE student) to the political and societal ("Ratification of the Federal Constitution in Worcester County," and "The Establishment of the Industrial Training and Technical High School for the City of Indianapolis, Indiana").

The WPI of today is in many ways different from the school in its earliest years. WPI now enjoys a large and learned faculty of devoted scholars and teachers. We enjoy a capable and hardworking support staff. We enjoy a diverse, bright, and energetic student body. We enjoy the support of loyal and generous alumni and benefactors. We enjoy first-rate facilities and an attractive campus. We enjoy all of this because of the rich heritage passed down to us.

We look forward today to entrusting this heritage to Jon Strauss. We wish him success, just as WPI's first president enjoyed success. We wish him the vision and the energy of his predecessors. We wish him faith in the school and, perhaps more importantly, faith in the future.

We look forward to his innovative leadership as WPI continues a long tradition of excellence in scholarship, in teaching, and in service.

Welcome to Worcester

From John B. Anderson, Mayor of the City

Distinguished Guests,

What a pleasure it is for me to extend the greetings of the City of Worcester and the people of Worcester on this happy occasion.

We celebrate the inauguration of WPI's new President, Jon Strauss, and in doing so welcome another in the line of distinguished educators to this institution.

Jon Strauss, your career has been that of a traveler and learner. You have gone from Midwest to East and to Europe and to the Far West and now to New England. You have mastered electrical engineering and computer science and that more obscure science of university budgets and administration. You have built a career that is a model of those words *Lehr und Kunst* (Learning and Skilled Art) which are WPI's motto. You are strikingly at home here.

And so, too, is WPI. We in Worcester rejoice that this institution carries our name for it is so much a Worcester institution—not in any limiting sense, but rather in the sense that like WPI, Worcester is a place of learning and skilled arts; and like WPI, Worcester is growing and changing and addressing new areas of inquiry while retaining our values. WPI's college halls are a litany of Worcester's rich history of learning and skilled arts: Alden, Higgins, Fuller, Washburn, Morgan, Daniels, Harrington, Salisbury, Stoddard. WPI and Worcester share dozens of elements of intimate linkage—we grow and thrive together.

Mr. President, with joy and respect, I extend the hand of friendship and welcome you on behalf of all our citizens.


R. Greeley
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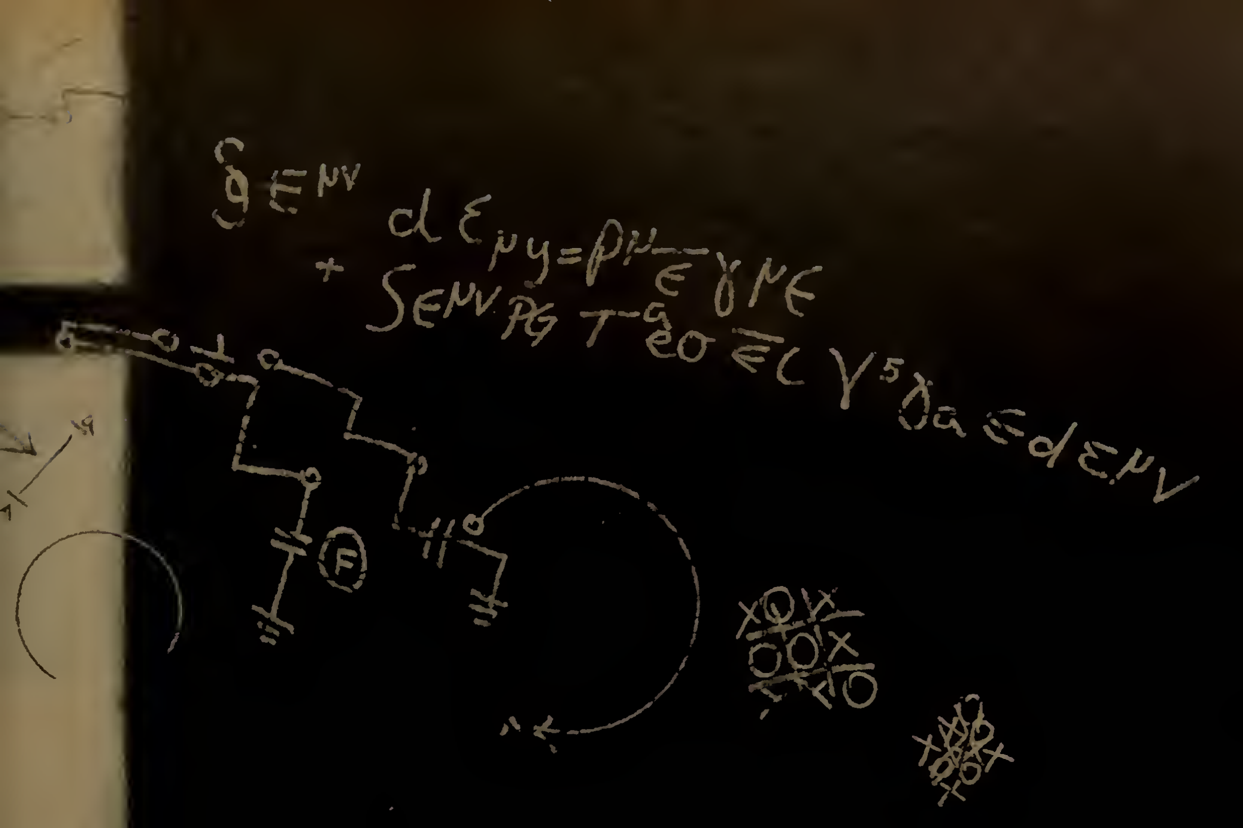

But will it do windows?

Computers may have vision, intelligence, and even common sense in the future, if WPI's Artificial Intelligence Research Group has its way.

by Paul Susca

Sometime late next year it will be stalking the halls of Atwater Kent Laboratories. Low to the ground, its body twice the size of a large dog, its neck as long as your arm, it will edge intently toward its goal. Electrical Engineering Professor Peter Green is responsible for its presence. He and about two dozen students, graduate and undergraduate, will have designed and built its many integrated systems—navigation, steering, drive, and decision making. *It* will be the Mobile Robot, representing the next generation of computer-aided systems having the ability to "think on their feet."

Ambitious as the Mobile Robot Project is, it is but a sample of what's happening in WPI's program in Artificial Intelligence, or AI. For three decades, the AI

Illustration by Richard Giedd

Lee Becker, below, associate professor of computer science: "Industry is predicting the need for thousands of knowledge engineers in the years ahead."

field itself has attracted computer scientists trying to find ways to make computers think and learn the way humans do. Everybody knows that computers are good at manipulating piles of numbers, scanning databases, storing and retrieving information, and even performing some complex tasks such as playing chess or diagnosing diseases. But the challenge of AI today is to teach computers to perform seemingly simple tasks that come naturally to us humans, things like understanding speech, recognizing images, and making quick decisions based on fuzzy information.

Students and faculty with WPI's AI Research Group (AIRG) are learning to tackle all of these challenges, coaxing computers to perform more intelligently in areas such as vision, medical diagnosis, real-time decision making, teaching, understanding languages, and the learning process itself.

Some of the computer software that makes these accomplishments possible is here now, and optimistic investment analysts predict that AI will become a multibillion-dollar business within a decade. Amidst all the excitement, WPI has been building its own AI program, bringing together WPI talent and rising stars from other recognized centers of AI activity, and giving students a chance to participate in leading-edge research and system development.

A clear-cut definition of artificial intelligence is hard to come by, but most of WPI's AI devotees, including Computer Science Professor David C. Brown, think a useful description is "intelligent human activity that we don't yet know how to do using a computer." In other words, says Brown, AIRG chairman, if someone has figured out a way to get a computer to do something, it's not AI. Facetious as that distinction may sound, "AI methods" refers to that which is not AI but used to be, or that which is based on what used to be AI.

By that definition, Professor Green's work with systems such as the mobile robot falls into the AI methods category. AI scientists have long tried to figure out how to program computers to make difficult decisions based on lots of indistinct data under tight time pressure. Recently, using system architectures modeled after that of the human brain, they have begun to make strides toward that end. The result is a generation of systems that can

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find their way to a goal without being given directions.

Green explains, "Instead of telling the robot, 'Go down the hallway and turn right, etc.,' what we'll tell it is, 'Go to the coffee lounge,' and it has to figure out how to get there based on what it knows about the layout of the building, avoiding obstacles, and so on."

Partly through a two-year, $50,000 grant from Westinghouse Educational Foundation, early versions of the robot will "simply" be expected to navigate the building and avoid obstacles, he says. But enhancements could include artificial vision systems, radio communications, and other add-ons, all linked into the robot's real-time decision-making system. Real-time, Green explains, is the ability of the computer to make decisions in restricted amounts of time while the situation is changing continually.

Green hopes the robot project will develop into a means of training students in the emerging field of real-time AI, a field in which WPI's group is among the nation's best. "All the students get exposed—at the appropriate level—to the techniques and methodologies of real-time AI," Green says. WPI is also offering what Green believes to be the first course in real-time AI in the country.

He is talking a blue streak, one AI topic leading to another. You have to interrupt Peter Green sometimes to get a word in, but he's good-natured about it. Where do real-time systems fit into the AI field? Where are the applications to be found? Right now, real-time AI is a very small part of the overall AI field, Green answers, but that, he believes, will change in the near future. Applications range from automated battlefield vehicles to inventory management systems.

Green, who had 17 years of experience in the computer industry before coming to WPI two years ago, got involved in real-time AI while working at MIT's Lincoln Laboratories on a real-time system for tracking aircraft. Gangly, bearded, and usually grinning, Green projects a sort of father image. You can also sense his exuberance about being on the frontier. One of the things he finds appealing about the real-time AI field, Green says, is that any advance represents real progress in the field. And even a small research group like WPI's can stay in the forefront.

But Green's group is not all that small, especially considering that he has been at WPI for only two years. Some of his grad students, commenting that he can't bear to turn away a student who wants to work with him, marvel at the size of Green's program and at his ability to manage so many students. The Mobile Robot Project alone involved about 10

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David C. Brown, left, assistant professor of computer science and chairman of the WPI Artificial Intelligence Research Group: "If someone has figured out a way to get computers to do something, that something is not AI."

David P. Henry '86, right, and Stephen J. Oullette '86 consult with Computer Science Professor Peter Green on details of the WPI Mobil Robot.

Major Qualifying Project (MQP) students last year, another 11 this year, and two M.S. students. That's in addition to M.S. and Ph.D. students working on AI topics ranging from new computer architectures to systems that play multi-dimensional tic-tac-toe.

The common element in most of these projects is real-time decision making. "It turns out that there's a whole class of real-world problems that you can't solve with conventional approaches," Green says. There is too much data for the computer to evaluate, too many possible directions to take in solving the problem, and too little time.

One approach to real-time problem solving is to do what a human being does: set priorities, make tentative decisions, stay within the bounds of the "brain power" you have available. Without this approach, he says, "I have seen computers sit there and procrastinate all day rather than solve a problem." The computer keeps analyzing how to approach the problem without getting down to work.

A whole new class of computers is needed to perform well on real-time problems, Green says. One of his Ph.D. students, Bill Michaelson, on part-time leave from Raytheon Company, in Sudbury, MA, is working on the design of such computers. These systems may comprise a thousand or more processors all connected in a ring, grid, or other network so they can share information while they each work on a different aspect of a problem. It's this scheme of increasing the connections between processors that models the connections between nerve cells in the brain.

Green and his students are also working on a public demonstration of this approach (called activation networking) to computer systems that are modeled after human neural networks. The project will be part of a major exhibit put together by the Boston Museum of Science. Using the neural network approach and computers donated by AT&T, Green's team—including Ph.D. student Weigen Shi, Stephan Wyss '86 M.S., and a large number of MQP students—has been developing a system that will play multi-dimensional tic-tac-toe with museum-goers.

The purpose of the exhibit is to demonstrate the "thinking" process of a real-time problem-solving system, which will comprise a "community of experts," each working on a different aspect of the tic-tac-toe game. Museum-goers can watch each of the computer experts develop recommendations and see how the whole system works together to make decisions under time pressure. The "Age of Intelligent Machines" exhibit will tour science museums all over the country between 1987 and 1990.

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Graduate students Reynold Dobson '85, left, and Andrew Cott '85, right, in the image processing laboratory with Associate Professor of Electrical Engineering David Cyganski.

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Human thinking and decision making are not the only processes that AI researchers have attempted to emulate. Vision, or image processing, is just as difficult to accomplish as real-time decision making because, for one thing, the natural vision process is not a conscious effort.

"Vision is an intrinsically difficult thing to do," says David Cyganski '75, associate professor of electrical engineering, about the work that he shares with EE Professor John Orr. "In a fraction of a second humans can pull in a complete situation by taking a glance," Cyganski adds. "No computer vision system comes anywhere near that." Existing artificial vision systems used in industry can only compare images they see with what they already know, he explains. The computer might know what a particular object looks like from one angle, but a slight change in orientation or positioning can make it unrecognizable.

That's where Cyganski and Orr have been extending the frontiers of their science. They have already developed a system that can recognize a wider range of flat objects faster than any other existing system. Their more advanced work has involved processing more complex images such as satellite photos of land masses and pseudo-transparent three-dimensional objects.

It's easy to tell that there's something about image processing that possesses David Cyganski. Animated, smiling, laughing—out of sheer enjoyment of the subject, it seems—Cyganski gets turned on by image processing because he's a mathematician at heart. But the branch of math that Cyganski and Orr use in their image processing work, called tensor theory, is so arcane that, although Albert Einstein used it to express his theory of relativity, theirs is the first concrete application of tensors that Cyganski knows of.

Before he returned to WPI in 1979 to

Peter Green, below, EE professor: "I've seen conventional computers just sit there and procrastinate all day rather than solve a problem. They can't always set priorities in really difficult problems."

work on his Ph.D., Cyganski got his kicks applying math to design problems at Bell Laboratories. After becoming proficient in one-dimensional signal theory in his Bell Labs work, Cyganski turned his attention to two-dimensional signal theory which, he found, has applications in image processing.

Although he had already begun the transition from communications engineering to image processing before he came to WPI, Cyganski still teaches communications courses today. "I'll turn out hundreds of communications engineers to a handful of AI people," he says, "which is good, because that's roughly the ratio in which they're needed right now." That ratio, however, may become better balanced before long.

Not completely consumed by his attraction to high-level math and his achievements in image processing research, Cyganski has a passion for teaching, too—a passion that led to his being named WPI's teacher of the year in 1984 by the Board of Trustees. Underlying this dedication is a belief that many of the world's problems result largely from ignorance—of science as well as of humanity. He sees education as the answer. "They won't throw bombs if they're educated," he hopes, "and if our science gets good enough maybe we'll find that we don't need bombs anymore."

Cyganski's boyish smile fades somewhat when he talks about topics like societal issues and education. These subjects are frought with difficult dilemmas. Cyganski notes, "It's unfortunate that as a society we're very often pushing toward deeper and deeper knowledge of subjects without making sure that more people have some knowledge about everything." Maybe he is more keenly aware of this problem because of the esoteric nature of his own image processing work, where undergraduates are usually unable to make a contribution because the mathematics are far beyond them.

Instead, Cyganski coaches undergrads on projects involving AI methods. "There, you're not trying to make breakthroughs of a theoretical nature—you're trying to make new applications. There's a difference," he explains. "You can bring undergrads far enough along so that they can apply AI methods in new ways." During the past year these projects have involved the use of AI approaches in analyzing circuit designs and a system that uses simplified AI methods to recognize handwritten characters.

John Orr, Cyganski's partner in image processing, recalls the work that led to their fruitful collaboration. The two professors were co-advising a couple of M.S. projects dealing with the recognition of objects' location and orientation. "We started out with a method which I think we both would agree now was pretty naive. It failed in all sorts of interesting ways," Orr remembers, "and that led Dave to recall his experience with tensors and think about applications of that to the same problem." Their work in object location and orientation just kept branching out from there, Orr says.

Orr had had experience with image processing problems before. Advising an MQP at the University of Massachusetts Medical Center (UMMC), in Worcester, Orr and his student were looking for an automated means of determining the stroke volume of the hearts of cardiac patients. The heart volume project didn't succeed, but it did pique his interest in image processing, he says. The object location and orientation work followed.

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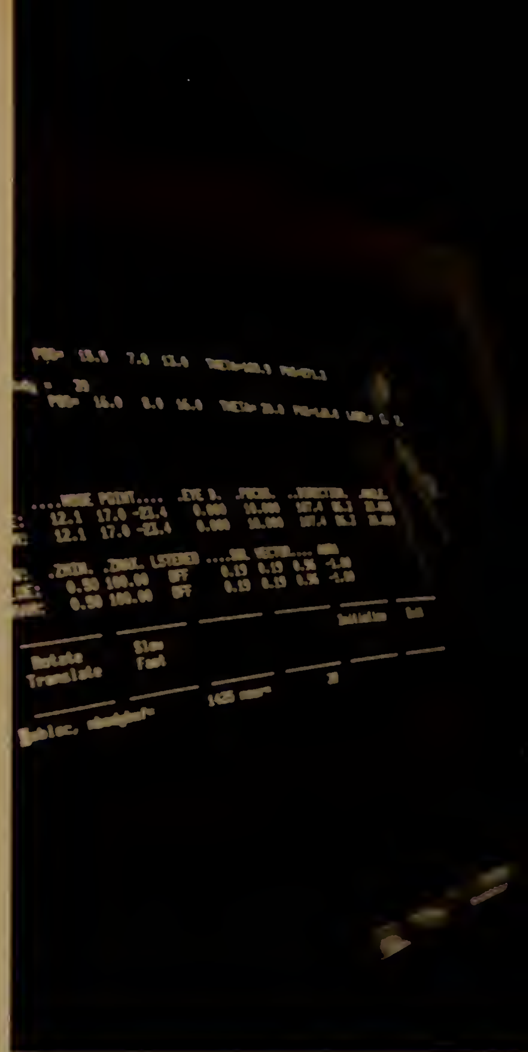
Orr, displaying only a faint smile when he recalls his early attempts at image processing, comes to life when he talks about the connection between teaching and research. As long as you're doing research, Orr believes, you're a student, and a person who is a student himself often makes a better teacher.

Orr knows about teaching from way back. "I had always wanted to try teaching," he says about his pre-WPI days. "It's hard to know exactly why, except that everyone in my family is a teacher." He immediately volunteers some observations on the teaching challenge. One of the problems is figuring out how much guidance to provide, beyond leading students through the sticking points. Sometimes, he believes, the most effective way to learn is the way he did. "If you figure something out yourself," he says, "you have a better understanding of it."

One of the hallmarks of artificial intelligence research, according to Computer Science Professor James M. Coggins, is making decisions based on fuzzy data—disorderly, incomplete, inaccurate, ambiguous, misleading, distorted, or noisy information. Something about Coggins himself seems disorderly, or at least unsettled—his office is more disheveled than most; he keeps his windbreaker on for the entire hour-long interview. Maybe it's because, although he is part of WPI's Computer Science Department, Coggins' laboratory is across town at the UMass Medical Center, where he and graduate student Kenneth Fogarty are developing an image processing sys-

In a laboratory deep in the University of Massachusetts Medical School, Jeanne Travers '86 works on an image processing experiment using an interactive graphics system to analyze protein distribution inside single cells. Software for the system was designed by Computer Science Assistant Professor James M. Coggins.



tem to aid in physiology research.

Coggins' work is a good example of how AI methods come in handy in interdisciplinary applications. "This project starts with the physiologists and the chemists who are making the radioactive dyes that they put into a cell to make the protein glow," he says with a vestige of a South Carolina accent. The glowing of the fluorescent dye is picked up on film, image processing techniques are then employed to make sense out of the fuzzy pictures, and the results are displayed with the 3-D graphics system.

"It's the artificial visual system that interprets the 3-D images," Coggins continues, "picking out these protein bodies and measuring their angles." The purpose of the whole system is to aid in the study of a protein, alpha actinin, which has a role in the contraction of muscle fibers. The end product of Coggins' and Fogarty's work is an interactive, three-dimensional color image of protein bundles represented by capsule-shaped bodies in perspective against a dark background.

Although undergrads have not been able to participate in the core of Coggins' work on the artificial visual system (which involves applying mathematical "filters" to process the images), there has been room for undergrads on related projects. Susan Abramson and Beth Thalen, for example, developed the system's 3-D graphics cursor, or pointer, that enables researchers to interact with the processed images of protein bundles.

Interdisciplinary work like the UMMC project is a favorite of Coggins'. "I hang around with humanities and social science professors, just for the stimulation of hearing people talk about different kinds of problems," he says. One of his projects—with John Wilkes, associate professor of social science and policy studies—involved using an intelligent indexing and retrieval system in non-quantitative research. It was because of his need for variety that Coggins came to WPI. "Every day is different here," he says, "You have projects at various levels, at various stages of completion with the students. Then you have your own projects. It's exciting."

Making decisions in real-time and using fuzzy data are part of the AI picture, but equal excitement over applications for AI has centered around expert systems, another area that WPI is covering well.

"There are at least three ways you can look at the AI field," David Brown says. "One way," he explains, "is to simulate the result without caring too much about how you get there—we're not interested in that approach. A second approach involves simulating the method, trying to capture how the human expert does it. A third way is to simulate a human expert's thinking mechanisms, which is closer to the neural level," Brown explains. He is interested in the second of these approaches.

In addition, Brown is studying how people design things. Capturing the human expert's method of designing is the focus of Brown's work with M.S. student Teresa Chiang, in which she is building a system designed to interrogate experts about the design process. A related project by M.S. student Douglas S. Green seeks to model the way humans think about how things fit together—qualitative rather than quantitative reasoning. Yet another project, conducted by M.S. student Robert Breau, involves using DSPL, a language developed by Brown for use in expert design systems, to model the way designers integrate their knowledge so that the designing job becomes routine.

So far, all of Brown's work with his students has focused on the routine design of relatively simple components. But you have to take one step at a time in expert systems, Brown cautions. "Sometimes you have to be more pessimistic than optimistic because there's been a lot of hype about expert systems. So it's much better to say that they can't do half the things people claim they can," he says.

"That needs to be done on the undergrad level too because a lot of students latch onto the sci-fi aspects of AI," he says. "You have to try not to be too optimistic because they have their optimism built in already."

Brown chooses his words carefully; the tidiness of his office reflects his highly systematic thinking. He expects his students to be rigorous, too, often pressing them in class to back up their assertions with better logic—no sloppy reasoning allowed here. But the other side of his high expectations of his students is that he grants free rein when they are ready to handle it. Students also seem to appreciate his evenhandedness; he listens and gives equal weight to their ideas. But his quickness and the step, jab, step back, thrust again of his speech remind you that he happens to be WPI's fencing coach.

Brown also coached fencing at Ohio State University, where he earned his Ph.D. in 1984. But it was at the Univer-

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sity of Kent in his native England, where his thesis dealt with question-answering systems, that Brown became hooked on Artificial Intelligence. Since then, his academic work has focused mainly on design processes, especially routine design.

How do you get this knowledge from the designer into the expert system? You start by immersing yourself in the domain of the designer, Brown says, to learn the vocabulary and acquire a general familiarity with the material. What follows is a long series of interviews with an expert designer, going over examples, asking questions, probing to reveal the thinking behind each decision. Then you try to construct a system, run some sample problems on the computer, show the results to the expert, and go through the cycle again and again. "Knowledge acquisition is one of the major problems at the moment in the development of expert systems," Brown says matter-of-factly, "People are trying to find ways to automate the process because it's so painful."

So painful and time-consuming is it, in fact, that some people predict a demand for thousands of knowledge engineers in the coming years, according to Computer Science Professor Lee Becker. Building an expert system can take a year and a half of the knowledge engineer's time and maybe an additional half-year of the human expert's time, Becker says. And time is money. One way around this problem is to have an expert system that will interrogate the human expert, thereby eliminating the knowledge engineer's job. But Becker, who has a tendency to answer questions before you're finished asking them, has doubts about that approach.

Instead, he is concentrating on using less of the expert's time. He does this by using what he calls "traces," records of the diagnostic process that a physician follows in interpreting examination and test results. Using CSRL, a computer language for expert diagnostic systems, developed at David Brown's alma mater, Ohio State, Becker is working on "machine learning," building knowledge from observing a process rather than asking questions about it.

He shares his interest in knowledge acquisition processes with Brown. Becker also works with Peter Green on data interpretation and diagnostic processes for real-time AI systems. Becker brings to his collaborations a background in linguistics and cognitive psychology, and so serves as the expert on the human cognitive process and its neural models. Becker continues to apply AI techniques to language problems as a way of harking back to his years as a linguist. His students have done work in that area, too. MQP students Sharon E. Taubenfeld '87, Ronald S. Avisa '88, and Caleb A. Warner '88 recently designed an intelligent computer-aided instruction (ICAI) system for teaching German.

Other ICAI projects under Becker may someday make his own job easier. Master's student Xiaoyi Huang, for example, is working under Becker's guidance to build an expert system that teaches a course in database systems. In addition to containing the knowledge that it is trying to teach, the expert system will contain a model of the student's knowledge and a set of common misconceptions that

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M.S. students Teresa Chiang and Douglas S. Green are working with Computer Science Assistant Professor David Brown on developing computer systems that will model the mental processes by which designers and other experts solve problems.

students can be expected to have.

Lee Becker's enjoyment of his work shows in his casual but voluble manner. Sometimes, however, he has a tendency to stray a bit off the subject, maybe being pulled by the centrifugal forces of his interests. But he manages to keep students awake through long evening classes, says one grad student, with his animated and often droll chalk talk. "There are aesthetic aspects to the subject that I like to impart to the students," he says wryly.

Becker became interested in expert systems while teaching linguistics at Indiana University. There, he took his first computer science course and immediately began seeing applications in computational linguistics. "Linguists gather data by interrogating someone who speaks a language; they then look for generalities and changes of sounds in different contexts," Becker explains. So he started working on an expert system to do descriptive phonology, involving the analysis of sound patterns in natural speech. Becker was hooked. He soon began using computers in semantics, trying to develop an algorithm that could deduce the meanings of words and other linguistic knowledge through context.

Expert systems have absorbed most of Becker's energy for the past two years. He is fascinated by the possible uses of computers in testing theories about the human cognitive process. "The computer is a tool that allows you to formulate explicit theories," he says. "It shows you whether you could learn x by this method y with a particular input z."

But AI, and expert systems in particular, are not without their critics. Some argue that true experts, rather than following rules or defined patterns of decision making, function largely on intuition, something computers can never do. Becker takes issue with these nay-sayers. "I believe that all those problem areas are areas where cognitive psychology has not yet proposed any good hypotheses," he replies. "If we can do a cognitive task, a computer can do a cognitive task."

Perceptual tasks are another matter, concedes David Brown. Image processing research, for example, is only beginning to model human perception. And neural network methods for computers represent only the most rudimentary aspects of human thinking.

Brown offers one final perspective on AI: "Artificial intelligence is more than a set of tools and techniques that can be used in computer engineering. It's an approach to investigating the knowledge and reasoning that underlie intelligent activity. AI is but one of many tools that will be used in the future to build 'intelligent' computer systems."

As for the prospects for employment in this emerging field, he adds, the shortage of AI specialists is major and growing, reflecting industry's surge to avoid being left out in the cold. And, with salaries for Ph.D.s in AI hovering around the $50,000 level, the next few years may well find other colleges and universities hard pressed to catch up with students' demands for programs focusing on the latest generation of AI.

Paul Susca is a freelance writer living in Rindge, NH.

How did we ever get along before they invented the ———?

If you were rating the world's greatest inventions—from the wheel (or before) up to the compact disc—what would head your list?

Would it be a device prompted by Mother Necessity, urging her children to solve some problem with an ingenious thought or experiment?

Would it be like a Slinky—something whose utility doesn't immediately spring to mind? Or would it be something like those sticky yellow paper things—which solved a problem you didn't know you had?

Name your candidate for World's Best Invention, and tell us why.

Those whose answers are chosen to appear in these pages will receive $100. (How does money rate as an invention?) We'll accept essays, of 500 words or less, until October 1, 1986. Please send them to the magazine, in care of the editor, and marked "Inventions."

Allen Carroll

THE JURY IS STILL OUT

on how an onslaught of lawsuits and federal regulations will affect the basic fabric of campus life.

By Leslie Brunetta

After a night of heavy drinking, a student tries some acrobatics on a trampoline parked in a fraternity's front yard. An accident happens: the student is confined to a wheelchair. A jury finds his university entirely liable and awards the student $5.2 million.

A graduate student fails his preliminary doctoral examination. The failure is not due to his own lack of scholarship, he claims, but to the hostility of his professors toward his ideas. He sues the university for $4 million for depriving him of his education and future career opportunities. At first, the claim is dismissed, but later a partial appeal is granted.

A university appoints a new president. Fourteen faculty members bring suit, charging that the appointment violates a consent decree settling an earlier class-action sex discrimination suit. The suit asks that the appointment be rescinded and the candidate barred from a new nationwide search.

"Academic deans today have to have lawyers at their sides," says Estelle Fishbein, general counsel at Johns Hopkins University. This wasn't always the case: before about 1960, suits against universities were extraordinary occurrences. When Fishbein began her duties as special assistant attorney general for the University of Maryland in 1968, she sat down to read all the past cases involving higher education: "It took me just two and a half days. Now I get a thick journal quarterly, full of higher education cases."

Statistics kept by the National Association of College and University Attorneys (NACUA) back up Fishbein. Between 1946 and 1956, about 150 cases concerning higher education were reported. That's an average of 15 cases per year. Today, nearly every issue of the weekly *Chronicle of Higher Education* reports two or three cases. Since its founding in 1961, NACUA has grown from a membership representing fewer than 50 schools to one representing about 1,200. NACUA member Roderick Daane, general counsel to the University of Michigan, notes that since 1972, the percentage of colleges and universities employing in-house counsel has doubled and that 70 percent of schools whose annual budgets top $50 million consider in-house counsel necessary.

Why do colleges and universities today face legal problems in their dealings with students and faculty that seemed unthinkable 30 years ago? And what happens when these problems impinge upon educational decisions?

"A GOVERNMENT INTEREST FOR FAIRNESS AND A PRIVATE INTEREST FOR QUALITY ARE BUTTING UP AGAINST EACH OTHER. THEY SHOULDN'T BE MUTUALLY EXCLUSIVE, SO THE QUESTION IS HOW CAN THE TWO COEXIST?"

Traditionally, universities have existed as a world apart from nonacademic society. Students and faculty members subjected themselves to the absolute authority of their academic elders in exchange for protection from outside authority. Attendance at—and employment by—a college or university was considered a privilege rather than a right, and courts were reluctant to interfere.

The relationship between student and college was further cemented by the concept of *in loco parentis:* most students had not yet reached the legal age of majority and were viewed by the courts as having been committed by their parents to the institution's care. In the 1913 Gott v. Berea College case, the court affirmed the common notion that since colleges had the same aims as parents, ". . . we are unable to see why, to that end, they may not make any rule or regulation for the government or betterment of their pupils that a parent could for the same purpose."

After World War II, things changed. Returning soldiers, women, and students from wider social, ethnic, and economic backgrounds began to flood campuses and to question the value of many academic traditions and assumptions. And when student uprisings broke out in the '60s, the schools themselves went beyond the campus perimeter to seek legal redress. Students followed suit—literally.

Court decisions reflected these changing moods, and in turn helped to encourage them. In 1961, the Fifth Circuit Court of Appeals served notice to public universities that the hermetic seal around in-house disciplinary procedures had been ruptured. In Dixon v. Alabama State Board of Education, students who had been expelled for misconduct claimed that they should have a right to sufficient notice and a hearing, and won. From then on, state schools, as government agencies, would have to extend constitutional rights of due process to students accused of misconduct.

The case set a precedent: in 1969, ruling on Tinker v. Des Moines Independent School District (high school students sued to wear black armbands in protest of the Vietnam War), a court found that students don't "shed their constitutional rights to freedom of speech or expression at the schoolhouse gate."

"Privilege" rang more loudly on private campuses. But it was inevitable that private schools too would have their day in court. The concept that lawyers and judges eventually formulated to tackle the private education sector was native to the private business sector: the contract. Since the first half of the century, the contract theory (stating that school and student were legally bound to behave in specified ways) had occasionally been used by schools to defend their own rules. But by the early 1970s, students began to see that two could play the game. Students who failed to gain admission, flunked out, or faced a multitude of other problems charged that the schools had violated the contracts implied in their brochures, catalogs, or other materials. And the courts often backed them up.

In the 1976 case of Steinberg v. Chicago Medical School, for instance, the Appellate Court of Illinois found that when the medical school accepted Robert Steinberg's application and $15 fee, it entered into an enforceable contract with him to stick to the admissions criteria stated in its admissions bulletin. While this is an unusual case (the courts have usually found that the relationship between institution and student is contractual *in nature*, rather than that an actual contract exists), it's a precedent that colleges continue to view with some alarm.

On top of these judicial challenges to traditional academic relationships have come legislative ones. Any college or university receiving federal funds has to comply with executive orders, legislative acts, and amendments to acts prohibiting discrimination against students and employees on the basis of race, color, sex, national origin, handicap, or religion. With the stakes high—loss of even a portion of federal funding can force an institution into straitened circumstances—colleges and universities have formalized admissions and hiring procedures to an extent unthinkable by pre-war standards. And they have become zealous record-keepers in the hopes that challenges under the regulations can be fended off with strong evidence of the institution's fairness. Even so, nearly any admissions, financial aid, or hiring decision made by administrators can be fraught with anxiety.

From the time a college begins to court applicants, problems can arise. "The whole atmosphere has pricked our legal conscience, particularly when we publish admissions material," says Philip Calhoun, vice president for admissions and administration at Franklin and Marshall College. "We have to consider carefully what we say and then to fulfill the promises that we make." The Steinberg case and others have made administrations so leery about the contractual nature of their relationship with students that they may be tempted to undersell their institutions. "We constantly ask ourselves, 'What can we say to students who are applying?'" says Robert Chambers, president of Western Maryland College. "All of us make claims about the wonders of a liberal education. What happens if some kid says, 'I heard you say that and now I can't get a job.'"

Once a student is enrolled, there are other possible dangers to face. The vigilance applied to admissions materials is reapplied to course catalogs, descriptions of programs and facilities, and any other publications a student might rely on for

Liability: A lot to pay, a lot to lose

"We make tempting deep-pocket targets," says Jon C. Strauss, president of Worcester Polytechnic Institute. Unlike other corporations, which tend to have assets tied up in buildings and machinery, colleges and universities usually have a major portion of their assets in endowments, a highly liquid form. And since the current legal system often forces the most vulnerable defendant—even if found only partially liable—to pay the entire settlement, colleges have a lot to lose.

With liability insurance coverage in short supply nationwide, many institutions have become even more vulnerable. WPI, for instance, like most other universities, does research for products that eventually turn up in the marketplace. In the past, the school held errors and omissions (E&O) insurance, covering it against claims that its research was either faulty or deficient. But as the policy's expiration date drew near last year, now retired vice president for business affairs David Lloyd knew that obtaining a new policy would be difficult: "Our annual cost was going to increase by over 2,500 percent."

That was the insurance industry's left jab. Next came the right hook: the school could obtain only about 16 percent of the umbrella liability coverage it had formerly held, and that at the cost of grossly inflated premiums. Furthermore, Lloyd says, "The new exclusions were so dramatic that it meant we had virtually no E&O coverage and no directors and officers coverage. It boiled down to a traditional personal injury and liability policy." To protect its endowment, WPI has decided to require indemnification by corporate sponsors and to incorporate separately the Alden Research Lab. That way, any claims made against work done in the lab should be limited to the lab's own assets. "It's ridiculous," says Joaquim S.S. Ribeiro, Lloyd's successor, "that after 100 years the facility has to be separated from the college."

Other, mostly larger, institutions have been more fortunate in their coverage. Johns Hopkins University, for instance, in collaboration with 11 other schools including Brown and Princeton, formed a captive insurance company in Bermuda in 1982. Captive companies (usually based in Bermuda or the Bahamas to take advantage of more favorable tax laws) allow members to pool their resources to form a reserve against claims. "It gives each member the advantage of being part of a large group," says T. Jesse Buhite, Johns Hopkins's risk and insurance manager. "It also means we have the clout of a big corporation in terms of premiums volume—insurance companies will take notice of us together where they might not singly. We find we've been able to hold the line on costs and maintain coverage."

Not that the captive company has solved all of the university's insurance problems. "We'll accept liability for our own negligence," says Buhite, "but not for that of others." The university, like other businesses, tries to transfer risk in all of its everyday contracts. If it hires a building contractor, it will place an indemnity clause in the contract (absolving Hopkins from any negligence on the part of the builder) and make sure that the contractor is properly insured. But since contractors are having as much trouble as everyone else getting coverage, the situation has become complicated. "A lot of companies can't afford to abide by these rules anymore," says Buhite. "It flushes people out of the marketplace."

Risk transfer is one way of dealing with potential problems. Risk avoidance—foregoing any activity that may incur risk of being found liable—is another. At Villanova University, cheerleaders were asked to cut some stunts that might lead to injuries. And the Rev. Robert Martin, O.S.A., assistant to the vice president for student life, wonders what educational activities may have to be cut in the future: "I should think that many colleges are thinking about curtailing study abroad programs." —LB information. "Our college handbook is reviewed by a legal solicitor," says Philip Calhoun. "The intent remains the same in terms of describing the college's courses, but we have to make sure there are no loopholes."

As the country's general level of consumer awareness has risen, so has that of students. "In the late '60s and early '70s, students were issue oriented," notes John Shirk, F&M's college solicitor. "Now they're more self-focused, more likely to sue over a personal problem than a principle." A study by Donald Gehring, a University of Louisville professor, of more than 600 suits brought by students against their schools between 1970 and 1985 backs up Shirk. The pivotal year, according to Gehring, is 1975: cases about individual admissions decisions, grades, and financial aid begin to overtake cases concerning civil rights.

"Given the demographics," says Bradley Dewey, F&M's vice president for academic affairs and dean of the college, "students and parents are more in the driver's seat than they used to be, so they're more emboldened." Dewey also believes that the tighter job market makes students and their parents think an awful lot rides on the difference between a B+ and an A-. And the increasing cost of an education at a good independent college or university just aggravates matters. "People want to get their money's worth," says Chambers. "With prices as they are, if there's a glitch somewhere, they can think, 'I've got a legal stake in this.'"

But this wrangling for perceived increases in a degree's value can ultimately backfire, according to administrators. "Private institutions have a right to set up their own expectations about academic standards," says Rita Byrne, dean of student affairs at F&M. Supposedly, as courts seem to recognize, these standards are what attract students in the first place. In almost all cases addressing academic evaluations where the school can prove that nothing unusual has happened, the courts have declined to doubt the institution's judgment.

In the meantime, though, schools have had to expend time, effort, and money that could have been used more productively. There lies the intimidation factor: is it worth going to court, or should the grade be bumped up just this time? "We can't afford to be intimidated," says Fishbein, "because then our degree is cheapened."

Courts may take a hands-off stance on academic cases, but they're more willing to get involved in disciplinary ones. With the dismantling of the *in loco parentis* framework for student-school relations, colleges and universities have often found themselves caught in a double bind. On the one hand, they are obliged to treat students as adults—to spell out regulations, state in advance the mechanics of disciplinary proceedings, and then guarantee that due process is allowed in those proceedings. On the other, schools are often held accountable for the injuries resulting from actions taken on a student's own initiative.

Alcohol: responsible drinkers, responsible administrators

"Up until the mid- to late '70s, alcohol was an ongoing, itchy problem on campuses," says the Rev. Robert Martin, O.S.A., assistant to the vice president for student life at Villanova University. "Now we perceive it as part of the whole national redefinition of alcohol as a problem. And because of the third-party liability cases, colleges are much more inclined to think through their alcohol policy from a legal, rather than from a purely educational, point of view."

The fact that students legally reach maturity in all other areas of their academic and social lives two to three years before they reach the legal drinking age has created a new area of tension between student and school. On the one hand, most colleges consider it part of their obligation to teach students to handle alcohol responsibly. On the other, schools must abide by state laws, and, in an attempt to avoid liability, must police activities in a way that is welcome to neither school nor student.

At Worcester Polytechnic Institute, for instance, as at many other schools, problems with liability insurance led to the demise of the college pub. According to Joaquim S.S. Ribeiro, vice president for business affairs and treasurer, "When we could only get $1 million in liquor liability coverage—down from the previous $60-million coverage—we felt we had to close our pub." While this may lessen the legal responsibility of a school, it doesn't lessen the perceived educational responsibility: "Raising the drinking age has driven drinking behind closed doors or off campus," says Robert Chambers, president of Western Maryland College. "I'd rather have them drinking where we can supervise them."

It would seem that the simplest and safest measure a college could take in such circumstances would be to ban alcohol consumption by students all together. Guess again: once schools take such absolute measures, the courts have found them to have voluntarily assumed a duty to make sure that no students drink, and therefore to be liable when injuries as a result of student drinking occur. Instead, colleges have to come up with a broad-based program protecting both themselves and students. "We tell students the realities," says Rita Byrne, dean of student affairs at Franklin and Marshall College. "We list Pennsylvania laws on drinking and drugs and make them aware of the liability problems. These are intelligent young people—if you explain the risks to them, they're wary about accepting the responsibility."

Even so, at F&M, restrictions exist to protect the college: no staff member can buy alcohol for students, and the spaces allotted for student parties on campus are limited. And with the host laws—laws that hold the server of alcohol responsible for the damage caused by his intoxicated guests—becoming more severe, the college is carefully watching its pub, where beer is occasionally available to those students over 21. Although the college makes sure its patrons are of legal age, administrators worry about what might happen if someone over 21 passes on a drink to someone under the legal age. "The courts seem to impose even heavier penalties," says Byrne, "when someone underage is involved." —LB

"Students are not exactly in our care," says the Rev. Robert Martin, O.S.A., assistant to the vice president for student life at Villanova University, "but they may need instruction on how to live as adults away from home." Villanova's attitude is part of a general educational philosophy predating the liability crisis—that the whole student, not just the part that studies, should be educated. That philosophy, as it turns out, fits the sphere of legalities quite well: if a school can prove that it has given students reasonable information about the consequences of dangerous or frowned-upon activities, the courts may be less likely to find the school at fault for those actions.

Perhaps the most frequently encountered discipline problems having legal ramifications are those involving alcohol. Many states have raised the drinking age to 21. Some courts have found the seller or host serving alcohol responsible for the damage caused by the drinker. And then there's the difficulty of obtaining liability insurance. College administrators have had to think long and hard about how to deal with the problem. "Because of the tightening up of alcohol laws, we've had to tighten up," says Chambers. "Last year we had 15 students separated from the college for disciplinary reasons, and virtually every case was related to alcohol."

Seemingly extreme precautions against injury and unjust accusations are legally necessary, many administrators agree. But many also feel that some students miss out on a vital lesson: adults are responsible for their own actions. If a disciplinary case reaches the courts, whether or not a student is guilty of breaching college rules is rarely any longer at issue. The burden of proof is usually on the school to demonstrate that channels for due process were in place, and, more importantly, that these processes were followed.

"You can't summarily dismiss people anymore and get away with it," says Fishbein. "We've all had to clean up our procedures, which is a good thing. But it's gone too far." John Shirk thinks that, in many cases, everybody loses: "Because the courts often focus on technicalities rather than on whether or not the student did what he was accused of, students learn a lot about technicalities and not much about correcting their behavior. I worry that the lesson, that there are limits to acceptable behavior, won't carry over into later life."

With the advent of constitutional guarantees against many forms of discrimination in the 1970s and the tightening of the academic job market in the 1980s, suits filed by faculty members against their employers have also become a regular feature of the academic landscape. Says Shirk, "Today most employment problems are accompanied by some kind of a discrimination claim."

"IT USED TO BE THAT A DEAN WOULD SEND AN ENCOURAGING NOTE TO A JUNIOR FACULTY MEMBER AFTER A GOOD LECTURE. NOW YOU DON'T BECAUSE IT COULD SHOW UP IN COURT AS INDICATING A PROMISE FOR TENURE."

Since the 1960s, when tenured academic jobs were easier, at least statistically, to come by, the relationship between colleges and universities and their faculty members has changed markedly. Young faculty taking a place on the tenure track know that the numbers are stacked against them, that they must make a mark with both their teaching and their research, and that they may work hard and steadily for up to seven years only to be told that there is no permanent place for them at their institution. Finding another suitable position may be difficult. The tenure decision thus becomes the most important event in their professional lives.

Faculty tenure decisions are also among the most important events in the corporate life of a university. The decision is virtually irrevocable: "It's almost impossible to fire someone with tenure today," says Chambers. "It probably wouldn't stand up in court." So the institution has a lifelong investment (in monetary terms, often over $1 million per person in salary and benefits) in the superior performances of its tenured faculty.

The anti-discrimination laws exist to protect minorities from blatant hiring discrimination as well as to encourage active broadening of the nation's once nearly all-white, all-male faculty pool. College and university administrators say that they agree with these aims but that the regulations are often simply an excuse to vent disappointed faculty members' frustrations. The courts seem to side with the administrators' view: a study conducted by Lee and George LaNoue of the University of Maryland Baltimore County found that between 1972 and 1984, 39 cases of academic discrimination were filed and tried to conclusion in federal court. Only three were won by the plaintiffs.

However, supporters of those filing discrimination suits charge that this is another issue in which judges have tended to bow to scholars' academic judgments—if a smoking gun indicating discrimination doesn't turn up, judges

"THERE'S ALWAYS THE TEMPTATION TO DO THE SAFE THING RATHER THAN TO MAKE THE ACADEMICALLY WISE DECISION."

usually trust the assessments of those making the tenure decision. And, these supporters say, the plaintiffs' cases are crippled by their inability to gain access to many of the documents central to the tenure decision.

Most administrators stand firm against a complete exposure of the procedure: they assert that reviews written by peers, senior faculty, and outside reviewers must remain confidential. If they do not, they say, future reviewers will be less candid and therefore less reliable. And the result will be arbitrary appointments and a weaker faculty body. "Tenure is a unique arrangement," says Shirk. "And in judging candidates there isn't an objective standard. The government enforcement agencies tend to think there is and that the records will reveal it."

In February, F&M petitioned the U.S. Supreme Court to review the United States Court of Appeals for the Third Circuit's decision on just such a case. At issue was whether the college should have to hand over confidential peer review documents to the Equal Employment Opportunity Commission (EEOC), which is investigating allegations by a former assistant professor that he was denied tenure because of his foreign origin. The college argues that no discrimination took place and has either turned over to or made available for inspection all the documents requested by the EEOC except the confidential peer reviews.

The college petitioned for the writ because the administration believes that there isn't a consistent, established legal standard upon which an order to produce these confidential documents can be based. The Court of Appeals for the Third Circuit—which ordered F&M to turn them over to the EEOC simply because they were relevant to the investigation—went against decisions laid down by the Seventh Circuit (which ruled that the person alleging discrimination must show a strong and particular need for these documents) and the Second Circuit (which ruled that this person must show that his or her need for the documents outweighs the interest of the college in keeping them confidential).

The college also holds that the Third Circuit's decision runs counter to previous decisions handed down by the Supreme Court which give First Amendment protection to these documents. "A government interest for fairness and a private interest for quality are butting up against each other in these cases," says John Shirk. "They shouldn't be mutually exclusive, so the question is how can the two coexist?" The Supreme Court decided in June not to hear the case, so F&M will have to hand the documents over to the EEOC. Other colleges and universities, as well as F&M, will now have to reconsider the tenure review process and decide how to reconcile their desire for confidentiality with the courts' desire for evidence.

Like doctors who are afraid to do procedures because they're worried about malpractice suits, college administrators fear that some basic educational functions may be edged out by defensive legal maneuvers. "College administrators of necessity have had to become more management oriented," says Dewey. "The problem is achieving a balance between the hardnosed legal and economic realities and educational idealism." Potential legal problems have to be headed off before they can get started, and that often means less spontaneity, less openness, more suspicion on the campus. "There's always the temptation," says Fishbein, "to do the safe thing rather than to make the academically wise decision."

But doing the safe thing sometimes seems necessary. Doubts about liability coverage have gnawed at the essential activities of the university: "It worries me that we may have to limit our research to limit our liability exposure," says Jon C. Strauss, president of Worcester Polytechnic Institute. "It's contrary to the concept of academic freedom, that you investigate what needs to be investigated without consideration for the risks." Basic relationships have suffered, too. "It used to be that a dean would send an encouraging note to a junior faculty member after a good lecture," says Dewey. "Now you don't because it could show up in court as indicating a promise for tenure. That's bound to take a toll." And Robert Chambers laments traditional rites of passage: "A professor can't even have a beer with a student anymore," he says. "That used to be a cherished event."

Administrators point out that the federal anti-discrimination regulations have greatly helped to make campuses more accessible to minorities and women. And the re-examination of administrative policies has undoubtedly put a stop to many arbitrary decisions based on favoritism and preconceived ideas. "We can't let ourselves get bogged down and discouraged by these issues," says Dewey. "There's lots of good educating going on in spite of these problems."

The key to surmounting them, say the administrators, is to remember that the primary mission of the institution is education and then to build a strategy around that keystone by eliminating as many legal risks as possible. "You can do too much," says Father Martin. "You can put on so many bandages that the patient dies."

Leslie Brunetta is assistant editor of the Alumni Magazine Consortium.

A COOK'S TOUR OF

VACATIONS

Eight fact-filled pages.
Four Roz Chast cartoons.
A Hugh Kenner essay.
Here's a vacation package to read on the plane, on the beach, or on the back porch.

VACATION (vā kā'shən) n.

In Sabine, Italy, Vacuna was the goddess who granted vacations. Joel Farber, professor of classics at Franklin and Marshall College, says her name—and hence our word vacation—probably came from the Latin root *vaco*, meaning to be empty or void. *Vacatio* means an immunity or freedom from something.

Not a great deal is known about Vacuna. The best representation of her was found at the ancient site of Montebuono. The goddess stands solemnly above a throne surrounded by nude genies, holding torches she has lit for them.

She seems to have had connections with water, agriculture, healing, and leisure. Elizabeth Evans writes in *The Cults of the Sabine Territory* that Vacuna's name may refer to the purgative quality of mineral waters; she may have freed people from disease. Worshipped on the floating island at Aquae Cutiliae (a famous health resort frequented by Roman emperors), Vacuna, Evans suggests, may have been some divine Lady of the Lake.

Vacuna was also the goddess to whom farmers looked for blessing and rest. In ancient Rome, country laborers held a festival, called Vacunalia, in her honor each December after the crops were gathered and the lands were tilled. Then they rested.

—Rhonda Watts

WHEN YOU NEED A VACATION, TAKE ONE

"One of the most stressful things life offers is coping with the same things day in and day out," says Daniel Ziegler, a psychologist at Villanova University who runs a stress management program. "The same work, the same people, the same house, the same family, the same friends. Sameness can provoke stress." Unfortunately, change can cause stress, too. And so do overwork and underwork, too much stimulus and too little—in fact, the list includes an endless collection of opposites.

Sometimes stress produces physical strain: heart disease, ulcers, and high blood pressure. Sometimes the strain is psychological: depression, helplessness, hopelessness, conflicts in the family and on the job. "The people who work tremendous hours and never take vacations," says Daniel Rees, a Western Maryland College sociologist who studies employee productivity, "are the same people who get inefficient, don't make decisions well, are intolerant of their colleagues, and whose productivity has fallen off."

Ziegler's advice: "People should give themselves a break." Helen Vassallo, who teaches biology and management at Worcester Polytechnic Institute, seconds the motion: "It's important to get away. My college says that even if you teach at summer school, you should take a month off."

Ziegler doesn't like to generalize about what type of vacation people should take. "The peace-and-quiet-no-phones-few-people kind of vacation I love," he says, "would drive some people up the wall. Those people need to fly someplace and ski, and fly someplace else and gamble, and fly someplace else again."

Whatever vacation you like, Ziegler, Vassallo, and Rees have some advice: First, take the kids about half the time. "Families need to do things together," says Rees. "Teens need to stay in the family, too—and they don't always have to bring along a friend. But don't take a child-oriented vacation, don't spend the whole time at Disneyland or Busch Gardens. Parents need time alone together." Ziegler says parents need to balance private vacations with family vacations: "If you can afford it financially and emotionally, do both."

Second, separate vacations for spouses may not be such a great idea, although, as Vassallo notes, "constant companionship produces its own stresses." Ziegler suspects that a desire for separate vacations might be a symptom of insufficient separateness during everyday life. Separate vacations are sometimes suggested for couples having serious tough times. "They might be better as therapy," says Ziegler, "than as routine."

Third, don't work late the night before, slam everything together the next morning, and insist on leaving the house by 10 a.m. or the world ends. "The transition from work to play," argues Rees, "is itself stressful. Make the transition gradually, rehearse the change." On the stress scale where the death of a spouse rates 100, just going on vacation checks in at around 10. "Plan for the stress of leaving," says Ziegler, "pack ahead of time, loaf along."

Finally, take as much vacation as you can get. Experts disagree on whether your annual leave should be split into several vacations or taken all at once. "You don't want to pack a whole year's relief into one vacation," says Vassallo. On the other hand, says Rees, "It can take four days just to relax."

The main thing, says Rees, is that people get sufficient vacation time—a minimum of three weeks a year.

—Ann Finkbeiner

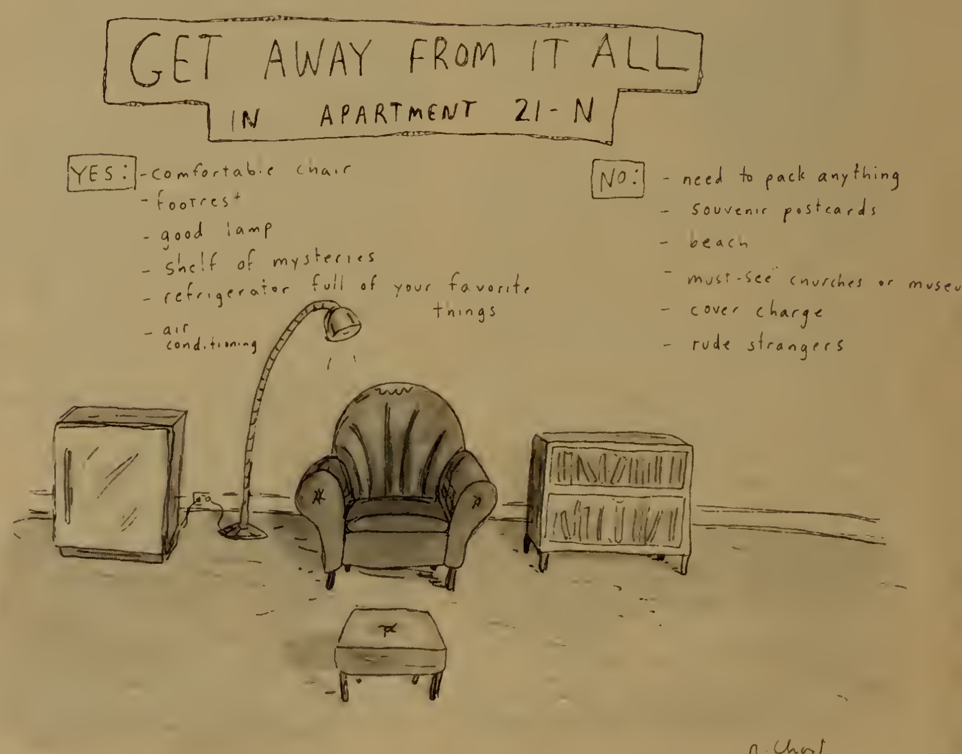
FICTION OF FREE-FALL

E.M. Forster's *A Room With a View* starts with people arriving in Italy on vacation. Nothing new there; fiction was always about people on vacation—people in free fall. Don Quixote was not punching a time clock. The great genre that extends from the *Odyssey* to *The Adventures of Augie March*—the picaresque, the tale of the unattached wanderer—is a saga of what we have learned to call vacation (interruption of routine). But Homer along with Saul Bellow (before Chicago's Committee on Social Thought flypapered him) could see it as the normal shape of human life, a taking of things as they come. Here "Vacation" means "back to normal."

It was the glory of Henry James that his people didn't "work." That meant: being free from predictable and fairly uninteresting pressures, they could expand, stretch, and dart fire. Some were dull, true, but if they were you could see the cause—and expect a most interesting pathology—in them, and not in their subjection to "9 to 5."

And the Hemingway hero—Robert Jordan in *For Whom the Bell Tolls*—has been cut loose to think about blowing up a Spanish bridge the way he might be thinking about damming a stream some footloose July, up in Michigan.

Fiction, 19th-century British fiction especially, has its gridded and ineluctable particulars—the clock, the calendar, the railway timetable, the city plan, in fact just about everything that pedantry assigns to "structure"—because as football needs its grid to persuade you mayhem is rule-bound, so the untrammeled bouncing about of human volition needs a look of containment before we'll acknowledge a writer's tidy job. For of writers we expect "Plot," and plot is chaos. "Plot," come to think of it, is foreshadowed in the *Odyssey*, when the winds of Aeolus come out of their bag,



and the scheme of any novel is:

BEGIN

Let the winds loose.

(Chapters of blowing about.)

A show of rebagging them.

END

I once heard the novelist Richard Stern confide that he began *Golk*, the saga of Herbert Hondorp, by "cutting Hondorp loose."

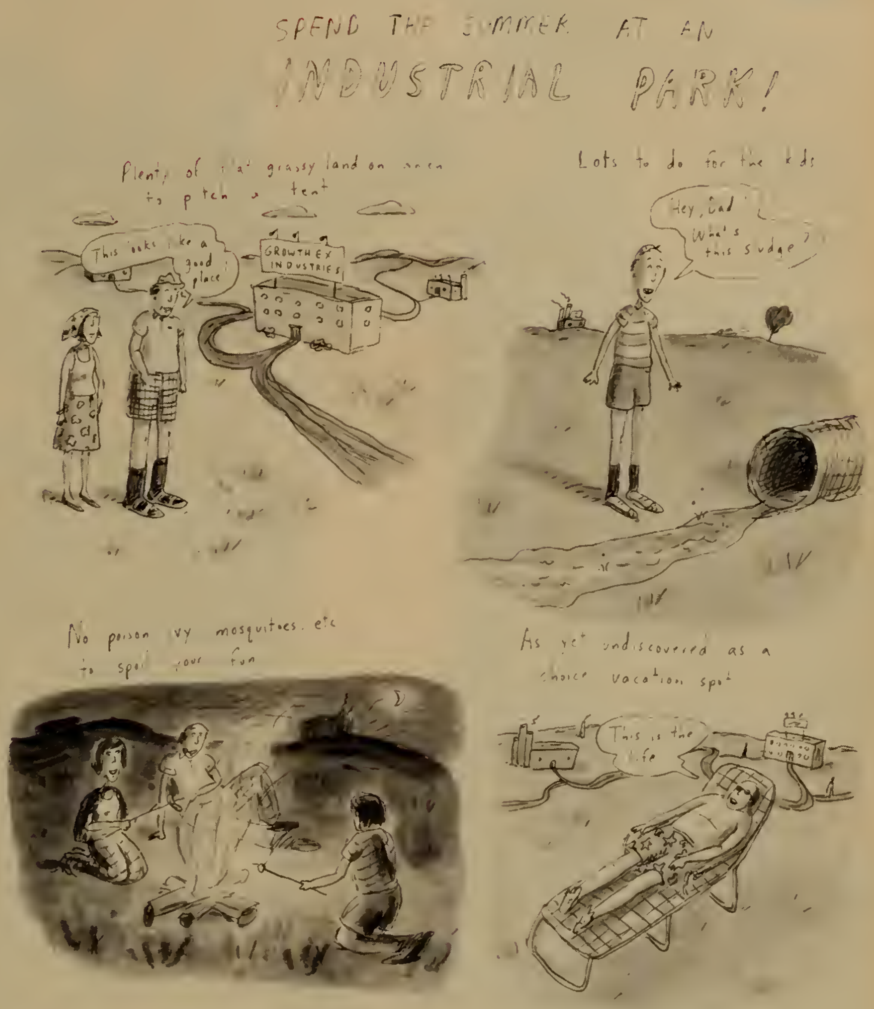
David Lodge wrote a story some years back about an English family's unsuccessful vacation. Their idyll had begun, it belatedly turns out, with the dog getting mortally run over, and the rest of the story was of the same texture (sunburn, seasickness). The story's subtext seemed to be that vacations are without exception unsuccessful, something it needed the dog's demise to bring home. That is a bourgeois perspective (Lodge's point). Following the Trojan War, Odysseus has a 10-year vacation of spectacular unsuccess, losing his ships and crewmen, being humiliated by Cyclopes worse than mosquitoes, tied to the mast while listening to song (which you'd not put up with in the Acapulco Hilton), and having his dog drop dead the minute he's back in Ithaca. Paraphrased, the *Odyssey* might be the stand-up monologue of a nebbish comedian, and such a thing may have crossed James Joyce's mind.

Fiction tells us that to be on vacation is mankind's natural state. That it's normal to be accountable for every moment is a potent counter-fiction, endorsed by the IRS as by all listers of figures. Thus real fiction rejects figures. They pertain to the anti-world. The moment Bellow starts mentioning numbers he's clawing us down into unreality, and the deadpan listing of Bloom's budget for the day is one of the high comic moments of *Ulysses*.

Fiction, the hammock: those are symbiotic, as the *New York Times Book Review* knows. Eyes always on figures (#1? #2? #7 last week?), the *Review* stands in for an industry. No member of a holiday crowd is more alert than the pickpocket.

—Hugh Kenner

Hugh Kenner teaches English at Johns Hopkins. He is the author of The Pound Era *and* A Colder Eye: The Modern Irish Writers, *as well as many other books.*



A SHORT HISTORY OF VACATIONS

"We Westerners have a funny way of dividing our time," says Sidney Mintz, a Johns Hopkins University anthropologist. "We think of work and play as polar opposites." That peculiar schism, says Mintz, produced the Western idea of vacationing—getting away from work.

But the idea is an old one. Aristotle talked about vacations in his *Politics*: "We do without leisure only to give ourselves leisure." And Romans had more than 100 "Roman Holidays" on the calendar. Ostensibly religious observances, the holidays were festivals of over-drinking, over-eating, and cheering on fights to the death. Gladiator fights and wild animal baiting figured as major attractions. By the close of Caesar's reign, some of these holidays lasted two to three weeks.

Medieval Europeans reverted to a vacation schedule based on sowing and reaping. Between harvests people were free to do as they pleased for days at a time. Although they couldn't travel far (ordinary people needed infrequently granted passports to travel even short distances), they could gather at nearby fairs, such as the Stourbridge Fair near Cambridge, which lasted three weeks every September, to eat and drink, trade goods, play games, dance, and tell tales.

When the Industrial Revolution started

WISH YOU WERE HERE

In 1865, a German and an Austrian independently decided that there must be a cheaper way to mail messages. Their idea: a piece of card that could be posted at a reduced rate. The Austrian Post Office liked the idea and issued its first card in 1869; other countries soon followed suit.

The first cards weren't much to write home about. They had a stamp, and room for the address on the front, and the message on the back. Privately printed cards depicting interesting scenes were already being sold as travel souvenirs when the plain post office cards came out. It didn't take long before people began to drop them into the mail. But the post offices were stingy: any cards but their own had to pay the normal letter rate.

The U.S. Post Office got wise in 1893, issuing picture cards for the World's Columbian Exposition. By 1898—realizing that not many tourists would spring for the two-cent cards and so probably wouldn't mail anything at all—they allowed private cards at the reduced rate.

But no messages were allowed on the address side; people had to write in spaces left around the picture. It wasn't until 1907 that senders could flip to the address side and write "Wish you were here."

—Leslie Brunetta

"I wouldn't send this card," says post card collector Ray Norris of Catonsville, Md., "but in the '00s and '10s, card buyers liked pictures of fires and lynchings, too."

During prohibition, there was more than one reason to go on vacation.

gathering steam in the late 1700s, rhythms of work and play changed dramatically. Factory owners needed reliable bodies on the job, bodies that wouldn't hear the call of local fairs and other diversions. And the best way to insure that, the owners figured, was to institute long days and long weeks. In England, for example, bank holidays (national days off) dwindled from 47 in 1761 to 4 in 1834. The Factory Act of 1833 guaranteed children eight half-days off a year in addition to Christmas and Good Friday. (The weekend hadn't been invented yet; only Sunday was a regular day off.) The act wasn't popular among owners, who thought it too liberal. Americans weren't much better off: Their standard work week in 1870 was about 70 hours long.

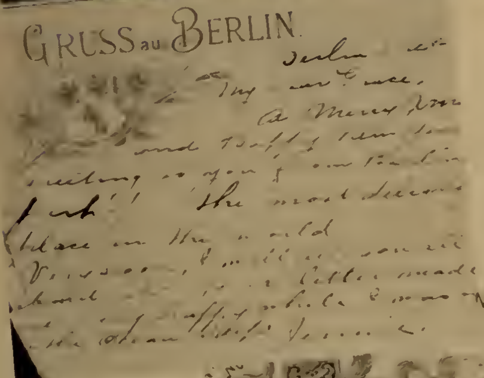
Still, on those few days off, workers who could afford vacations took them. English train excursions to public executions were popular, sometimes boosting the local crowds to mobs of 50,000 people. And some factory owners and churches organized daylong excursions for their workers to the seaside, major cities, and country pleasure-spots.

The king of excursions, Thomas Cook (who gave his name to the Cook's Tour), started out as a temperance pamphlet printer who organized a public train excursion from Leicester to a large temperance meeting in Loughborough in 1841. He soon began to arrange bigger and better excursions around the north of England, mainly to church and temperance conventions, and managed to get 165,000 people to London's Great Exhibition of 1851. Cook wasn't satisfied: "We must have RAILWAYS FOR THE MILLIONS," was his motto. By 1856, he had organized his first grand tour of Europe and soon became an agent for the sale of tickets to independent travelers.

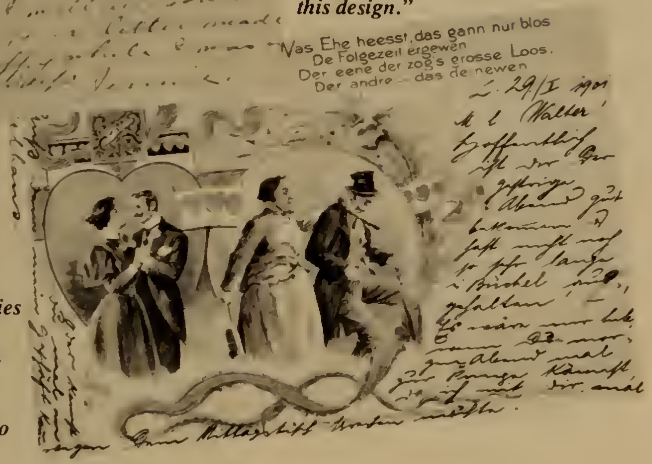
But the big vacation breakthrough came about when working people gained longer holidays with pay. One-, two-, and three-day excursions were all very well, but they were often more tiring than rejuvenating. The labor movements in most Western countries started agitating for paid holidays after gaining shorter work days in the late 1800s, but it wasn't until the 1930s that paid holidays became common. In England, for instance, about 1.5 million wage earners had holidays with pay in the 1920s, compared to about 11 million by 1939. As the number of vacationers rose, so did the number of seaside vacation camps (where campers were organized into

Many early cards, including this Japanese one, were collected as pieces of decorative art rather than mailed as souvenirs.

"'Greetings from the Mudbath' is from 1921," Norris says. "It lets you know the period's sense of humor."



"'Gruss aus' means 'greetings from,'" says Norris, who has over 10,000 cards. "Most turn-of-the-century travel cards copy this design."



"Whom marriage ties together,
Only time can tell.
Sometimes they charm forever,
And others—not so well."

These post cards courtesy of Ray Norris

sports and entertainment teams), tours around the country and abroad, and camping grounds in national parks and near popular historic sites.

The car reinvented the American vacation. In Henry Ford's affordable automobiles, the middle and working classes took to the roads in droves, on short Sunday drives and long camping trips. In 1910, a few tens of thousands of people had visited the country's national parks, but by 1935 about 34 million had stopped in, almost all transported by private car. With some canvas, and a lantern and stove, holidays could be do-it-yourself affairs—much less expensive than trains and hotels, and for many people, much less intimidating than dealing with supercilious bellhops and deskclerks.

From makeshift roadside stops sprang campsites equipped with showers and toilets. Next came campsites equipped with small sheds sharing communal facilities, then small cabins equipped with many of the comforts of home—the first motels. Or you could pull your lodgings with you, as trailer homes developed from homemade wooden cabins on wheels to the silver-bullet Airstream Clipper.

The airplane soon made foreign travel a possibility for those not yet satisfied. In 1936, Pan American Airways offered the *China Clipper*, the world's first transoceanic passenger flight, from San Francisco to Manila. The *Clipper* was for economic high-flyers willing to pay $950 for speed: The trip took six days (60 hours flying time with overnight stops at islands along the way) rather than the three weeks ships took.

The propeller-set became the jet-set when British Overseas Airways Corp. introduced jet service from London to Johannesburg in 1952. Added speed and comfort—and gradually decreasing costs—made flight increasingly popular. Today, about 30 million passengers a year leave the U.S. on flights bound for foreign destinations. With deregulation of the airline industry making cut-rate fares and updated versions of Cook's excursions commonplace, even college students can afford the Grand Tour.

But students are among the privileged few who can also afford the time to take leisurely vacations. Although 98 percent of the American workforce receives some paid vacation, an Industrial Age work ethic still rules. Even after five years with the same employer, according to the U.S. Bureau of Labor Statistics, the average worker has just 12.7 days off

a year: after 10 years, 15.9 days off. Weekends are great, but they end too soon. To really relax, you need a whole chunk of time. We have a long way to go before we catch up with the Romans.

—Leslie Brunetta

WHERE THEY GO, WHAT THEY DO

Like many things Western, vacations have caught on big around the globe.

In India, for example, the government now reimburses the rail-travel costs of every government employee's biennial "haoya badal" ("change of breeze"). The government largesse has its drawbacks, such as a flourishing black market that furnishes phony rail-receipts to unscrupulous employees, but still, the nation's vacation industry is booming.

"A century ago, the concept of a vacation was entirely absent in India," says Amit Mitra, an economics professor at Franklin and Marshall College. The only excuse for leaving home was to make a religious pilgrimage to one of India's plethora of shrines—"to pave your way to Heaven," Mitra says—and that often meant hitching up your camel, and risking death and starvation during a months-long trek through the Himalayas.

Then the British brought railroads, office life, and, of course, vacations. And when the new educated upper-middle class Indians began to emulate the British, they combined their vacations with the old idea of making religious pilgrimages.

The practice still holds. For the lower-middle class, it might just be a weekend trip—the Taj Express gets you from Delhi to the Taj Mahal in just three hours, with overnight accommodations as part of the package. Wealthier people, such as business executives in Bombay, might take a jaunt to the Caribbean-like nude beaches at Goa and Puri, but they're just as likely to tie in a beach trip with a visit to the religious shrine at Kovalam, at the southern tip of India near Sri Lanka, where there also happen to be several five-star hotels built into the face of the sea-cliffs.

"All the most beautiful temples in India seem to be near the sea," Mitra says. "I suppose the ocean provides easier access to God."

Religion is out of vogue in the Soviet Union, but as in India, the government is gung ho in its support of vacationing. The Soviet Constitution has recently been amended to guarantee workers in most industries four weeks of leisure time per year, and the railroads are cheap. (Aeroflot, the government airline, is also cheap, but somewhat unreliable. "Everything's a secret—they don't publish schedules," says Hartwick College political science professor John Lindell, a veteran of travel in the Soviet Union and the Orient. "Basically, you'll get a call at your hotel and a voice will say, 'It's time to go.' ")

Museums and war monuments are favorite short-term destinations for the Soviets—the Hermitage Museum in Leningrad is considered one of the world's finest. Beaches become the mecca during the short summer months.

"The Black Sea, with cities like Sochi, Yalta, and Odessa, is an area that has elements of the California Gulf coast and the Northeastern Atlantic," Lindell says. "Its latitude is comparable to Minnesota's, so the summer is brief but very warm and beautiful." The beaches are also beautiful, but not always the most comfortable; to fight erosion, the government has removed all the sand at the Sochi and Yalta beaches and replaced it with pebbles.

The Soviets are group- and family-oriented when it comes to vacationing; factories and businesses often maintain low-priced vacation villas on the Black Sea for their employees, and often two or three families will book a villa together.

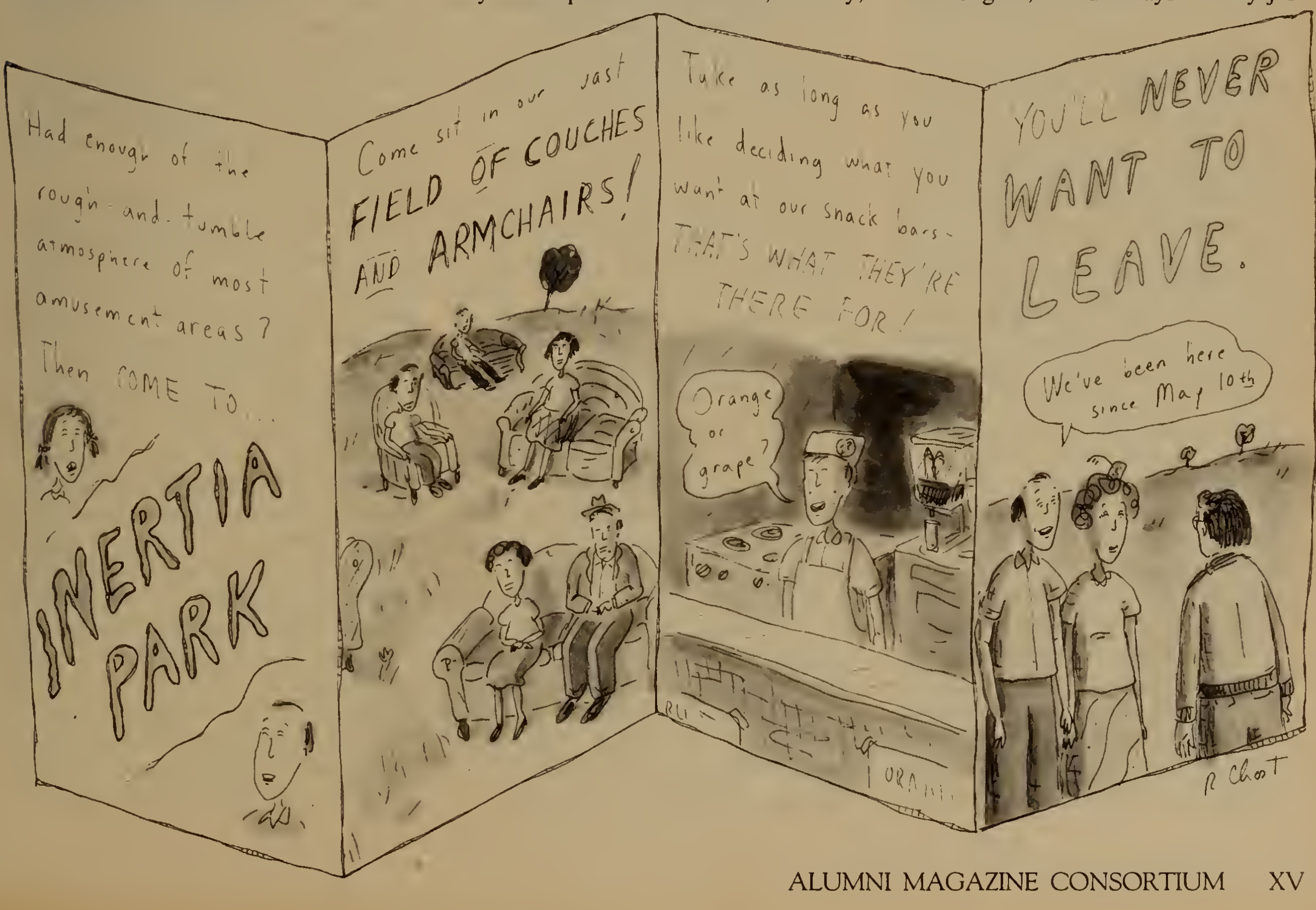
The Soviets are also fond of river cruises on the Dnieper, the Volga, and the Don. But Lindell quickly dispels a Twainesque vision of latter-day steamboats. "It's like 'Love Boat,' only less elegant," he says.

Lindell adds that traveling abroad is an option only for a certain elite in Soviet society.

"The system is rigidly stratified," he says. "People in the industrial, military, or educational elite can travel within the Eastern Bloc—you know, Poland or Czechoslovakia. Higher up, you can maybe go as far as Yugoslavia, the Mideast. And when you reach the pinnacle—if you're a superstar athlete or performer with the Bolshoi—you get to go to the West."

The hardest of the hard-core tourists appear to be the Japanese, who also fall within Lindell's purview. "They go everywhere, en masse, by the busload, by the planeload," he laughs. Whole offices will book train and hotel reservations together, and "at any turn in the road where there's a gift shop, they'll stand on a platform and get their picture taken."

Every Buddhist and Shinto shrine is jammed starting in the spring, when the high schools make their annual trips to Kyoto and Tokyo, and they stay that way all through the summer. December and January are heavy traveling months, too, because the Japanese, "about 99 percent of whom are Buddhist or Shinto," says Lindell, have adopted Christmas as their favorite holiday. "It has nothing to do with religion," Lindell says. "They just



like the tree and giving gifts." (Doesn't sound much different from the West.) January brings "Adult Day," when young people turning 21 in the year ahead travel to their local shrines to get blessed. (Shinto, by the way, is an indigenous, state-oriented religion influenced by Buddhism and Confucianism which emphasizes "the spirit of things," Lindell says, "such as the environment, not polluting it—though of course, they do a lot of that.")

For honeymooners and other romantically inclined, the red-dyed hot baths at the resort city of Beppu, on the island of Kyushu, are a big attraction. Abroad, Guam and Hawaii are the hot spots for those with money. During the winter, ski vacations in Sappuro are the rage. "A typical worker in Tokyo can catch the ski train Friday afternoon, ride all night sleeping sitting up, be on the slopes the next morning and all day Sunday, then ride back all night and be at work Monday morning," Lindell says.

Socialist France is also very supportive of vacationers—the average French worker gets five weeks, usually taking one in the winter and four in the summer. The Riviera has become so jammed in the summer—there are many trailer parks, some just outside St. Tropez—that the southwest Mediterranean has become the more popular beach escape among the French themselves, says Johns Hopkins graduate student and Marseilles native Christian Fournier. Fournier says that the Spanish Riviera is the favorite French vacation spot abroad, in part because it is so inexpensive. In general, not that many French travel abroad, Fournier says, although there is a certain holdover of "'70s adventurousness" among young people. "There are tour and charter companies such as 'Nouvelle Frontière' " (yes, the name is borrowed from John F. Kennedy) "which will organize a safe adventure for you trekking in the Andes, that kind of thing," he says. "They still have a branch organization in New York City."

For the majority who remain in France, the goal is often to find an out-of-the-way place in the countryside. "Families like to stay with local people at a farm in beautiful rural areas such as Périgord, or Anjou," he says. The wealthier have adopted the practice of maintaining a "secondary residence" (weekend and summer house), such as a renovated farmhouse in Provence or the Luberon, a "gentrified" area of old stone buildings made over into villas and mansions. Americans often rent in these areas, too, and Fournier says "it's not so expensive as in the U.S."

—Joe Levine

DON'T DRINK THE WATER

Travel agencies offer exotic tours these days. You could have had a cruise to the equator for a clearer glimpse of Halley's Comet. How about hiking in the Himalayas? Or an African safari? Words of warning from Bradley Sack and Alan Rabinowitz: Adventurous destinations call for specialized health precautions.

Sack directs the Johns Hopkins International Travel Clinic, and Rabinowitz (a 1974 Western Maryland College grad) spends two out of every three years in the wilds of Central America and Asia studying endangered species for Wildlife Conservation International. Travel agencies, they agree, are not always the best advisors about what health precautions to take.

Rabinowitz has travel health tips learned from experience. Over the last 10 years, he's contracted a variety of parasitic diseases: hookworms, round worms, amoebic dysentery, typhoid, and even a parasite that gets under the skin and eats its way out through flesh.

The most important precaution on his list is to avoid mosquito bites. Mosquitoes carry yellow fever and malaria, which can be fatal if not treated. Wearing a long-sleeved shirt in dense forest areas and always sleeping under a mosquito net are good preventive measures.

Some African strains of malaria, notes Sack, are even resistant to chloroquine, a standard medication for preventing the disease. He agrees with Rabinowitz: The best bet for avoiding mosquito-carried diseases is not to be bitten. Use a good mosquito repellent.

For travel to Northern Europe, Australia, and Japan, Sack says, immunizations are seldom necessary. But for travel in Central America, Asia, and Africa, be immunized for hepatitis B, typhoid, tetanus, diptheria, and polio. Visitors to China also need a vaccination for Japanese encephalitis. Although most travel agencies still recommend cholera vaccines before traveling in developing countries, Sack says that "in most cases, the cholera vaccines haven't proved useful so we don't usually recommend them."

Diarrhea is a common health problem when traveling in developing countries. The best defense is taking preventive medication and carefully selecting food and drink. In Rabinowitz's travels in Trinidad, Thailand, and Central America, he's found that the natives don't always cook the food thoroughly, and their livestock, especially pigs, are infected with bacteria. He doesn't eat meat unless he knows it's been cooked thoroughly, and he's careful about who serves the food. Sack's basic food rule is to avoid anything that can't be peeled or cooked.

As for water, in Asia and Central America, Rabinowitz emphasizes, "Never, never drink the tap water!" He either filters or boils water or treats it with Halizone tablets. (Ice isn't safe either.) Tea or coffee are safe to drink (the water has been boiled), and bottled water is a safe choice.

He can't always follow his own advice, however. "My problem is that I often drink untreated stream water," Rabinowitz says. In Trinidad, where he studies vampire bats, or in Central America, where he set up the first-ever game preserve for jaguars, he has to live like the locals. "If I put tablets in my water to purify it, the natives might not talk to me."

Swimming in fresh water in Africa, Asia, the Caribbean, and the Mediterranean is not a good idea, Sack warns. Schistosomiasis, so-called "snail fever," is caused by a parasitic worm that breeds in fresh-water snails. The parasites can penetrate healthy skin and can damage vital organs if undetected for a long period of time. Swimming in the sea is okay, says Sack, because salt water doesn't contain the parasites.

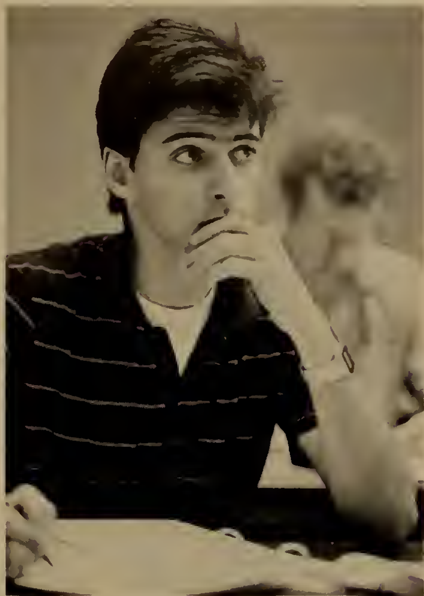
—Rhonda Watts

On the Fault Line

The Evolution of the WPI Plan

Today, 5,446 students have graduated under the WPI Plan. But in the past several years, change has come to the Plan. Is the Plan dead, as some critics on and off campus have maintained? Or is the program simply evolving to meet the changing needs of higher education and the society it serves?

By William R. Grogan '46


Michael Carroll

To evaluate the status of the WPI Plan today, it is essential to place its operation in perspective relative to the proposed objectives of the undertaking. The most authoritative summary of those objectives lies in the planning document itself, called *Two Towers IV—A Plan.*

The last of four major planning reports to the faculty and trustees, it was *Two Towers IV* that the faculty voted to accept as the basis for revising WPI's entire educational program. The faculty vote came in May 1970, and its action was endorsed by the trustees at the annual meeting the following month. The future educational program of WPI had already been the subject of intense discussion by students, faculty, and trustees for more than a year and a half.

Following its endorsement, the various features of the Plan were gradually phased in over a period of seven years. Each year saw more and more students pursuing the new degree requirements while the number of students enrolled in the traditional program was gradually reduced. By 1976, over 90 percent of the entire senior class graduated under the new program. Fall 1977 saw *all* of the students at WPI pursuing their degrees under the new program.

The seventies were heady years for WPI, just as the years since the Plan's implementation have been. But those times were somehow different.

They were years of intensive planning and fund raising. Proposal writing and course modification committees were everywhere. New programs—like Intersession, off-campus project centers, and independent study—were conceived and implemented.

Between 1970 and 1978 the undergraduate student body grew from 1,600 to 2,400, while the faculty increased in size, by 25 percent, to 175. Today the faculty numbers 215, and enrollment has plateaued at just over 2,600.

WPI's new program called for the elimination of all required courses and the institution of four performance-based requirements for graduation:

1. The Sufficiency in an area of the humanities consisting of five thematically related courses followed by an independent research activity synthesizing them through a mini-thesis.
2. The Interactive Qualifying Project (IQP), one-quarter year minimum, involving, where possible, an off-campus field component relating science or technology to social concerns or human values and involving interaction with people other than scientists or engineers.
3. The Major Qualifying Project (MQP), one-quarter year minimum, involving the solution of a significant problem in the student's major field, often with industrial cooperation.
4. The Competency Examination, a week-long written and oral examination of the student's ability to perform in his or her discipline.

Other changes were made at WPI to support the new program including a change from the traditional A, B, C, D, F grading system to one involving two passing grades, Distinction and Acceptable, with no record of failures, quality-point averages, or class rank.

Yet tension has existed at WPI since 1969 between the Plan's original concept of total curricular responsibility in the hands of students (with accountability maintained exclusively through terminal performance), and the commonly practiced concept of a college assuming much of that responsibility through curricular requirements along the way.

Over the years the internal management of the Plan required adoption of various procedures and definitions, while external constituents (for example, financial aid programs) demanded a type of on-going quantification of effort which the terminal-performance concept did not provide. Unfortunately, every definition required quantification, and every quantification required definition—each element in turn bringing a new constraint to the students.

To some of those who devoted their energies so intensely in the hope that the ideal Plan (especially in its emphasis on unrestricted individual program formation) would endure essentially unchanged, the years have been bitter ones, producing a seemingly endless series of compromises, constantly eroding the ideal, making its ultimate attainment more and more improbable. Most of the faculty, while seeing the Plan as an ideal, accepted the accommodations as the unavoidable adjustments required of a living system.

The academic catalog is now full of all sorts of regulations, all in one way or another limiting the freedom and flexibility the original concept envisaged, but necessary, I believe, for the reasonable administrative operation of the college.

Within the past three years three major changes were made: One, a grading change, which was thought philosophically minor, drew great attention; the second, a distribution requirement—a major philosophical retreat—was accepted quietly; while the third (a direct result of the second), replacement of the Competency Examination, again caused much student and faculty reaction.

Grades

In the early planning days when it was proposed that WPI have only pass/fail grades, it was felt that such grades would doom graduate school applicants and fail completely to recognize accomplishment of the outstanding students. A compromise system was developed resulting in two passing grades: Distinction (*AD*) and Acceptable (*AC*). Unacceptable work would have no record (*NR*) except in certain project situations.

Since the grading system involves communication with external agencies, however, there was a chronic problem of explaining adequately what the *AD/AC* really meant. There was growing evidence that graduate schools which were not familiar with WPI were not giving WPI students the consideration they deserved.

Many parents were concerned about a grading system they often confused with a pass/fail system (although prospective students themselves were ambivalent about the system.) Moreover, the lack of a *B* grade meant that many students who were not going to attain *AD* (essentially *A*) would tend to reduce their effort to make an *AC* rather than look for a possible *B* recognition.

It was an objective of the Plan to reduce the excessive grade-grubbing that haunts so many colleges and, in WPI's case, would likely have a negative effect on group project work, which requires a great deal of cooperation and peer assistance.

Accordingly, it was not proposed that WPI return to quality point averages and published class ranks, but simply change the *AD/AC* designations to the widely

Robert S. Arnold

understood *A/B/C* notation, which involved the insertion of a third passing grade (*B* level). Thus, we felt, WPI's transcripts might be better understood by external users and WPI would still record only passing work and not the penalty grade of *F.*

The change in the grading system, which was enacted in 1985, proved to be a highly personal issue with the students, while some faculty who opposed the change saw in it a major retreat from the Plan.

To other faculty members, however, the change seemed more cosmetic than substantive, and they did not feel that it would have a major impact on the nature of the educational program. I actually proposed adding a third grade in 1982, and I was not prepared for the intense emotional linking which eventually erupted between the grading system and the Plan's survival.

The strong anti-grade-change reaction was apparently the confluence of three factors: a conviction that the change would damage the positive peer-support environment at WPI; a sense of loss in that the change reduced WPI's uniqueness, something that had been made highly visible through its grading system; and a strong, delayed transferred resentment of the distribution requirements just adopted (see below) which were unpopular but over which, unlike the grade changes, many students and faculty members felt they had little control.

The change in the grading system was an internal matter, not required by any academic accrediting agency, and had it not occurred there would have been no crisis.

Coming as it did after the distribution requirements, the action's timing turned out to be unfortunate. It did seem to most faculty that in the long run better external understanding of WPI's measurement of accomplishment would be attained with the change to *A/B/C/NR.* The change will be effective in the fall of 1986 for new freshmen (Class of '90), and optional for others.

Distribution Requirements

Initially, under the Plan the opportunity for a student to design a highly creative educational program was extraordinary. There have been many exciting students—some of whom might never have come to WPI were it not for the Plan—who created programs and recorded accomplishments that would have been virtually impossible at any other college of engineering.

The Plan did not, however, fundamentally change human nature. To WPI also came many students of good motivation and ability, but inclined to do basically only what was required of them.

A case in point was the study of basic science on the part of engineering students. Prior to the Plan, specific, rigidly prescribed courses in physics and chemistry were required. The Plan did not require but strongly encouraged study and exploration in the sciences, and it was generally felt that engineering students would logically take such courses since engineering flowed from the fundamentals established in the sciences.

When, however, students discovered that they could perform quite well in both the MQP and the Comp and in upper-level engineering courses without science courses, as may well be the case in much professional practice, it was not long before the student grapevine took over, and the number of students satisfactorily completing science courses started to drop. The study of mathematics and some areas of engineering science were also affected, although not as significantly.

Accreditation of engineering programs is established by the Accreditation Board of Engineering and Technology (ABET). WPI has four applicable engineering programs: chemical, civil, electrical, and mechanical engineering. Students in these programs account for 75 percent of the undergraduate student body. Whether or not basic science courses are really needed for engineers is a matter for discussion elsewhere, but ABET believes that they are needed and today will not grant professional accreditation without them.


Michael Carroll

In fact, ABET specifically requires precise minima of a half year of sciences, a half year of mathematics, one year of engineering science, and a half year of design—none of which were specified within WPI's performance-based program.

The faculty was aware of ABET's expectations, but the ABET guidelines also said that experimentation was encouraged. The feeling at WPI was that if, by the time the degree was awarded, the graduates could do everything that the graduates of the ABET-prescribed program could do—and hopefully more—then equivalency would be established. That was not the way ABET eventually approached the case, however.

The ABET Saga. The ABET saga began with the first Plan accreditation visit in 1976. The blue-ribbon visiting committee of that year (including two members of the National Academy of Engineering) gave great encouragement to pursuit of the new WPI program, carefully examined the results of MQPs and Competency Examinations, and gave cursory note to the transcripts in a manner consistent with the Plan design. In the end they provided WPI with a full six-year reaccreditation.

In 1982 another visit occurred. This time a committee comprising members of a more traditional bent examined the transcripts in detail, compared them with ABET's distribution criteria, and determined there was significant variance in expected course completions.

A long series of—let us say—discussions took place between WPI and ABET on the matter of recognizing experimentation in engineering education in accordance with ABET's guidelines. WPI had taken ABET's published statement on encouragement of experimentation in engineering education literally and had been reinforced in its interpretation by the 1976 visit. But it has become painfully apparent that the experimentation now tolerated by ABET is limited to that which can be accommodated within its prescriptive program criteria.

After the 1982 visit, WPI was reaccredited for three years. For two years following the visit, the faculty and the Committee on Academic Policy went through agonizing discussions leading eventually to a motion that would allow all WPI departments the option of establishing 10 units (30 courses or equivalent work in projects) in designated generic areas (for example, science, mathematics, etc.) for their programs.

For the engineering programs, these would encompass the minimum ABET criteria. Such requirements would apply to students entering WPI after May 1984 (the Class of '88).

Late in 1984 a new team of ABET visitors arrived and reviewed transcripts of graduates in even more detail than before. The new distribution requirements, which applied only to the class that had just entered, did not affect what they found. In general they were unhappy that the faculty had taken two years to establish the distribution requirements following the 1982 reaccreditation. Now ABET wanted the distributions that were adopted even further tightened and defined to meet the minimum ABET criteria more precisely.

While the second round of changes adopted by the faculty were relatively minor, they caused further emotional reaction. The practical effect was that, by expanding the specific requirements, the flexibility of the overall program was further reduced. As of October 1985, a maximum of seven courses remain completely unspecified in engineering programs, except that the need for chemistry in chemical engineering further reduces any flexibility in that program.

Following the 1984 visit ABET reaccredited all four engineering programs with reviews expected in 1988.


Dean William R. Grogan '46, one of the architects of the Plan, WPI's "Academic Outward Bound."

The IQP: Deserving of Special Mention

The Interactive Qualifying Project is the most unusual degree qualification of the WPI Plan and is unique in American higher education. This project introduces science and engineering students to the priorities and concerns of nontechnical elements of society as they carry out research and undertake the solution of complex interdisciplinary problems.

For some, the IQP has been the most stimulating element of their educational experience at WPI. For example, more than 550 students and nearly 50 faculty members have carried out IQPs at WPI's well-known Project Center in Washington, DC. In 1986-87, a similar project center will open in London, England.

With the advent of Distribution Requirements, the IQP remains the major degree requirement which the student undertakes from a remarkably wide spectrum of choices. Individualistic in its selection and execution, the IQP meets many of the original objectives WPI established for its educational program.

Beyond ABET. While ABET was an important driving force for change, and probably caused more extensive changes than desired, there were other pressures mounting that would make some modification of the Plan inevitable. The very idealism that caused such profound change to take place at WPI in the first place would eventually lose credibility if not tempered by the acceptance of change itself.

In conceiving the Plan, WPI had deliberately moved away from the Strasbourg Goose process of trying to stuff the students full of every fact needed in their lifetime to that of providing key concepts in a highly motivational atmosphere with performance criteria for graduation.

Time was proving, however, that the knowledge gained through study of basic science serves a very different purpose than that in the applications-oriented engineering courses. In August 1982, I proposed to the faculty that before taking the Competency Examination, students in engineering programs must have completed two units of work [6 courses] in the basic sciences, the course or project work to be determined by the student with assistance of his or her adviser.

My recommendation concluded: "I know [these recommendations] unfortunately tend to have the unpopular flavor of adding more fabric to the system, but this is what I think is needed to maintain and strengthen the knowledge base of our graduates, and yet keep insofar as possible the ultimate responsibility for their own education in their own hands in a flexible system with terminal responsibility."

The extent to which "fabric" was again desired by most faculty and the severity of the problem of then tempering departmental forces which would over-design the curricula once more, were indicated by the fact that while only the four engineering programs were responsible to ABET, all major degree-granting departments except physics elected to use immediately their new option of establishing 10 units of distribution requirements, some of them going beyond the engineering departments in the specificity of their new distributions.

The Competency Examination Reconsidered

What eventually came to be called the Competency Examination was not in the earliest, most ideal concept of the Plan. Originally, the Plan proposed no course requirements but rather based all performance evaluation on project work. However, many faculty members feared that degree requirements which lacked some measure of evaluation directly related to course work would lack external academic credibility.

Thus a week-long, open-access examination to test students individually in problem solving and to assure a certain breadth of learning was designed. (Lingering and never-resolved ambiguities about the breadth vs. depth goal of the exam were reflected in the change of its title from "comprehensive" to "competency.")

Given the conflict between "comprehensive" and "competency," the Competency Exam, or Comp, has remained the most difficult degree requirement to handle effectively. Like other features in the program, the exam is faculty-labor intensive. With an "all or nothing" outcome, the exam has been, from the start, a highly emotional experience for students and faculty.

Creating individual exams which can measure four years of learning for individual students proved to be extremely difficult. The traumatic problem of dealing with as high as a 30-percent failure rate in the spring of the senior year was never satisfactorily resolved.

Too frequently, students who pass the Comp feel little motivation to continue their studies seriously. Perhaps most important was the student perception that only those topics likely to be covered on the exam really had to be studied in earlier course work.

On the positive side, the Comp indeed encouraged retention of information likely to be included on the Exam; it did force an intensive and beneficial review of one's entire major subject area. Surveys of alumni suggest that passing it instills an enormous sense of confidence on the part of successful students.

But whatever the other merits of the Examination, it was becoming increasingly apparent to many of us that an untenable situation was brewing relative to the expectation that engineering students meet all the conforming distribution requirements (which alone would qualify them for an engineering degree anywhere else) and then face possible denial of their degree should they fail this single *unvalidated* examination in the spring of their senior year.

Thus, on April 10, 1986, after another year of consideration in the Committee on Academic Policy, the faculty voted to eliminate the Competency Examination as a degree requirement for students who must meet the distribution requirements of their respective programs. Students in the Classes of '86 and '87, for whom distribution requirements were not yet mandatory, were given the option of graduating by either the distribution or the competency requirement route. Programs such as humanities, interdisciplinary programs, physics, and social sciences, which did not have stated distribution requirements, retained the Competency Examination.

Immediately, a number of students vocally expressed their surprise and opposition to the dropping of the Comp. "The Plan is Dead" banners appeared in dorm windows; *Newspeak*, the student newspaper, fumed; and the Worcester newspapers dispatched reporters to the campus.

Over the years the Examination had established a real esprit de corps among some students and alumni, and they were alarmed at the prospect of future generations not sharing in what had become a WPI rite of passage.

Perhaps, however, the real significance of the negative reaction lay more in the realization that the faculty had now officially bypassed the most prominent symbol of a halcyon era during which WPI tried very hard to establish a truly flexible, competency-based educational program. Now was the dramatic recognition of what had been reality for three years: the distribution requirement had replaced the Comp as the new show in town.

There were many undergraduates not heard from this spring who now quietly admit that they had breathed a very deep sigh of relief at the prospect of no longer having to face what was about to become for them a double-jeopardy situation in their senior year.

If any organizational generality can be demonstrated in this overall experience, it might be that reluctance to accept minor modifications early in the operation of a new system will almost certainly bring about an unwanted degree of major change later. (See accompanying story for more on the Competency Examination.)

Is the "Plan" Alive?

If the "Plan" is defined as a system of education wherein students, free of the usual curricular constraints, are encouraged to pursue learning as they themselves see fit with their accomplishment

William Denison

certifiable only through performance requirements, then the Plan lives only to the extent that within the distribution requirements there is choice in specific courses and in their scheduling.

It would be neither fair nor accurate, however, to dismiss the importance of the radical educational approach attempted, or the courage and faith that accompanied it, or to pass off as visionary and unimportant the profound educational impact it would have had were it not for the realities of communal atmosphere, external tolerance, and, above all, human nature that placed beyond WPI's reach the extraordinary educational Utopia its faculty originally sought to achieve.

The sweep of The Plan is so great, however, that—if one looks beyond the disappointments in the area of an ideal student-directed learning system and looks back instead on the overall objectives of *Two Towers IV*—one can find overwhelming evidence that most of the other original objectives are indeed being met today in the WPI system of education. The results:

- To provide intellectual breadth and a better understanding of themselves, their cultures, and their heritage, every WPI student now completes a Humanities Sufficiency.
- To provide an understanding of the priorities of other sectors of society, develop the ability to communicate effectively with disparate groups, organize and derive solutions to complex problems, and gain an awareness of the interrelationships between technology and people, every WPI student completes an Interactive Qualifying Project.
- To provide a capstone experience in the professional discipline, to develop design creativity, instill self-confidence, enhance ability to communicate ideas, and synthesize fundamental concepts, every student now completes a Major Qualifying Project. To provide for learning through an academic program with fabric and balance while encouraging individual student choices within that framework, most majors have distribution requirements.

Whether it is still appropriate to call WPI's present educational program "The WPI Plan" is a matter of personal interpretation. Most of it is in place and thriving, but the original open curriculum, to the extent that it actually existed, is now largely constrained. Still, the unique degree qualifications outlined above do indeed produce for our graduates a broad educational experience with many of those qualities sought for in *Two Towers IV.*

While the totality of the objectives has not been achieved, the remarkable achievements of the past decade and a half have not passed without producing an enduring legacy of great value. WPI today has a unique, dynamic educational program. Its projects and non-technical expectations provide WPI students the opportunity for a truly outstanding educational experience.

In the final report of the NSF advisory panel, Dr. John Whinnery, of the University of California at Berkeley, summed it all up this way: "The search for the ideal educational experience, like the Greek philosophers' search for truth, is in some ways easy and in some ways hard. It is easy in that one cannot miss the goal completely, and hard in that one cannot attain it perfectly."

William R. Grogan is dean of undergraduate studies at WPI.

The Binary Gateway to Graduation

"An academic outward-bound" is how Harvard University's David Riesman, a member of a visiting National Science Foundation advisory committee, once described the Competency Examination. For almost 15 years, the Comp (in the common parlance) served as the capstone of a WPI education, testing the mettle of every student in 11th hour, all-or-nothing fashion. But no longer.

By Kenneth L. McDonnell

Michael Carroll

The Competency Examination: Where every student must demonstrate his or her ability to integrate fundamental principles in solving open-ended problems under severe time limits. Here, Scott G. Young '86 CE is scrutinized during his Comp orals by (l. to r.) CE Professors Fattah A. Chalabi, Kris Keshavan, and Guillermo F. Salazar.

From the beginning, the Competency Examination, WPI's academic-hell week, had been the troubled sibling of the three other degree requirements constituting the WPI Plan. Neither the Major Qualifying Project, nor the Interactive Qualifying Project, nor the Humanities Sufficiency has suffered like the Comp. Nor have these Plan components created among students the apprehension—or perhaps misunderstanding—that the Comp has generated.

But all that is behind us now. For on April 10, at an open meeting of faculty and students, the faculty voted to disown this troubled child for most departments, doing away with what many students and faculty consider an original and integral element of the Plan, and replacing the Comp with a degree requirement based on the passing of prescribed "distribution"—or curriculum—requirements.

According to the proposal on which the faculty voted, students who entered WPI after May 1984, and who are required to meet published distribution requirements (DRs) in their major areas of study, no longer have to pass the Comp requirement. Students in this category who entered prior to May 1984 may elect to satisfy those DRs in lieu of passing the Comp. Only students majoring in humanities, interdisciplinary programs, social science, and physics have no published DRs.

"For too long and for too many students, the Comp had been a black cloud on the horizon," contends William R. Grogan '46, dean of undergraduate studies.

Administrative expediency? Or a rational and overdue response to a changing world? On page 35, Grogan explains the influences—both internal and external to the WPI community—that contributed to the Comp and other key Plan changes in recent years. As far as the Comp is concerned, Grogan says, ABET's (the Accreditation Board for Engineering Technology) call for more closely defined distribution requirements for graduation in WPI's four engineering departments finally influenced the faculty vote on the Exam.

It is the noon hour. Four faculty members are seated at a long table. They shuffle papers, reviewing the written portion of the Competency Examination submitted by the senior with whom they are about to meet. It numbers in the scores of pages. One panel member munches a sandwich. Time is tight during Comp Week for students and faculty alike: In the more populous departments, professors often serve on 12–15 Comp committees four times a year.

A knock at the door. Through it walks a student carrying his copy of the Comp. He looks as if he is merely visiting this planet, unsure of whether the next hour will contain his last breath of life.

"Please have a seat, Scott," the committee chairman says, trying to break the ice. The attempt is only partly effective.

"Ah, no, over here, please." Rod Serling would have had a field day with this scene.

And so it begins: the oral portion of the Competency Exam—WPI's rite of passage to the future itself. Or so it seems to most students as they approach the final hurdle in the long race to graduate "on time," in May with the classmates with whom they began their academic careers three and a half years earlier. To undergraduates the Comp looms larger than life somewhere down the road. Now, as seniors, down the road is staring them squarely in the face.

What then takes place for Scott is an experience he may never forget. Each committee member will discuss with him areas of his written exam which seemed to give him problems—and the areas that they found especially strong. He'll have a chance to redeem himself—or to dig himself deeper into a hole.

If redemption is in sight, he hopes his examiners will allow him to go beyond his written answers to explore with them areas of his discipline that specially interest him, so that he can demonstrate further his comprehension of, and competency in, his chosen field of study.

Somehow, he will realize later, the hour passes. He has had his opportunity. Now it's up to the committee to vote on his performance. He leaves, visibly shaken by the experience, unsure of his success. It has not gone well, he is certain.

A brief discussion among the committee members follows. Each has his or her own perspective on Scott's Comp performance compared with his grades in classes and on projects. The chairman mentions that the two are not consistent for all students.

They agree on a grade: AC. Acceptable. A passing grade. Having completed his other degree requirements, Scott will graduate in May. In his case, with honors.

It is—or was—a scene repeated for all WPI students, etched into their minds as fully as few other experiences in their lives.

The format of the Comp varied between academic departments, but its elements were fairly consistent: a one- to two-day written portion, often addressing design problems, followed by the orals and, in physics, a 15-minute presentation on some further aspect of the student's area of emphasis.

Those who failed the Comp—some 30 percent in each of WPI's four Comp periods each year—were required to repeat the Exam during a subsequent Comp period in order to graduate.

In theory, say most faculty members and students, it was a fine idea. "How can anyone argue," David Cyganski '75, associate professor of electrical engineering, asks rhetorically, "about a system that was designed to ensure that each graduate has demonstrated a mastery of fundamentals in his or her field of study, a system that provided quality-control feedback to the faculty? Where is the controversy regarding the Comp?"

Last year, Cyganski, a member of the Committee on Academic Policy, posed these questions in the preface of a report he had submitted to the Committee on departmental perceptions of the Comp. What he found in his research, and what becomes abundantly clear when one talks to students and professors alike, is that the controversy surrounding the Comp prior to its demise in April at the hands of the faculty did indeed reach to the furthest corners of the WPI community.

What follows here is a sampling of the comments I obtained in an independent, wholly unscientific survey of faculty and students. The evidence is anecdotal, but it seems to verify the vote of the faculty on this vitally important issue. One thing stood out in all my discussions: *no one* has no opinion about the Comp. Feelings run deep on this issue. They always have.

Ronald R. Biederman
Professor of Mechanical Engineering
In ME, I believe we handled the Comp in a fair way and in the spirit of the Plan. Students learned the material, and they integrated it in an open-ended problem, one with more than one solution—the type of situation in which engineers find themselves in industry—like designing a new product.

My problem with the Comp was its mechanics. We'd get bogged down in testing students' fundamentals rather than asking whether they had the tools to attack a problem.

I'm totally for the concept of the Comp, but we need a yardstick to identify problems along the way—before the senior year. "Why didn't I know about these problems sooner," parents would ask, but it was an unusual case for a student to get good grades and then fail the Comp.

Still, standards are standards—you have to meet them to become a licensed professional engineer, or an M.D., or to pass the Bar.

Linda A. Blackmar '86
My feelings are mixed. The Comp was a good quality control, but it caused me lots of mental anguish. It did force me to draw upon and integrate all my knowledge, but its time constraints were too demanding. I'd vote to keep the Comp because I want to see the Plan stay.

John M. Boyd
Professor of Mechanical Engineering
Traditional engineering education tries to prevent anyone from learning anything. Our technological society desperately needs a different kind of educational pattern. Students need to be encouraged to think about the implications of their technologies. In my opinion, WPI is one of the only U.S. colleges to bridge this gap.

The Comp, together with projects, was one of the first times students got to deal with problems whose answers aren't at the end of the book. In ME, we provided open-ended questions which didn't require expertise per se, but demanded that students exercise *literacy* and *process:* you start someplace, make assumptions, channel your thinking, come to some reasonable conclusions, and argue your case.

Still, it created too much anxiety; students hated it. And now, because of distribution requirements, it's an anachronism. WPI needs more of the type of education embodied in the Comp: emphasis on educational process, rather than on mere content.

Wilbur B. Bridgman
Professor Emeritus of Chemistry
The best students learn regardless of the system. But for marginal students, who can slide along for three years, the day of reckoning came too late with the Comp in place.

In chemistry, the Exam was never intended as a comprehensive test, but rather one of students' abilities to tackle new problems, using skills one would need for an initial assignment in industry.

The distribution requirements [DRs] would alleviate some problems, such as the senior slump that many students suffered following the Comp. Had the

Comp remained, DRs would have helped better prepare our students for facing the Comp.

Kevin A. Clements
Electrical Engineering Department Head
In EE, the Comp was an attempt to give students an open-ended problem experience, simulating a professional challenge, except that the time frame and scope of the Comp problems were necessarily narrower.

The Comp enabled us to gain a broader view of students' understanding of EE fundamentals. The problem was that it came so late in students' academic careers that there was little time for remedial action for those who failed. Mastery of late sophomore- and early junior-year courses are most critical.

My vote would have moved the Comp to the junior year and focused on the basics, perhaps requiring passage of the Comp before students could begin their Major Qualifying Projects.

David Cyganski '75
Associate Professor of Electrical Engineering
Failing 30 percent of students on the Comp is a terrible thing to do to them in their senior year. We wanted the Comp to just go away, but without the Exam, I question whether we won't be turning out students just as every other college does.

Stephen N. Jasperson
Physics Department Head
In physics we have no published distribution requirements, so the Comp will continue to be a crucial element of our degree requirements. It ensures that at the B.S. level our students are prepared for professional or graduate school challenges. It measures quality in ways that are different but complementary to project work. It's an integrative look at what has gone on during the student's career.

The Comp also provides a unique glimpse at what is and should be taking place in courses. It's impossible *not* to realize this when you see student performance in the Comp.

It gives students an opportunity to deal with a complex situation—to strip away the complexities and superficial elements of a problem, deal with fundamentals, and finally return the complexities to the equation in order to arrive at a solution.

"Seniors had built up to this crescendo—like an afternoon at the bullfight—but after the comp they couldn't bring themselves to ever study that hard again." William R. Grogan '46, Dean of Undergraduate Studies

John J. McLaughlin '86
In the absence of the Comp, I don't think I would have learned any less. And I question whether collectively Comp grades reflect class performance.

Monday night of my three-day Comp period, I did get *some* sleep, but Tuesday night I had to pull an all-nighter—this in spite of the fact that, as soon as I picked up my written problems on Monday, I knew I could pass it. I knew what resources to tap and how to approach the questions.

Still, I don't think it's fair to prevent seniors from graduating if they fail the Comp. It should be given earlier—in the junior year. Besides that, selection of faculty members for the Comp boards seems almost as prone to chance as a roulette wheel.

Walter F. Precourt '86
The mistakes I made on the written portion of my Comp were simply careless mental lapses. But in my orals, I was so tense that I just seemed to dig a deeper and deeper hole for myself. But in the end, I got through it.

I believe the Comp did simulate a professional assignment, but with more anxiety attached. The Exam forced you to review material of your previous three years, but I think Comp grades should be pass or fail. The AC [acceptable] doesn't always connote proper recognition.

Richard D. Sisson Jr.
Associate Professor of Mechanical Engineering
I served as chairman of the Committee on Academic Policy in 1983 and 1984, during earlier discussions of the Comp. The Comp's intent, in ME at least, was to serve as the capstone of one's education, demonstrating to the faculty that you are capable of an entry-level engineering position in industry. That's a good idea. My problem was with the dynamics of the Comp. I contend that, had I wanted to, I could have failed any student. It was such an emotional experience; it wasn't uncommon to see students shaking and teary-eyed during the orals.

Writing Comp questions was tricky—they needed to be difficult, but not too difficult, where seniors could demonstrate their competence, such as specifying the materials and processing required to make an all-polymer lawn mower. The Comp consumed huge amounts of faculty time—time that might be better spent on other activities.

Then there's the common macho perception that passing the Comp built confidence. I'm not so sure that's a good attitude. Still, I could understand parents' concern over having paid three and a half years' worth of tuition and suddenly being told, "Sorry, your child can't graduate."

Diane D. Skee '86
I definitely benefited from the Comp. It forced me to pull together everything I'd done academically up to that point. It was like a hazing. I wouldn't be surprised if most Plan graduates would want to maintain the Comp.

I spent the first half of my senior year preparing for the Comp. I audited basic EE courses, for example. Probably my regular courses suffered as a result. Some sort of formal review process would have helped.

I hope the rationale for the Comp was to test for understanding of fundamentals rather than for students' ability to think on their feet or solve problems under pressure.

John van Alstyne
Dean of Academic Advising
Four of the best students in the Class of 1986 told me that the Comp was the best thing they had ever done academically, but that they wouldn't want anyone else to have to go through what they had. Underclassmen seem to be relieved that they won't have to endure what their friends did.

It's a mistake to consider the Comp as a central element of the Plan. The essential parts of the program—projects and the Humanities Sufficiency—remain securely intact. The new distribution requirements ensure the credibility of the Plan, so there's no longer a need for the Comp.

The Comp was similar to joining the Marines: you were proud that you had done something few others had.

Michael Carroll (all)

Douglas W. Woods
Social Science and Policy Studies Department Head

I'm skeptical about the notion that passing the Comp was indicative of students' abilities to perform as professionals in their fields. In courses, students were tested on the material covered in seven weeks, but the Comp tested you on material covered over three and a half years. This is ridiculous! No wonder students found the experience traumatic.

The Comp did teach students that the material taught in courses might come up again on the Comp, which is positive. But the ability to integrate fundamentals, to bring together concepts from several sometimes unrelated courses—essential for success on the Comp—is better left to project work or a senior seminar.

With the Comp in place, we were left with a degree requirement that did little in the way of quality control—the impact on student behavior and how students choose specific programs of study—to say nothing of the costs in terms of student trauma and faculty effort.

Donald N. Zwiep
Mechanical Engineering Department Head

WPI should be proud of its success with the Comp, at the same time recognizing that as a unique degree requirement, it had trade-offs. It was one of the best measures we had for assessing the degree to which students are capable of handling an independent study activity on a short-term basis, to demonstrate that they can handle new problems. If this goal of "learning on a need-to-know basis" can be accomplished, then the half-life of individuals as scientists or engineers is infinite. It also provided excellent feedback to the faculty on their own work as teachers.

One of the Comp's less distinguishing factors was that it came so late in the academic career, creating a less than optimal opportunity for remedial feedback to students who failed.

To say that students experienced anxiety over the Comp—yes, of course, just as they would over any formal examination process. The Comp was no more or less anxiety-producing than final exams would be.

In a traditional system, it's far more traumatic for students and their families to deal with a failed required course in the final days of the final semester than with a failed Comp in January.

THE ENTREPRENEURIAL SPIRIT

FOURTH IN A SERIES

First Alert!

By Michael Shanley

Fire detectors make homes twice as safe as unprotected dwellings from fire deaths, thanks largely to the inventive good fortunes of Duane Pearsall, a key advocate of WPI's Fire Protection Engineering Program.

In 1984, structure fires in the United States numbered 848,000, down from 1,065,000 in 1980, and 869,000 in 1983, according to the National Fire Protection Association (NFPA). Considering the fact that these figures reflect only those fires in homes, factories, offices, and other structures to which firefighters were called, the improvement is substantial. How many more "close calls" go unreported is anyone's guess.

One reason for the decline, experts observe, is the widening use of fire detectors, especially in dwellings. In fact, in 1985 a Louis Harris poll found that 74 percent of U.S. households have at least one detector, and many have more.

Fire detectors are proven life- and property-savers. According to a U.S. Fire Association study, people who have home fires and lack detectors are twice as likely to die from the fire as are people who are protected by the devices. And early warning often enables residents to douse flames without the help of firefighters.

But it wasn't until the late 1960s that home fire detection overcame the hurdles that had stymied widespread use for 40 years: technology, cost, and visibility.

Much of the credit for developing the technology for an effective, low-cost residential fire detector rests with Duane Pearsall, a member of WPI's Firesafety Board of Advisors, who is considered the father of the home smoke detector. And like many inventions, his was born of brilliance—and no small supply of luck.

"Actually, we were trying to develop a device to control static in photographic darkrooms when an odd thing happened," says Pearsall, 63, from his office in one of the many new buildings that have sprouted on the plains south of Denver. "We accidentally discovered that the instrument was very sensitive to smoke. Every time someone smoked near it, the meter would react."

When Pearsall mentioned this to a representative from the Honeywell Corp., makers of firesafety systems, he was told to forget about static control and focus on smoke detection.

Soon thereafter, in 1966, Honeywell offered Pearsall's company, Statitrol, a contract to develop 15,000 detectors. The detectors were intended for commercial use, as supplements to sprinkler systems.

After the Honeywell contract was completed in 1970, Pearsall and Lyman Blackwell, a local inventor, came up with an idea that would make smoke detectors available to every homeowner. They planned a device that would eliminate the two problems thwarting previous attempts to develop an inexpensive, practical detector: false alarms and "the battery problem."

Statitrol's new ionization-type model took care of the first problem—it was sensitive, reliable, and not prone to false alarms. The second problem—the danger of dead batteries leaving the alarm powerless in an emergency—was solved by Blackwell's new mechanism that sounded a warning when the batteries were low.

These developments turned out to be key in lowering the cost of home fire detection, and the new detector made widespread acceptance of the technology by homeowners and builders alike a reality.

As late as 1972, complete detector protection may have added $700 to $1,200 to the cost of a new home, partly because an NFPA standard dictated not only smoke detectors outside all sleeping areas but also heat detectors in all other rooms. So to

Duane Pearsall in his Denver office: "Discovery of the technology that led to the home fire detector was almost an accident."

protect your home and family with in-home detectors would have run about the same as today's estimated cost for complete home sprinkler protection. Pearsall's work changed all that. Tests found that the power of the new smoke detectors made additional heat detectors unnecessary.

The next major step was to gain widespread acceptance, which meant getting the detector incorporated into the model building code. This took some time. "We had to educate people about the importance of an early warning system," says Pearsall. "That's the value of the detector. It doesn't put out fires—it saves lives."

But public service television announcements promoting the new technology did little at first to broadcast the word, coming as they usually did in the wee hours of the morning. Detector installations reflected Nielson ratings: until 1974, the number of homeowners installing the devices hovered around the 10 percent mark nationally.

Yet Pearsall continued to lobby tirelessly for the detector. Still, not until American manufacturers recognized the potential market for the new technologies did they begin to advertise aggressively, buying prime-time pitches by celebrities such as William Conrad and Danny Thomas.

These initiatives, together with competitive pricing, packaging, and in-store promotion turned the tide. Detector levels of 1975 were double those for 1974, and 1975 sales were tripled a year later. By 1977, only 12 percent of respondents to a national survey did not know that fire detectors were available for home use. Nearly twice this number had already installed them.

"Even with 1,000 employees working in two plants, we couldn't keep up with the demand," says Pearsall. And other companies were trying to pick up the slack. When Pearsall sold Statitrol to Emerson Electric in 1977, there were 54 companies in the smoke detector business.

In 1983, 37 states had at least some smoke detector requirements for dwellings and apartments, compared with only 19 in 1977. Moreover, 16 states had made the installation of the device Pearsall had pioneered mandatory in residential construction and called for retrofitting existing dwellings in some situations. The trend shows no signs of reversing itself.

It was in 1980, while he was in Boston to receive the Fire Protection Man of the Year Award from the National Society of Fire Protection Engineers, that Pearsall heard about WPI. "Dave Lucht, director of the FPE Program, told me about the Institute's new undertaking."

Pearsall, no longer in the business but still interested in the progress of firesafety in America, made a proposal: he would match any gifts to the program, up to $10,000 a year for five years.

"I looked at it as giving something back to an industry that gave me the opportunity to be successful," says Pearsall, referring to the fire protection community's support for the home smoke detector.

Since 1978, Pearsall has been an advocate for small businesses. He was named national Small Business Person of the Year in 1976 and has testified a number of times before House and Senate subcommittees.

He is currently one of four general partners in Columbine Venture Fund, Ltd., one of the largest venture capital companies in the Rocky Mountains—and is still putting out fires, no doubt.

Michael Shanley is a freelance writer living in Holden, MA.

LIFE BEYOND WHOOPIE

Michael Carroll

Life on Boynton Hill has changed recently, due to tighter controls on fraternities and a crack-down on drinking. But once the dust settled, students started making the changes work. It's tomorrow's freshmen who may well reap the greatest benefits.

By Evelyn Herwitz

For Campus Police Chief Alfred T. Whitney, WPI is like a small town: "It's the kind of place where you get to know people, a place where the students—even the troublemakers—come back to visit after they've graduated to let you know how they're doing."

These past few years have been pretty quiet ones for WPI's 13-person police force, especially when compared with the turmoil of the Vietnam era. Whitney welcomes the peace. But the lack of protests doesn't mean his officers aren't busy.

For one thing, there has been the Commonwealth's new higher drinking age to deal with. And there have also been the fraternities. In this small town where everyone's "occupation" is a demanding academic curriculum, WPI's 12 fraternities play a dominant role in breaking the tension—more often than not with parties.

Though the Greek houses are by no means the only party hosts on campus, their fetes have long dominated WPI's social life and continue to overshadow events sponsored by SOCCOMM, the student Social Committee.

In the past fraternity parties always meant lots of students and a fair share of alcohol. But since the drinking age in Massachusetts was raised to 21 in 1985, Whitney has been faced with the task of enforcing policies which change the entire nature of campus social life. Besides the tighter age guidelines on drinking, there are new limits on party size, and guests are admitted by invitation only.

For the most part, Whitney is pleased that students in both fraternities and residence halls have cooperated with the new rules. But the transition has not been altogether smooth. And with the recent closing of the Goat's Head Pub, even more students have been turning to the fraternities for entertainment.

For Whitney, the new guidelines have meant a need to monitor more closely the

"People complain about the social life here, but that's hard to buy when you realize how many extracurricular activities are available."
—Michael Wagner '88

pulse of student social activities, though he says he has noted improvements in the number of alcohol-related problems on campus.

But for students, the changes in campus policy have had much more fundamental ramifications. The demise of the Pub, long a popular watering hole, coupled with revised party guidelines have left some students with the feeling that social life at WPI is not what it once was.

"People used to call WPI, 'Whoopie,'" says Jeanne Travers '86. "But it's definitely not a party school anymore."

It was Travers and her classmates who felt the impact of the new policies most directly. First came rules about party posters, then guidelines on how many people could attend parties and who could be served alcohol. Finally, the school found it could no longer afford to carry liquor liability insurance and forfeited its liquor license for the Pub.

In its stead, Gompei's Place opened in the spring of this year, serving up nonalcoholic beverages, pizza, and live entertainment. Pub aficionados find it a weak substitute for the old hangout. But they also admit that those who never knew the Pub will probably enjoy Gompei's.

"I couldn't come back here as a freshman knowing what it used to be like, but I could come in as a freshman and enjoy WPI for what it is," says Mary Allen '86. "There's a lot of downgrading WPI's social life by upperclassmen who knew how things used to be. But if you come in with the new guidelines, you won't mind it because you won't know what you've missed."

To a large extent, what students will miss, or feel they haven't missed, depends on where they choose to live after freshman year. While freshmen are guaranteed a room on campus, upperclassmen select from three options: residence halls, Greek houses, or off-campus apartments. Of those who decide to remain on campus, about 20 percent pledge with fraternities and sororities, and the rest remain independent.

While housing doesn't define student social life, the decision to join a fraternity or stay independent can make a major difference in how a student feels about fitting into the campus social environment.

"If you really want to be known as an active person, it's a little easier if you're a Greek," says Jeanne Travers, who last year represented independents and commuters on the Executive Council of Student Government. "You can accomplish this if you're an independent, but you may have to work harder at it."

Living in residence halls for three years and then off campus during her senior year, Travers decided to remain independent because of experiences during high school. "I come from a small town where there were many cliques," she says. "Fortunately, I was in the 'right' group. But I saw what happened to those who weren't, and I didn't like it. WPI has its share of cliques, and I just wanted to avoid that here as much as I could."

Mary Allen's decision to remain an independent reflects Travers's views: "I have a lot of friends in all three sororities here, and I was afraid that if I joined one, I'd lose some of them."

Allen's solution was to get involved in campus life in other ways, including becoming a student hall director. Travers, in turn, became active in intramural swimming and volleyball, last year serving as captain of the women's volleyball team. And both built friendships that crossed Greek lines. "It's such a small campus that you always know someone in the fraternities. Your friends are there as well as in the dorms and apartments," says Allen.

At the same time, both admit that being women in a mostly male college facilitated their inclusion in social activi-

Marvin Richmond

Michael Carroll

At the signing of the Fraternity Bill of Rights and Responsibilities in November 1985, below, Brian D. Huntley '80, left, a member of the Alumni Interfraternity Council; Michael Gonsor '86, Interfraternity Council past president; and Kimberly M. Fay '86, Panhellenic Association past president show the document.

Joyce Kline '87, Panhellenic Association president.

Michael Carroll

Brian Huntley '80

Michael Carroll

ties. "As a female independent, you're still invited to the fraternity parties, and you know many of the women in sororities," says Allen. "But it's probably harder for the male independents."

By choosing to live in a residence hall, male independents like Michael Wagner '88 know that they may be closing themselves out of fraternity parties. Since campus party rules dictate that guests must be invited and numbers limited, most independent men are automatically excluded from fraternity functions.

Wagner doesn't mind that, however, since he says he doesn't find much purpose in fraternities anyway, and is looking forward to rooming in the Stoddard residence complex again in the fall.

Wagner's alternative for relief from the academic grind is the Lens and Lights Club, which is responsible for lighting and visual effects at many campus events. "People sometimes complain about the lack of social events at WPI," he says. "But there are so many clubs and so much money poured into them, everyone should make use of them. They're a great way to make friendships."

Clubs—everything from chess to drama to scuba—together with varsity and intramural athletics, professional societies, and student life programs like SOCCOMM and the Student Alumni Society, are of course open to all students, independent and Greek alike. In all, nearly 100 extracurricular activities are played out during the academic year.

Beyond all this, there are the friendships that grow in shared living space. And to some extent, the architectural design and personality of each residence environment influences how those friendships form.

Take the campus residence centers. There are the old, spacious doubles and singles in Sanford Riley Hall, which are transformed each year into mini-apartments with bedroom lofts; the 13-year-old Ellsworth-Fuller apartments, two-story townhouse suites which open onto an interior courtyard; the small but quiet doubles and singles in the Stoddard complex; two houses on Trowbridge Street, one for men and one for women, which afford independents a fraternity-like living environment; World House, for a small number of international students; and the latest upperclass housing addition, Founders Hall, completed in 1985, with its self-sufficient suites, its own dining room, and amenities like a country kitchen and weight training room.

But unless and until Gompei's Place catches on, independents are currently without any central gathering place, other than the "Wedge," a snack bar and lounge between Morgan and Daniels Halls.

But all that may change in the not-distant future. Says Jon C. Strauss, WPI president, "We have a plan underway to turn Alden Memorial into a shared environment, to help meet the Institute's pressing needs for a setting that can create a spirit of community among our students, faculty, and staff."

Still, as things stand now, that sense of being dispersed and disunited, in spite of small group attachments formed in residence halls, clubs, or intramural teams, can create a feeling of isolation for even the most active independents.

"It's definitely difficult to go to a school that's so Greek oriented," says Travers. "Everyone feels like an outsider occasionally. I get frustrated when I see things like 'Greek of the Week' in *Newspeak,* the student newspaper, instead of 'Student of the Week.' There are a lot of independents who are just as active.

"Even when you sign forms here, say for a loan, they ask if you're a member of a sorority or a fraternity. Sometimes I think if you write 'no,' they assume you don't do anything."

"Nothing unites the independents except becoming alumni," says Allen. Adds Travers: "The Greeks have their letters and we have ours. They call us 'GDI's'–'goddamn independents.'" But

"People used to call WPI 'Whoopie,' but it's definitely not a party school anymore."
—Jeanne Travers '86

Daniel J. Sullivan '87, bottom center, new Interfraternity Council president, with fraternity brothers Brian A. DeFlumeri, left, and chapter president Michael Skowron '87 at the Phi Kappa Theta house on Institute Road.

for many independents, the distinction is one they wear proudly.

Like the residence halls, WPI's 15 Greek societies—12 men's and three women's—also have their own distinct personalities. Often drawing together students with similar interests, the houses are homes to tightly knit groups of friends. And the stereotypes abound. Among the men, there are the preppies of Phi Gamma Delta, the soccer players of Alpha Tau Omega, the brains at Tau Kappa Epsilon, and the football jocks at Sigma Phi Epsilon. But the fellowship that is the butt of jokes is also the fraternities' main attraction and source of strength.

WPI's three sororities provide women with a ready-made social community, though none owns its own house. One, Phi Sigma Sigma, rents a building with three apartments, and the others—Alpha Gamma Delta and Delta Phi Epsilon—are based in off-campus apartments that are passed on to members from year to year.

For Joyce Kline '87, a member of Alpha Gamma Delta and incoming president of the Panhellenic Association, comprising representatives of each sorority, joining a sorority was a foregone conclusion: "My sister belonged to a sorority in college, and she's still in close contact with her sisters," explains Kline. "So I knew I wanted to be part of the Greek system when I came here."

Mike Gonsor '86, immediate past president of the Interfraternity Council (IFC), was drawn to Sigma Phi Epsilon by "similar personalities" and common interests. "A fraternity is more than just a place a live," says Gonsor. "I developed my closest friendships, my best experiences at WPI—my best memories through the fraternity."

But not all the memories are good ones. The new alcohol and party policies received mixed reviews from many students—Greek and independents

Michael Carroll

Michael Carroll

"I couldn't come back, knowing what WPI used to be like. But as a freshman, I could enjoy the place for what it is."—Mary Allen '86

alike—and administrators had to respond.

Things came to a head early in 1985, shortly after the new party policies went into effect, and the brunt of the situation seems to have hit Sigma Phi Epsilon fraternity: "It was the first week of the new rules," says Mike Gonsor. We had to have a guest list in by Wednesday for Saturday night, so we put down 75 to 100 names—and 150 showed. A WPI police officer was outside, counting the number of people going in and out. We felt as if the school was looking for someone to bag—and we got caught."

The penalty was social probation—no parties for the rest of the year. Then, a couple of days later, a group of Sig Ep pledges were dropped off in an unpopulated area away from campus and told to find their way back. No one was injured during the hazing episode, but local police were called in to round up the students.

"The hazing was the culmination of several incidents over a 12-month period," says Dean of Students Janet Begin Richardson. "We decided that some serious action had to be taken."

In May of 1985, the Sig Ep Alumni Corporation—graduate brothers who serve as volunteer advisers to the fraternity—announced that Sig Ep's WPI chapter would be suspended for three years.

"At first, nobody could believe they'd closed it down," says Joyce Kline. "The announcement followed the residence hall selection period, so Sig Ep members had to find homes under pretty difficult circumstances, considering Worcester's housing crunch." (See box.)

"Our fraternities are not 'Animal Houses,' but they knew someone would get it sometime," says Mary Allen. "I think the school needed to say, 'We're not just talking anymore.' And if the alumni advisers hadn't closed them down, the school might have."

Roger Perry, WPI director of public relations and an alumni adviser to his fraternity, Theta Chi, agrees. "When one house closed, the others realized that the college meant business," he says.

For Mike Gonsor, it meant finding another place to live during his senior year. But it also meant participating in a concerted effort by many of his brothers and their parents to reverse the alumni council's decision. After a year of work, not only by the members of Sig Ep, but also by other fraternities, parents, administration, faculty, and alumni, the fraternity's charter was reinstated as of this fall, and a new set of responsibilities were defined for the Greek system.

"Over the past few years, the fraternity system at WPI hasn't been looked upon very highly," admits Gonsor. Though no one ever seriously discussed the idea of closing all fraternities, as was done at Amherst and Colby colleges, he says, "we were headed down that road. We realized the situation was real, and we had to turn it around."

One of the first steps, already planned before Sig Ep was suspended, was a retreat for new fraternity presidents in March of 1985. Roger Perry, one of the retreat's organizers, says the one-day session focused on fraternity responsibilities and the problems that had developed: "By the end of the day, we had laid the groundwork for a real change in attitudes," recalls Perry. "I think the participants realized that, for some fraternities, things had hit the skids."

In November 1985, another special one-day event was held, this time for new fraternity members. The so-called "membership fair" drew 600 students, and was designed to welcome freshmen pledges into the Greek system, rather than into a particular house. Activities culminated in the signing of a fraternity members' Bill of Rights and Responsibilities.

Also in November, WPI President Jon C. Strauss commissioned a task force to define standards for fraternities and sororities regarding, among other things, the responsible use of alcoholic bever-

WANTED:
Clean Apartment Close To Campus

It's a well-known fact in Worcester that housing is at a premium. Enjoying a development boom that has been a long time coming, the city is experiencing increased demand for living accommodations at a time when the vacancy rate for rental space is less than one percent.

And while local officials and private developers scramble to provide enough new living space to meet the demand, this fall WPI will be experiencing a housing crunch of its own.

To the surprise of campus officials, a record-high number of freshmen decided to come to WPI this fall. "We had targeted 640 students," says Bernard H. Brown, vice president for student affairs. "But we ended up with 744 acceptances."

While Brown says that number will "melt" over the summer, he still expects there to be an extra 60 to 70 freshmen arriving on campus for orientation.

Those numbers represent success at a time when the number of high school seniors is dropping rapidly, especially in the Northeast. WPI's strong showing, Brown says, is due in part to revised recruiting publications, an intensified direct mail campaign for prospective students, and more favorable financial aid packages.

Michael Carroll

Founders Hall, constructed in 1985, will ease the Institute's housing crunch with its 229 new beds for upperclassmen.

But the extra students also mean that freshman housing will be tight.

To fulfill a longstanding WPI policy guaranteeing on-campus housing for all freshmen, Dean of Students Janet Begin Richardson says that plans include tripling doubles and doubling singles in freshman residence halls this fall.

Among other options are the use of campus-owned houses adjacent to WPI. But that would probably be a last resort, says Brown: "We prefer to keep freshmen together."

A portion of the Ellsworth-Fuller Residence Center.

And there is one other alternative. Though freshmen are guaranteed housing, they are not required to live on campus. "If they wish to get an off-campus apartment, that will be okay," says Richardson.

Nonetheless, because of the housing shortage in Worcester, apartments near WPI are in limited supply, and rents can start at around $650 a month, plus utilities. Upperclassmen who choose to live off campus usually make arrangements in January or February, long before the beginning of the fall term.

So, the planning to fit everyone into campus residence halls is underway. Says Paul Outerson, director of housing, "There's a lot of tripling up on paper, but everything keeps changing up to the last minute."

"We encourage freshmen to live on campus because we believe it's a valuable experience," says Richardson. And that policy holds, even if all 744 members of the Class of 1990 show up. "We will house them."—EH

ages and appropriate relationships with neighbors.

Chaired by Trustee William Densmore, the task force comprised students, faculty, administrators, alumni, parents, trustees, and neighbors.

In addition to outlining the personal and legal obligations of Greek societies at WPI, the task force suggested criteria for evaluating fraternities' and sororities' behavior. It also suggested involving other campus organizations, neighbors, alumni, faculty, and parents as well as the fraternities and sororities in the evaluation process.

According to the suggested review procedure, those sororities and fraternities which had met a set of goals for all Greeks would receive public recognition. "It's as important to recognize those who are doing a good job as it is to take action against those who aren't," says Chief Whitney, a task force member. "Basically, the report sets up a standard to live by. If the recommendations are adopted and we get some steady reporting on each fraternity, good or bad, I think it will have some effect."

"The task force has been a good thing," says Joyce Kline. "President Strauss has made it known that fraternities will stay on campus, and that every student group has responsibilities for improving relations."

Even before the task force issued its report, the Interfraternity Council had adopted new policies aimed at controlling alcohol consumption. Last fall, the IFC decided to have a "semi-dry" rush. "No alcohol was served at the informational house tours during the first three days of rush," explains Mike Gonsor. "During the next six weeks, the houses could serve alcoholic beverages at any rush event or party."

This fall, Gonsor says, the IFC will go even further and ban alcohol from all rush events. (Sororities have traditionally had a dry rush.) "No freshman will be able to get into a party until he's received a bid, or until the end of fall term," Gonsor says. "That way, you can't go to a party just to drink in order to get people to know you."

Another rule limiting the flow of beer and liquor is a new IFC policy prohibiting fraternities from selling alcohol at parties. Formerly a source of income for many Greek houses, alcohol sales require a liquor license—something which the houses can no longer afford, given the high cost of liquor liability insurance. (For more on the insurance crisis affecting all of higher education, see story beginning on page II.)

Fraternities violating the rule don't do so for long. "There's a lot of peer pressure not to charge," says Gonsor. In addition, though there is no formal self-policing effort among the Greek houses ("It's very hard for us to set it up," says Gonsor), IFC leaders have made an effort to help keep an eye on things: "Last year, one fraternity was generating repeated complaints by a neighbor over party noise," Gonsor recalls. "The IFC vice president and I went to their party to help keep a lid on things."

Even with new alcohol rules in place, Chief Whitney's officers will have to remain vigilant. "If partyers didn't see the police cars, it would be more of a problem," he says. "There have been some improvements in the way fraternities are handling themselves," concludes Whitney. "But we won't really be able to tell until this fall."

In spite of the problem of underage drinking, however, the IFC's Gonsor is confident that the groundwork he and others laid last year will enable the Greek houses to measure up to the expectations of Strauss, Whitney, and others. With Gonsor's graduation in May, Daniel J. Sullivan, incoming IFC president, and his fraternity officers will be shouldering the weight of responsibility accepted by their predecessors.

"In the past, you felt that every house was out for itself," Gonsor says. "But now, with a strong IFC, the houses realize that they're part of a system—and that the system is only as good as the houses trying to promote it."

The IFC's efforts have not gone unnoticed by campus administrators. "Two years ago, when alcohol and party restrictions all hit at once, the fraternity leaders were not willing to regulate themselves," says Bernard H. Brown, vice president for student affairs. "But now, they've taken back that responsibility."

Evelyn Herwitz is a free-lance writer living in Worcester.

The Inauguration luncheon in Harrington Auditorium. The story on the investiture of Jon C. Strauss begins on page 2.

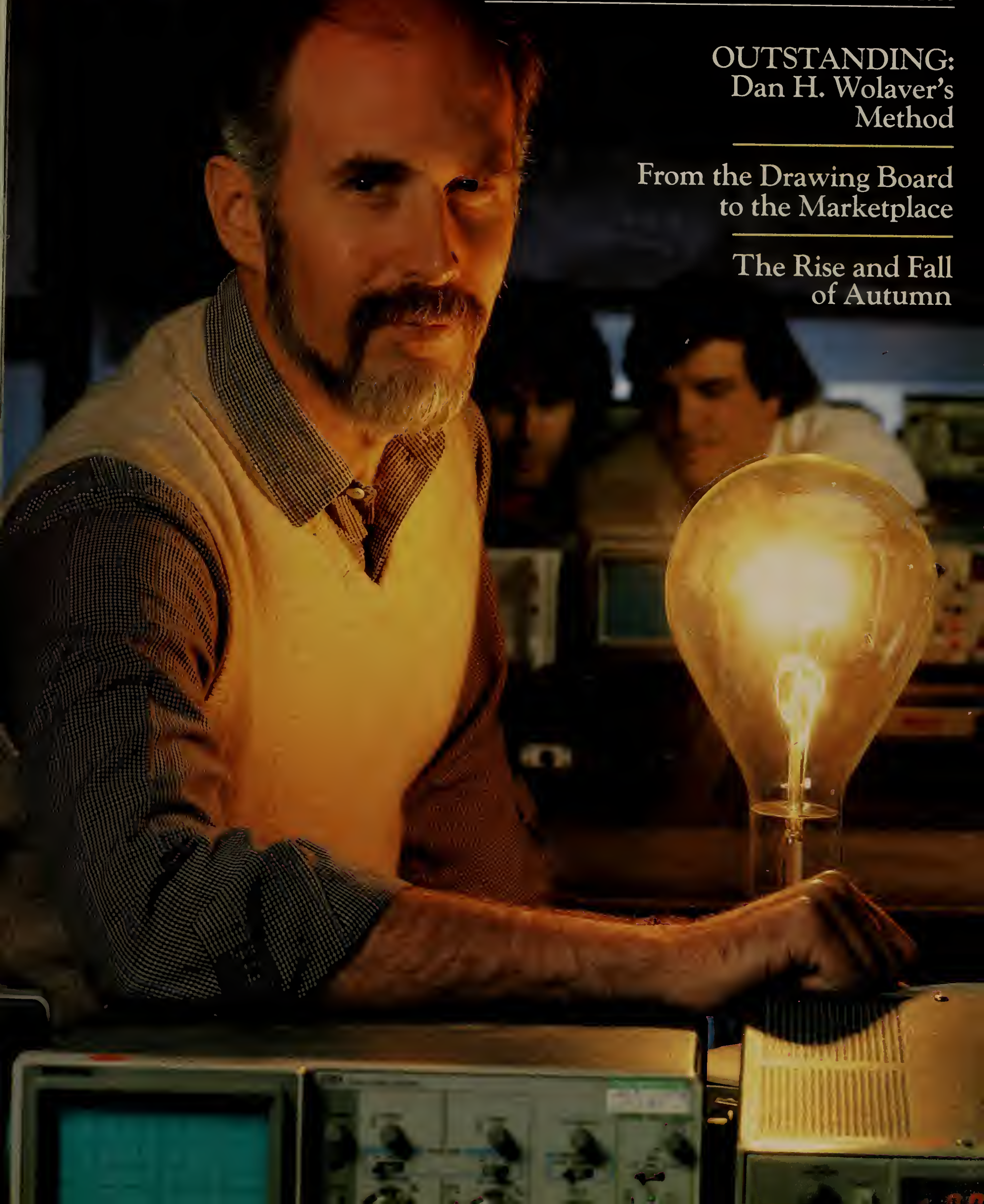
Robert S. Arnold

With pomp and circumstance, WPI inaugurates its 13th president, Dr. Jon C. Strauss. **The story on page 2.**

WPI Journal

WORCESTER POLYTECHNIC INSTITUTE

FALL 1986



OUTSTANDING: Dan H. Wolaver's Method

From the Drawing Board to the Marketplace

The Rise and Fall of Autumn

A Special Message to WPI Alumni, Parents, and Friends

Over the past few weeks, a few of us here in University Relations have been at work preparing brief biographical sketches on those individuals who have contributed to the endowment of WPI over these past 12 decades of our history. The first such donor, of course, was John Boynton, who anonymously provided the challenge to "the citizens of Worcester": If they would construct a building for the new school, he would endow the college with much of his lifetime savings. In 1865, that amount—$100,000—was a handsome sum, for at that time the barter system served as the means of exchange for most families.

Those sketches tell a wonderful story of the history of WPI, one different from the usual "college history"—the study of presidents, the development of academic departments, and the evolution of the campus. In a sense, these essays on many of WPI's benefactors recount the real outcomes of the WPI experiment. That experiment—*Lehr und Kunst*, teaching and skilled art—has come to serve so well so many of us during our lifetimes.

Many of those donors provided gifts of consequence that resulted from highly successful careers. Some donors had little direct connection with WPI. And with special poignancy, many wives left much of what remained of their inheritances (some large, some small) from their "Tech men" to the institution for which their husbands had had a special affection.

Equally striking to me were endowments that came from individuals who had had comparatively modest careers and who, by frugality and at times self-denial, returned to WPI something of what they felt the college had meant to them. This history of WPI, *In the Founders' Footsteps,* will be published in late November. I hope many of you will be interested enough to write to me for a copy. A good story of American science and technology will be contained within its covers, as well as a special human history of the builders of today's WPI.

Since the very first day of classes on November 10, 1868, WPI has quietly gone about the business of educating young men (and since 1968, young men *and* young women), preparing individuals for careers of economic worth and social value. Some 118 years ago this month, that first class of 32 students faced a barren hillside with two lonely sentinels—Boynton Hall (dedicated on November 11, 1868) and Washburn Shops—on the outskirts of what was to become the second-largest city in New England. But as the years ticked by, each successive freshman class found a campus steadily enriched with new resources: a growing faculty, better equipment, new buildings and playing fields, more books, a wider variety of student activities, *and* more scholarship and financial support.

Whenever each of us may have passed through what Richard W. Lyman, our 1986 Commencement speaker, referred to as "our pleasant hilltop campus," we benefited, albeit sometimes unknowingly, from the beneficence of those who passed before us. Over the years, what the school has become is due in no small measure to the support that had been provided by the countless other believers in John Boynton's challenge. Today, as our history demonstrates, if an institution is to grow in strength and stature, it must continue to attract resources, both material and human. And in the domain of science and technological education, the Institute had better not stand still!

Very shortly, our alumni and friends will be hearing about a major campaign for support as WPI prepares for its 125th anniversary in 1990. This campaign will seek the resources required to make WPI—today a very *good* institution—into an *excellent* one, the goal articulated by President Jon C. Strauss in his inaugural address last May. Thus we have launched the "Campaign for Excellence." Between now and 1990, we will be seeking $52.245 million, no mean sum.

We begin this effort on a very solid foundation. WPI's budgets have been balanced for 11 consecutive years. And with periodic surpluses, the Institute has been able to acquire property along its borders for future expansion, especially for student residences, and to keep deferred maintenance on our physical plant to a minimum.

This fall, we welcomed an oversubscribed freshman class—740 strong. In academic achievement, it is the strongest in at least a generation. More than 60 percent of these young men and women came to WPI because financial aid was provided. Some 20 new faculty, a full 10 percent of their total numbers, were recruited in the past year, six in electrical engineering alone. And fully refurbished outdoor athletic and recreation facilities are now available to a college community that is perhaps more fitness-conscious than ever before.

This foundation is the legacy of our past support: donors to the Annual Alumni Fund; individual gifts; planned gifts and bequests from alumni, parents, and friends; and grants provided to us by local, regional, and national businesses, corporations, and philanthropic foundations.

What WPI can become in 1990—our next historic milestone—depends upon you. If WPI means as much to you as it has meant to those represented throughout *In the Founders' Footsteps,* it will leave me in great confidence that the Campaign for Excellence will succeed, ensuring that WPI will continue to be the vital, progressive institution that we are today.

All of us are going to be asked to pull hard on the oars!

Best wishes to all our readers for a year-end holiday season filled with life's rich blessings.

Donald F. Berth

Donald F. Berth '57
Vice President for University Relations

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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, Hartwick College, Johns Hopkins University, Villanova University, Western Maryland College, Worcester Polytechnic Institute) and appear in the respective alumni magazines of those institutions. Second class postage paid at Worcester, MA, and additional mailing offices.
Staff of the Alumni Magazine Consortium: Editor, Donna Shoemaker • Wrap Designer and Production Coordinator, Amy Doudiken Wells • Assistant Editor, Leslie Brunetta • Core Designers, Allen Carroll and Amy Doudiken Wells.
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Acknowledgments: Typesetting, BG Composition, Inc.; Printing, American Press, Inc.

Diverse views on subjects of public interest are presented in the magazine. These views do not necessarily reflect the opinions of the editors or official policies of WPI. Address correspondence to the Editor, The WPI Journal, Worcester Polytechnic Institute, Worcester, MA 01609. Telephone (617) 793-5609. Postmaster: If undeliverable please send form 3579 to the address above. Do not return publication.

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Cover: Electrical Engineering Professor Dan H. Wolaver has been honored with the 1986 WPI Board of Trustees' Award for Outstanding Teaching. Story on page 35. Photo by Michael Carroll.

The Importance of Private Higher Education

Michael Carroll

Recently, I had the opportunity to speak with a prospective trustee of WPI about why he should take on the responsibilities that membership on the Board involves. I spoke, of course, of the excitement I found at WPI, and of the rewards of service to young adults and the community.

I also emphasized the importance of private higher education in the United States and its contributions to our nation's acknowledged worldwide leadership in post-secondary education. Without our independent colleges and universities, I postulated, higher education as well as the nation itself would *never* have developed as rapidly as it has.

As Harvard University, the nation's first college, recently celebrated its 350th anniversary, it and our 1,800 other independent colleges and universities can be proud indeed of the leadership they have provided. For at private institutions such as WPI, it is merit alone, unfettered by the bureaucracy of government, that decides the fate of curriculum content and process, scholarly research, and insti-

"Private colleges are free to pursue educational goals in an environment that brings together the best that free enterprise and healthy competition have to offer."

By Jon C. Strauss

tutional administration. We are able to pursue educational goals in an environment that can be characterized as the best that free enterprise and healthy competition offer.

Most experts agree that, were it not for the quality standards set by private institutions of the caliber of Harvard or Stanford, the nation's premier public institutions, like the University of California or the University of Wisconsin, would be mere shadows of their present forms.

Moreover, those same experts would affirm that the Massachusetts Institute of Technology, WPI, and our peer institutions provide educational innovation and quality that serve as models for distinguished engineering schools at public institutions such as the Universities of Massachusetts or Illinois.

Here at WPI, the Plan is a good example of the creative power of private education. Emphasizing outcomes rather than just the process or content of education—real-world problem solving rather than lock-step curricula—the Plan serves as proof of principle for engineering and science education the world over.

Understandably, implementation and, more recently, enhancement of the Plan have required what accompanies any new venture: a willingness by its creators to take risks, together with the commitment of time, personal sacrifice, and financial resources needed to make the change viable. It is unlikely that this sort of innovation could have occurred in the typically more conservative realm of public higher education. The costs would be too high, the changes too severe. But at WPI, as in business, we encourage prudent risk taking and successful innovation in the pursuit of knowledge.

"The continuing success of our public colleges and universities depends on enhancing the quality of our private institutions."

Some will argue that what appear to be significantly lower costs of public higher education portend the ultimate demise of our private institutions. Yet this view ignores respected studies indicating that the publics are often *less* cost efficient than the privates.

The costs of tuition and room and board may appear significantly lower at public institutions, but this is due largely to the substantial subsidies which publics derive from taxpayer "contributions." Still, colleges such as WPI cannot ignore the dynamics of the marketplace, especially in these days of dramatic reductions in the number of high school seniors nationwide. [You may be interested in turning to page I, for a story entitled "Higher and Higher Education," which addresses the issue in some detail.]

Let's examine the scenario in which U.S. higher education is influenced by private institutions. We can gain some insight into this situation by looking at the history of educational systems that have not benefited as directly from private institutions.

Europe is a good example. The great public universities—The Sorbonne and Heidelberg, for instance—while known for their extraordinary scholarship, have been far less influential in the societies they serve than have U.S. universities. In fact, many observers contend that U.S. universities are having a greater impact on Europe than many of Europe's own institutions.

Similarly, universities in Japan and other Eastern nations seem to have remarkably little impact on the societies and the commerce they serve. This situation cannot be fully ascribed to the absence of a healthy private higher education sector in Europe and the Far East, but that absence is certainly a contributing factor.

Typically, governments—state or federal—are too cumbersome and too far removed from the needs of academia to be permitted to be solely responsible for standards of higher education. Less influence on education by the public sector leads to more effective responses to society's needs.

Higher education's public sector, however, is far from an intellectual wasteland. Many of the publics enjoy hard-earned reputations for excellence in teaching and research. For the sake of the nation and the world, they had better: public colleges and universities educate more than 80 percent of the nation's undergraduate students and perform over 50 percent of federally sponsored research. To extend the argument offered above, the continuing success of these institutions depends in no small measure on enhancing the quality and vitality of our private institutions.

As we face this challenge, it is vitally important that every member of the WPI community—trustees, faculty, students, staff, alumni, and friends—recognizes the special trust and responsibilities thrust upon each of us as members of private higher education.

And, oh yes, the prospective trustee with whom I discussed what I've shared with you is now the newest member of the Board. As such, he has accepted the responsibilities of helping the Institute evolve and prosper for the years and generations ahead—for the benefit of WPI and all of society, at home *and* abroad.

"In our schools and colleges, the aim should be to train the mind rather than to impart technical information."
It was in 1915 that L.B. Stillwell, former president of the American Institute of Electrical Engineers, made that remark. Seventy-one years later, Stillwell's belief that engineers must learn how to think, not just how to do, remains a challenge to engineering educators—the central theme in a pedagogic debate that has spanned decades.
But accomplishing this balance, at a time when innovations in science and technology can become obsolete in just months, calls upon educators to be inventive themselves. And while much has changed in technological education, some things have not.

In the 30 years since the Soviets launched Sputnik and spawned the space race, technological development has intensified to the point that innovation is commonplace. Engineering students who toil four and sometimes five years to master a body of rapidly changing knowledge often find their training outdated soon after graduation. The dilemma for engineering schools is twofold: how to stay abreast of new developments without becoming mired in soon-to-be obsolete technology—and how to turn out engineers and scientists who are able to keep current long after they graduate.

For WPI, meeting the challenges of the post-Sputnik era has meant renewed attention to the values L.B. Stillwell expressed at the turn of the century, when satellites, robotics, and genetically engineered organisms were still the dreams of science fiction writers.

"We've moved a long way from a 'how to' orientation toward a focus on *why* things happen," says William R. Grogan, dean of undergraduate studies. A member of the Class of 1946 who returned as an electrical engineering instructor after World War II, Grogan became involved in efforts to adapt WPI's curriculum as the space race triggered a shift in priorities from techniques to engineering science.

"During the '50s we had many, many courses that were handbook oriented," recalls Grogan. "There was a great deal of drill and repetition. A lot of the labs were simply boring—'do this, do that, verify the principle.' There wasn't much creativity involved, and reports were often copied from fraternity files. Students did a great deal of analysis, but very little synthesis."

After Sputnik, however, intensified research efforts created a "knowledge explosion" which Grogan says made it impossible for students to remain abreast of the latest generation of technologies and techniques. "Practice became a moving target," he says. "The only things that remained stable were the fundamentals."

A deep shift in classroom instruction and laboratory projects from current practice to underlying principles resulted. But even as the revised approach enabled engineers to function better in a rapidly changing technological environment, Grogan says it also created frustration and confusion. "There was a much longer period of time before students saw the fruits of their efforts," he explains. "Under the old system, they could design things quickly. Now it took longer to understand subjects like physics and mathematics. That was very frustrating for some students, especially if they had been drawn to engineering for the hands-on gratification."

To restore that lost sense of progress and tangible outcomes, Grogan says the WPI Plan, instituted in the early 1970s, introduced the Interactive Qualifying Project and Major Qualifying Project as degree requirements. "The projects have been extremely effective, both in enabling students to synthesize ideas and in aiding their personal growth," says Grogan, who discovered the motivational value of projects in his own classroom as early as the 1950s.

In 1973, WPI introduced another change in curriculum structure. Seven-

Tech 101: The New Curricula

By Evelyn Herwitz

week terms replaced 15-week semesters, and student course loads shifted from a half-dozen classes per semester to three per term. The idea, says Grogan, was to help students concentrate on a few subjects at a time, rather than "just go from course to course." But even as the four-term structure better enables students to focus their attention, Grogan admits it is still an imperfect solution to an age-old pedagogic problem.

"We have always tried to teach too much in too short a period of time, and we always will," says Grogan, "because I think students have an enormous capacity to learn that is not often tapped. But sometimes we delude ourselves into thinking that if we've covered something in class, the students understand it. You can cover a barn with a thin coat of paint—but will it last through the winter?"

How to explain fundamental, abstract concepts within a tight time frame is of particular concern to the Physics Department faculty. Though the basic subject matter in freshman physics has not changed dramatically since the 1930s, a renewed emphasis on concepts has intensified the challenge of explaining ideas that contradict intuition.

"In the late 1960s, the introductory physics courses were far and away the most hated courses on campus," says associate professor Van Bluemel. Along with professor Thomas H. Keil, Bluemel is teaching freshman physics this year. "When we came here in the mid-'60s, the courses were very drill oriented," says Keil. "Since then, we've been trying to place greater emphasis on concepts and ideas, rather than just plugging in variables to set problems."

That shift to an even more abstract focus, however, has not necessarily increased enthusiasm for freshman physics. "Students often come into freshman physics with the same conceptual biases as Aristotle," says Bluemel. "To really understand the discipline, each person must go through an intellectual transition similar to the historical development of classical physics."

The basic dilemma can be illustrated with a simple example: "Imagine you are sitting in a car that suddenly starts moving forward," explains Department Head Stephen N. Jasperson. "You feel as though a force is pushing you back against the seat. But actually, what you experience is a force moving you forward, when your body wants to stay at rest. That's why Newtonian physics seems strange—because the principles seem contrary to expectations based on your experience of the world."

Even more alien are the concepts underlying Einstein's theory of relativity, first published in the early 1900s. "Of all the material presented in introductory courses," says Jasperson, "relativity is probably the most unsettling because it's so obviously at odds with experience. If two events happen simultaneously for one person, we're accustomed to believing the same is true for everyone else. But not according to relativity."

Although these contradictions have been plaguing students and professors for nearly a century, pedagogic approaches to them have only recently come under close scrutiny. So strong are

In the Solid State Physics Lab, this student built a capacitive dilatometer capable of taking experimental measurements at extremely low temperatures. Using advanced technology gives students a better feel for the abstract concepts of physics.

Michael Carroll

Michael Carroll

Computers have reduced part of the detailed analytical work of freshman chemistry to split-second tasks, freeing up time to study such fields as quantum mechanics and thermodynamics. Learning other lessons, however, still requires goggles and flasks.

student preconceptions about the physical world, reports recent research in the *American Journal of Physics*, that conventional instruction, regardless of teaching method, typically fails.

"Learning physics is a lot like mastering a foreign language," says Keil. "Not only do you need to understand English terms that are used in a very different, specific way than you're accustomed to, but you also need to understand mathematics and graphics. We tend to translate quite freely among the three, but most freshmen can't."

Hoping to bridge that conceptual barrier, Keil has developed the first in a planned series of computer modules for freshman physics. "It's designed to create a kind of play space where students can experiment with physical concepts," he explains. "The module starts with a projectile on top of a cliff. Students can adjust factors like height and speed, and the computer records the trajectory and other data about the projectile's motion. It's a way of giving students a world more like the one we're trying to teach them about."

Unlike the world of physics, the world of chemistry is readily observable. Lab experiments are replete with bright colors, strong odors, occasional loud noises and often unintended, but equally instructive lessons in phenomena such as the effect of acid on denim jeans.

But in keeping with the trend among all sciences since the 1950s, chemistry as a discipline has become more quantitative. At the freshmen level, what was once a course in descriptive inorganic chemistry now includes a heavy dose of physical chemistry.

Subjects such as quantum mechanics and thermodynamics, which provide the theoretical structure for analyzing physical properties of chemicals and chemical reactions, are now central to a curriculum that once emphasized memorization of formulas.

"We used to focus on problems like what a substance looks like, what reacts with what, and the characteristics of the reaction," says Nicholas K. Kildahl, associate professor of chemistry, who this year is teaching the freshman course. "Now we ask questions like how much energy is released during a particular reaction, rather than focusing on the reaction itself. Quantum mechanics has enabled us to look deeper, beneath the phenomenologic observation, to explain why things happen."

The shift away from descriptive chemistry, however, has sparked some criticisms. "Presumably, the theoretical approach gives you a background for meeting new situations and gives you a basis for understanding new developments as they come along," says Wilbur B. Bridgman, professor emeritus and a physical chemist. "On the other hand, theory can't explain all chemistry yet. One simply has to learn some facts as facts." That concern, shared by many

"Thirty years ago, many labs simply bored students: Do this, do that, verify the principle. Lots of analysis but little synthesis."

chemists who fear that students are learning theory at the expense of mastering the language of chemistry, is, according to Kildahl, prompting a "big move" to return to descriptive chemistry.

Nonetheless, powerful analytical tools such as quantum mechanics are now an accepted part of any freshman chemistry course.

Labs, too, have become more quantitative. And the demand for more detailed data observations has prompted development of a whole new generation of instrumentation that has revolutionized the chemistry lab. In upperclass and graduate analytic chemistry, for example, the spectrometer, which reveals the identity of chemical components by analyzing how much light a solution absorbs, has replaced laborious, "wet" techniques for isolating substances.

Freshmen also benefit from instruments such as electronic balances. "Thirty years ago, it took a long time to weigh things," says Professor Ladislav H. Berka. "Then, you'd record the scale reading each time the needle stopped swinging on either side of the zero. Adjustments with weights would be made until the initial average with empty pans was again obtained. You could take as many as eight averages in one weighing.

"Now it takes about two seconds to put your sample on an electronic balance and simply read the weight. You can get a lot more accomplished."

William Denison

Veteran ME Lab Technician John "Joe" Gale shows his welding techniques. Below left: In 1915, in PC (Pre-Computer) days, this was the scene in drafting rooms. Right: Now, PCs hold sway in the engineering design graphics course taught by John J. Titus (l) and George Y. Jumper, Jr.

Michael Carroll

Much as the tools of the chemistry lab have changed in the past three decades, no less dramatic has been the transformation in the drafting classroom of WPI's Mechanical Engineering Department. Once filled with rows of drafting desks, the large room in Higgins Laboratories now houses dozens of computer work stations. In front stands a blackboard-sized screen that projects a view of the instructor's video display.

Demonstrating how the system works, Associate Professor George Y. Jumper, Jr. instructs the computer to recall a simple drawing of a square with a diagonal line across the upper right corner. As he types on the keyboard, the square rotates through different planes, revealing the object's true identity: a cube with one corner sliced away.

"The student creates a three-dimensional mathematical model of the object, and then the computer does a two-dimensional representation in any view the student selects," explains Jumper. "The results are very professional. At the end of seven weeks, everyone can make a fantastic, polished drawing."

Evidence of the computer's power lines the classroom walls. Prominently displayed is a student's detailed wire frame drawing of a can crusher; nearby, for inspiration, an intricate illustration supplied by Wyman-Gordon Company of a forging that resembles a topographical map.

Initiated last fall, the micro-CADD lab (short for microcomputer aided design drafting) has transformed engineering

William Denison

Michael Carroll

Chuck Kidd

design graphics from a course that most students tried to avoid to one of the department's most popular offerings. "They're having a ball, making these drawings," says Jumper, as he deftly instructs the computer to turn a point at the tip of an abstract figure into a red sphere. "The computer eliminates a lot of the tedium."

While students still study basic sketching techniques and design standards, much of their class work involves learning how to create and manipulate engineering designs on the computer. "Drawings are an important way that engineers communicate with each other," says Jumper. "If used properly, the computer can do the dog work of drafting while the students learn to address the tough conceptual questions. And it allows them to put their learning into practice the way it's done in industry."

That strategy of using state-of-the-art technology to increase student mastery of fundamental concepts is central to the mechanical engineering curriculum. As in other scientific and engineering disciplines, the trend has shifted away from what Department Head Donald N. Zwiep calls "information transfer" toward mastery of principles basic to all engineering problems. Modern computational tools like CADD encourage that learning process by increasing the student's ability to tackle in-depth problems.

But Zwiep's basic advice to new ME majors is the same as it was when he joined the faculty 30 years ago: Develop a strong background in basic math and science, a working knowledge of engineering science and design, and an understanding of the humanities and social sciences.

"Though necessary, information transfer must be combined with the ability to learn on a 'need to know' basis in a professional atmosphere," says Zwiep. "Then the half-life of the engineering graduate becomes infinite because learning becomes a continuous rather than a finite process.

"Engineering involves a lifetime of learning. Anyone not willing to dedicate himself to that is dead in the water."

Washburn Shops features state-of-the-art machining tools and video systems. Center left: The PC labs in Higgins are usually full. Right: ME Department Head Donald N. Zwiep urges learning on a "need to know" basis.

Of all the engineering disciplines, one of the most dramatically affected by recent technological developments is electrical engineering. With the invention of the transistor in 1948, ever smaller and more efficient electronic circuits have become possible. Every decade has brought major technological breakthroughs: digital computers in the 1950s, integrated circuits in the '60s, microprocessors in the '70s, and very large scale integrated (VLSI) circuits in the 1980s.

In the EE lab, computer work stations have replaced benches littered with wires, electronic components and soldering irons. With a few keystrokes, students can design schematic diagrams of integrated circuits on a color monitor. Once their designs are complete, they can test them on the computer using simulation tools. The debugged design, recorded on disk, can then be sent to a chip manufacturer for production.

Beginning this fall, partly in conjunction with Westboro-based Massachusetts Microelectronic Center (M^2C), students learning the basics of VLSI design will have access to an even more convenient way of making chips. Called electrically programmed logic devices—EPLD—the technology uses "small" chips, containing 2,000 to 3,000 transistors (in contrast with the 50,000 to 500,000 transistors found in microprocessors), unconnected by any wiring.

"You plug the chip into a programming board connected to a personal computer," explains Professor Wilhelm Eggimann. "You can then program the chip to do what you want. Then you simply unplug the chip and try it out."

The Challenge of Faculty Recruitment

Recruiting engineering school faculty in the post-Sputnik era has often proved as challenging as striking the right pedagogic balance between principles and applications.

In recent years, competition for science and engineering Ph.D.s has intensified, as high-technology firms siphon graduates away from academia. In addition, says Richard H. Gallagher, vice president and dean of the faculty, there has been a "doubling of output" from engineering colleges, increasing competition among universities for a limited supply of qualified faculty members.

"Fifteen years ago, 40,000 students graduated from engineering schools in the United States," says Gallagher. "Today, the figure is somewhere between 80,000 and 90,000." In part, he says, those figures represent general demographic shifts. But the increase in engineering students also reflects the drawing power of a high-tech career and the influx of women to engineering colleges.

With more students to teach, the search for qualified faculty has intensified. "It has always been difficult attracting individuals who are excellent teachers with some commitment to research," says Gallagher. "But I think the WPI record shows we've been very successful." —EH

Like an audio cassette that continues to play a message until erased with a magnet, the chip will retain the programmed circuits until it is passed under ultraviolet light. "If the program works, you can make a dozen chips by just plugging them into the program," says Eggimann. "Instead of waiting two months for your chips to be manufactured, you wait just two seconds."

But even as students, anxious to learn the latest in chip design, flock to take courses in what is now WPI's largest department, EE faculty members share their colleagues' pedagogic priorities. "The technological applications change about every 10 years," says EE Professor Harit Majmudar. "We choose different problems. But the principles remain the same."

Like ME's Zwiep, Majmudar stresses the need for engineering students to master fundamentals, rather than get caught up in the complexities of current applications: "Physics and math are technology-neutral, as are the basic principles of engineering analysis and problem solving. The good engineers and scientists who will do research and be leaders have to excel in thought processes and problem solving."

Evelyn Herwitz is a free-lance writer living in Worcester.

Michael Carroll

Left: Wilhelm H. Eggimann, EE associate professor, shown with colleague Ronald J. Juels (r), teaches VLSI circuit design. Right: Professor Harit Majmudar sums up that EE's fundamentals remain the same.

DRURY LANE AT REGENT STREET

There was no question now. As soon as they were "settled," they must engage a maid. A real maid. Not a hired-girl, nor an oafish Mrs. Lundstrom. Something to match the house. A black uniform and white apron for dinner. And dinner would be at night—not at noon.

—Esther Forbes, *Miss Marvel*

They were still newcomers, by Worcester standards. Neither descendants of Revolutionary War heroes nor city founders, they hadn't been in town long enough to join the high-society families over on Elm and Cedar Streets. But they had been in town long enough to make more money in a year than most of their neighbors would earn in a lifetime.

Men with a knack for turning inventions into marketable products, they were Worcester's rising industrial elite. Their fortunes were built on grinding wheels, forging, drawn wire, and textiles. And they intended that their homes would reflect their accomplishments.

So in 1899, when Worcester partriarch Stephen Salisbury III—a WPI trustee and son and namesake of the WPI founder who gave the land on which the college is built—decided to subdivide his land on the hillside west of Park Avenue, these up-and-coming families were among the first in line for parcels.

Most of the lots along newly named Massachusetts Avenue, Drury Lane, and Regent Street were small—an acre or less—and expensive by turn-of-the-century standards. Parcels sold between 1899 and 1901 went for $3,000 to $11,000, depending on lot size.

But the houses were at least as large as the owner's budget could allow—and sometimes larger. Servants' quarters were considered a necessity, and the latest innovations, such as central vacuuming systems, were touted features.

It was a lifestyle far removed from the factory floors that made all this possible. As families like the Jeppsons, Stoddards, and Fullers moved in, the elegant hillside neighborhood behind the newly constructed American Antiquarian Society building soon replaced Elm and Cedar Streets, a half-mile to the south, as the nucleus of Worcester's upper-class establishment.

Although the lifestyles of their owners may have changed, the 19 homes built between 1899 and 1919 in what is now Worcester's only local historic district retain the grace and charm of that pre-World War I era. And at least three of the homes have been preserved in much the same style as they were built. Owned by WPI, the Jeppson House at 1 Drury Lane, Hughes House at 15 Regent Street, and Thayer House at 4 Regent Street are now home to the Institute's president, vice president and dean of faculty, and vice president of student affairs, respectively. The three "executive residences" are among 16 off-campus buildings owned by the college.

Donated by WPI trustee George N. Jeppson and his wife, Selma, in 1941, 1 Drury Lane was the first of the Institute's three acquisitions west of Park Avenue. Now home to Jon and Jean Strauss, the former Jeppson residence was a later addition to the Massachusetts Avenue neighborhood.

Though the Jeppson family lived in the house for many years, the original owner was Frank O. Woodland. A Swedish immigrant, Woodland bought the one-acre tract from Stephen Salisbury's heir, the Worcester Art Museum, in 1912. Worcester architect Lucius Briggs, who

The Institute's three homes recall the spoils of Worcester's early industrial growth. They are among our most handsome and heavily used facilities.

By Evelyn Herwitz
Photos by Michael Carroll

helped design the Worcester Auditorium and War Memorial, drew the blueprints, and contractor E.J. Cross built the two-storied, stuccoed, Georgian Revival mansion.

Woodland lived in the house for only a few short years. Not long after he built his home, the story goes, Woodland suffered a major financial loss and committed suicide. His estate sold the house to Julia C. Brown in 1916, who in turn sold it to Thilda A. Jeppson two years later. Thilda was the wife of John Jeppson, George's father. As was the custom of the times, title to real property was often placed in the wife's name.

"There was a crack in the tile in the downstairs bathroom," recalls John Jeppson, son of George and Selma, of visits to his grandparents' house. "As children, that's where we thought the bullet went!" Further speculation about the

Opposite page: This solarium, one of two in Jeppson House, offers an informal flavor to the otherwise public feel of the main floor of the house. Right: To the left of the main staircase in this executive mansion stands a door to the dining room.

The Strausses are the seventh WPI first family to live at 1 Drury Lane, donated by the grandparents of John Jeppson (left). Opposite: the living room.

demise of the home's unfortunate first owner was "not encouraged," however, adds Mr. Jeppson. Still, there was plenty to do and explore in the 16-room home at 1 Drury. "We had great visits at my grandparents' every weekend," says Mr. Jeppson, past president of Norton Company, who retired in 1984 as the company's honorary chairman. "My grandmother was very solicitous. She used to feed us too much and take us for rides in their Pierce-Arrow."

The elder John Jeppson, a potter by trade, together with Milton P. Higgins, first superintendent of the Washburn Shops, Professor George I. Alden, and others, founded Norton Company. Jeppson died when young John was only five. "He worked beautifully with his hands," says the younger Jeppson, who describes his grandfather as a "bearded patriarch" who kept a potter's wheel in his Norton office to make mugs and vases for friends on special occasions.

When Thilda died in 1925, a few years after her husband, Mr. Jeppson's father, George, inherited the estate and moved in with his wife and three children. For young John and his sisters, Britta and Betty, nearby Bancroft Tower Park soon became a favorite place to play. And John found his own special spot on the Drury Lane grounds: a stone post that proved the perfect perch for watching WPI baseball games.

The house itself had lots of doors and corridors to inspect and an attic playroom. There were other interesting features too, like the huge dryer in the basement, with its six-foot racks that slid in and out of a giant, gas-heated frame. And the north and south porches had heating pipes running under the ceramic tile floors, "so your feet would stay warm even in the winter," says Jeppson.

For the most part, George and Selma Jeppson made only minor changes, splitting one upstairs bedroom into two, and adding a poolroom in the cellar. An avid gardener, Selma Jeppson created a formal garden off the south porch and built a terrace to the east of the garden.

"The house was very Swedish—very light and neat and airy," says Margaret Erskine, who grew up around the corner at 8 Massachusetts Avenue and was a schoolmate of Betty Jeppson. A full compliment of Swedish servants discouraged any kind of horseplay, she recalls. "You always behaved very properly there. It was a pretty posh existence."

Her mother-in-law, Katharine Erskine, also recalls visiting the Jeppson home. A member of the Bancroft School's board of trustees, which George Jeppson chaired, she was once invited to 1 Drury for a smorgasbord breakfast. "The house looked very much as it does today," says Mrs. Erskine, who can remember walking with her sister, author Esther Forbes, through the fields that became 1 Drury Lane. "It was a very handsome home. We always looked up to it as an outstanding, attractive addition to the hillside."

Bancroft School trustees were just some of the many guests whom the Jeppsons welcomed. Undoubtedly their most notable visitor was Crown Prince Gustaf Adolf of Sweden. "Worcester was one of the centers of Swedish activity in this country, and he was making his rounds," says John Jeppson, who was about 10 at the time. "He was a tall, dark-haired, good-looking guy. My parents had a tent set up on the Park Avenue side of the house, and we had invited him for lunch." Other than that impression, Mr. Jeppson's most salient memory of the Crown Prince's visit was being "very upset at having to wear a sailor suit!"

The Jeppsons continued to prosper during the 1930s, and enlarged a country home they kept in Brookfield, MA. They also acquired a house in Florida, where George Jeppson had hoped to retire.

A trustee of WPI, George Jeppson decided to donate the Drury Lane home to the Institute in 1941. At the time, the assessed value of house and property was $46,000. But John Jeppson believes the market value was actually closer to $60,000. Today, estimates David Lloyd, former WPI treasurer and vice president for business affairs, the estate is worth nearly three-quarters of a million dollars.

Despite his plans for retirement, however, George Jeppson stayed on at Norton longer than he'd intended. Having already given up the Drury Lane home, and not wanting to commute from the country house in Brookfield, George Jeppson found an apartment in Worcester. Eventually he bought another house in the city, which he sold after the Second World War ended.

The center of Jeppson family activities is now their Brookfield country home. And the house once visited by the crown prince of Sweden now welcomes WPI faculty, staff, students, and out-of-town guests.

Following a tradition established by Admiral Wat Tyler Cluverius, the Strausses are the seventh presidential family to reside at 1 Drury Lane.

The once ivy-cloaked, stuccoed facade, with its broad porte cochere on the west side, is now painted a light gray with striking maroon trim. Inside, light grays and pastels dominate, recreating the airy feeling that once characterized the Jeppson home.

A panelled study to the left of the foyer provides a refuge for President Strauss—his "brainstorming room," according to his wife, Jean. For her, the cozy study is also a favorite place to "curl up with a good book" in front of the fireplace.

The foyer opens onto a large living room with its own black marble fireplace. On the mantel is a trombone, one of several antique brass instruments displayed throughout the room. Other personal touches include a small Shaker desk in the foyer that stands next to a skulling trophy won by George Alden's grandson.

Borrowed from WPI's archives, the trophy has special significance to Jean Strauss, a former national singles rowing champion who finished eighth in the 1980 Olympic team trials for skulling. Today, she and the president keep in shape by rowing on Lake Quinsigamond. In fact, she says, "It was Jon's interest in learning to row, while we were both living in the Los Angeles area, that helped bring us together."

Enjoying her new home for its "coziness" in spite of its size, Jean says she especially likes the twin solaria, one at either end of the house. Both decorated in white wicker and cool pastels, the green-tiled north patio and blue-tiled south patio provide relaxing, intimate spaces that balance the more formal central living and dining rooms.

The south patio, she says, with its sunny bay window and view of a walled-in garden, is her favorite room—"a great place to enjoy a morning cup of coffee." The bay window is also a favorite perch for one of the Strausses' pets, L.A. Alley Cat, who revels in a good stretch in the morning sunshine. Meanwhile, the couple's two dogs, George and Gracie, make themselves at home in the terrace beyond

the walled garden.

Back through the foyer and up the curving front staircase, past an antique grandfather clock presented as a gift from alumni to WPI, is the master bedroom suite. There, a cozy living room with a white marble fireplace opens onto a bedroom with private bath. "Sometimes living in this house feels like living in a fishbowl. It's not difficult, but it's different," says Mrs. Strauss. "This suite is our private place."

Of the remaining eight bedrooms, the Strausses have combined three to create a suite for a caretaker who watches the house and animals when they are away.

With its spacious yet comfortable main rooms, inviting patios, and gracious grounds, 1 Drury Lane has all the elements for a variety of social gatherings. More than 3,000 guests, including members of the senior class, faculty, staff, and alumni, have visited with the Strausses during their first year at WPI. "I love entertaining here," says Jean Strauss.

Just across the street from the Strausses' home, at 15 Regent Street, proudly sits the Hughes House. Now home to WPI Vice President and Dean of the Faculty Richard H. Gallagher and his wife, Therese, the two-storied brick house was donated to the Institute in 1959 by Earl C. Hughes '14 and his wife, Mary.

Built in 1919 on land purchased from the Worcester Art Museum by a Mr. Batchelder in 1917, the house was the last to be constructed in the neighborhood. Also designed by architect Lucius Briggs, the home is believed to have been constructed by E.J. Cross. With its hipped roof and balanced chimneys over a central, symmetrical section, the house exemplifies the Regency Revival style popular at the time. Other features then in vogue were the small portico supported by Ionic columns and dentilled cornice.

In 1922, Batchelder sold the house to John F. Tinsley, vice president and general manager of Crompton and Knowles, and his wife, Helen. The Tinsleys lived at 15 Regent Street until 1954, when the home was sold to Earl Hughes, then vice president and later president of Bay State Abrasives.

"Mother fell madly in love with the Tinsley house," recalls Emma King Hughes Peterson. Daughter of Mary Hughes and step-daughter of Earl Hughes, Mrs. Peterson was already married by the time her parents moved to Regent Street from the house they'd built in 1927 on Salisbury Street. With only her youngest brother, Earl Jr., still living at home, Mrs. Peterson says her parents wanted a smaller place than their six-bedroom Salisbury Street house. (That home is now the Petersons'.) Their new residence, which at the time contained two bedrooms, better suited their needs, she says, and was also more accessible by car in the winter.

"It was a gracious, lovely, comfortable home for entertaining," says Mrs. Peterson. "Mother especially loved the staircase that curved up two stories over the front door. She wanted everyone to be married there."

Other favorite places were the panelled library/living room, and, to the rear of the house, a sunny music room where Mrs. Hughes used to keep both an organ and a piano. On the sun porch to the right of the music room, Mrs. Peterson recalls her mother's card room, which was always set up with card table and chairs. To the left of the music room was a bar which opened onto a formal dining room.

"She did a lot of entertaining there and loved it," says Mrs. Peterson. "They

At 15 Regent Street, Dick and Terry Gallagher stand beside the foyer staircase that curves up two flights (far left). The Regency Revival style home (right) was a gift to WPI from Earl C. Hughes '14 and his wife, Mary. The house features at the rear a latticed entryway and garden fence.

thought they'd be there forever." But as things turned out, Mr. Hughes's health necessitated a move to Florida. An "ardent supporter of WPI," Mrs. Peterson remembers, Earl Hughes decided to donate his home to his alma mater. In January of 1959, when the Hugheses presented their home and 40,000 square feet of land to the Institute, its assessed value was $29,500. For gift purposes, however, David Lloyd says the house was valued at $75,000. Today, he places the property's worth at nearly a half-million dollars.

For about a year after the Hugheses moved to Florida, a minister from All Saints Episcopal Church occupied the home. Then T.W. Van Arsdale Jr. became the first WPI vice president to live at 15 Regent Street.

The Gallaghers are the fifth WPI family to reside in the Hughes House. Having lived there for the past two years, Terry Gallagher enjoys her home as much as did her predecessor, Mary Hughes.

"It's large enough to entertain in, but small enough to feel like home," says Mrs. Gallagher. The formal dining room, with its intricate floral scrollwork over door and fireplace, and the mahogany-panelled library are spacious but not overwhelming. What was once Mrs. Hughes's music room is now the Gallaghers' living room; the sunny card room, a television room; and the bar, Dean Gallagher's study.

Upstairs, the large master suite features a tiled shower with nine nozzles. "You can really get a good spray!" notes Mrs. Gallagher. Two other bedrooms share a connecting bath, while what were once the maid's quarters over the kitchen today provide a spare room and extra study.

Avid travellers who have visited 54 countries on six continents, the Gallaghers have personalized their home with treasures from their trips. A collection of Japanese Hakata dolls is displayed beneath a glass coffee table in the living room, and glass shelves are filled with articles as varied as a stuffed bird from China, a carved wood zebra from Africa, and an ostrich egg fragment.

"We've blended a lot of modernism with the older furniture that belongs here," says Mrs. Gallagher. "It's a grand old house. We're so proud of it."

A few houses down on the other side of the street, 4 Regent is the third executive residence acquired by WPI. Purchased in 1966 for use by the vice president for student affairs, the nine-room house and 8,000 square feet of land sold for $22,000.

Now worth around $400,000, the two-and-a-half-storied, stuccoed house was built in 1916 on land purchased from the Worcester Art Museum by Earl Thayer.

Designed by architect Edward Topanelian, son of a prominent Armenian community leader, the Georgian bungaloid house is distinguished by first-floor palladian windows and a heavy, hipped roof with a pedimented dormer. Mission influence is evidenced in such exterior features as the triple double-hung windows above the first floor, and the deep roof eaves with exposed outriggers.

According to Frances Thayer Chapman, oldest daughter of Earl and Rosa Thayer, the interior of the house was in large part a mirror image of the house Topanelian designed for her aunt.

About five years old when she moved into the house with her parents and younger sister, Eleanor, Mrs. Chapman remembers the home for its circular front

Bernie and Gayle Brown share the Thayer House with their three teenagers, Matthew and twins Jody (left) and Tara (right). A sunroom, situated off the formal dining room, is a highlight of the stuccoed Georgian bungaloid, purchased by the Institute in 1966.

Thayer's detailed woodwork graces the main staircase and living room.

stairway, mahogany-panelled living and dining rooms with their built-in, leaded-glass shelves, and, best of all, the third-floor play room. "We had a doll house there with all the fixings," she recalls.

Initially, she believes, the sun room was an open porch which her parents later had enclosed and heated. Though the grounds were small, there was always the Antiquarian Society across the street. "We used to play hide and seek there," says Mrs. Chapman.

After her husband's death, Rosa Thayer remained in the house until she died in 1965. At that point, Mrs. Chapman says she and her sister decided to sell the house to WPI. "The college seemed to want it very badly, and we knew it would go into the right hands and be well maintained," she says.

First home to Dean of Students Martin VandeVisse, the Thayer House recently became the residence of its fourth WPI family, Vice President for Student Affairs Bernard H. Brown; his wife, Gayle; and their three children.

Brown's predecessor, Robert F. Reeves, remembers 4 Regent Street as "a very comfortable house" with beautifully crafted interior woodwork. He also appreciated some of the antiquated, but intriguing, features of the place. "It had a central vacuum system, which they used to activate by hauling buckets of water to a tub in the attic," explains Reeves. "They poured the water into an airtight container. As the water flowed out, it would create a vacuum." Wands attached to holes in the walls of each room would suck dirt into a collection chamber in the cellar.

That vacuum system hasn't been used for years. But other features of all three houses have kept WPI's physical plant staff busy. As in any old home, problems such as corroded pipes, basement flooding, and worn gutters have required attention. Of 4 Regent Street, for example, WPI College Engineer Anthony J. Ruksnaitis says, simply, "Murphy's Law has presided in that home since the first day we bought it." Of the three homes, Ruksnaitis says 15 Regent is the most solidly built, and has required the least work.

Though disasters tend to strike at the most inopportune moments—a pipe broke in honor of the Strausses' first Christmas Eve—the residents have high praise for WPI's maintenance staff. Of both WPI's plant services department and security force, Terry Gallagher says, "We feel very much protected."

And despite any maintenance difficulties, all three houses are valuable and valued acquisitions. Generous gifts or prudent investments that have enabled several members of the Institute's leadership to live in style and to enhance campus social life, these magnificent residences stand as reminders of a significant period in Worcester's economic and architectural development.

Higher and higher education

Paying for private college in the 1980s brings up the issues of higher costs, bigger debts, threatened cuts in aid, and the search for a good return on investment.

Photographs courtesy Chronicle of Higher Education

By Donna Shoemaker

Rob Ruth's story seems almost a vignette from America's past. From the 8th grade on, he helped his parents on the family dairy farm in Telford, Pa. Rob banked on receiving the reward for his labor much later, in the form of college tuition for his pre-veterinary studies. Rob and his sister both chose to attend the same private college, Franklin and Marshall. The Ruths sold a tract of land to developers to help pay for eight consecutive years of hefty college bills. At F&M, Rob found a new interest, in human medicine, and this fall, he's at Harvard Medical School. "I won't be taking over the farm," he says.

"My family and I have followed the philosophy that we try not to borrow more than we have to," Rob explains. But it's here that his story takes a contemporary twist. Despite his own labors and his family's foresight, Rob has already accumulated almost $10,000 in debt for student loans and undoubtedly will owe far more before becoming Dr. Ruth. But he's willing to accept that responsibility. Adds his father, Merrill Ruth, "If Robert wants to do it, we're going to get him through one way or another. He's always really hung in there." Both father and son are sensitive to the long haul ahead. "My parents are looking toward retirement. I hate to have to see my father continue to work," Rob adds.

His undergraduate debts are about on par with the national median debt level ($9,000) for 1986 graduates who borrowed for college. In the 1980s, for the Ruths and for other families with children in college, the rules of financial survival have been changing as the cost of a college education—particularly at independent institutions—has far outstripped inflation. With four years at a prestigious private college now costing about $65,000, has the price surpassed the ability of a middle-income family to pay? On whom has the burden fallen the hardest? For years the specter of "creeping careerism" has loomed over the liberal arts: Do heavier student loan debts tend to herd young people into the more lucrative professions? Whose responsibility is it to pay for the education of the next generation?

In these and other questions—about access, about the competition between publics and privates, about the long-term effect of a "fly now pay later" approach—can be found a core concern: People want assurance that the big-ticket purchase of a private college education still carries a tacit guarantee of value and lasting worth.

In private colleges, to provide the small classes, the first-rate faculty, the latest equipment, and the finest facilities that the public has come to expect, there seems to be no obvious stopping point where spending won't have a return in quality. In that quest for excellence, influence, and prestige, colleges can spend a limitless amount "for seemingly fruitful educational ends," noted Howard Bowen, one of higher education's best-known observers, in his seminal report for the Carnegie Commission (*The Costs of Higher Education*, 1980).

"You never have enough money. You always know what to do with the money you bring in. So we bust a gut to go out and raise a little more," adds Michael Hooker. That's true for public or private institutions, he believes. He has experienced both worlds: Since July, Hooker has been chancellor of the University of Maryland Baltimore County campus and formerly was president of the nation's most expensive college—Bennington—where this year's tuition, room, and board run $16,950. He sees how educational costs keep spiraling upward. The funds aren't used to lower tuition but for such things as recruiting and retaining good faculty, decreasing course loads and class sizes, stocking laboratories and libraries, and supporting faculty travel and development programs.

"There is a crunch now," Hooker adds. "The publics are faced with the same motivation to improve their quality that the privates face, and they're not getting enough resources either, so they are turning to private sources. I understand the resentment the privates feel at this because I felt it myself at Bennington."

He says his favorite argument when he was there was that "private education is as cheap as public education—the per-student cost is no greater. But in the private sector, you've got to charge students more." He kids, "I always cringed when I said that because I wasn't sure I was telling the truth," although he did feel Bennington delivered "quality for the price" and provided generous financial aid. Sighs Hooker, "The sad fact of life is that there is more quality to be had than we have the capacity to pay for."

In 1950, one-half of the nation's 2.3 million college students attended private colleges and universities. Today, with almost five times that many college students, only two out of 10 are enrolled in independent institutions. Since the 1950s, public universities have been riding the crest of the G.I. Bill, the baby boom, and the Sputnik-inspired drive to expand and to improve education, all of which swung open the door to the democratization of higher education. Public colleges and universities thus have dramatically grown in their percentage of the market, in enrollments, and in quality as well. A college education is no longer a luxury but a necessity required by the business world even for most entry-level positions.

From the 1920s to the 1960s, both public and private higher education wended their way with relatively stable tuition, adjusted for inflation. Tuition in the early '70s at private institutions more or less kept pace with the rise in the per-capita disposable personal income. Tuition and fees at public colleges and universities, then on the average one-fifth the price of the privates, rose more slowly.

During the latter part of the '70s, college students, whether they realized it or not, were getting somewhat of a bargain. The federal government significantly expanded financial aid for middle-income families; in 10 years alone, federal loans swelled from $1.8-billion to $10-billion in 1986. It was also a time when inflation deflated faculty paychecks and maintenance projects were deferred for lack of funds. Retrenchment—achieved through cutting back on such expansionist staples as an ever-larger freshman class, new programs, and tenured positions—became an unwelcomed ritual in academe.

Meanwhile, the traditional pool of college students—the 18-year-olds—was beginning its projected decline. (The demographic reality is that, between 1979 and 1992, the pool will shrink by 25 percent.) The decrease is expected to hit hardest in the 13 states where 51 percent of the private four-year colleges are located and will be felt most deeply by those liberal arts colleges drawing upon their home states to fill the beds. For such institutions, 75 percent of whose operating budgets are funded through tuition, losing too many potential students to the competition could turn the belt-tightening into tourniquet time.

The federal aid designed to ease the "middle-class squeeze," some critics say, has instead subsidized even higher tuition. And now real and threatened cuts in federal aid are particularly alarming to private institutions. The 1980s ushered in four years of double-digit tuition increases at the privates; in 1982–83, some colleges even announced increases of 20 percent. The past two years have brought more modest increases (6 to 8 percent), still well ahead of the rate of inflation. The 1986–87 tuition and fee increases for public four-year colleges averaged 6 percent. At a public four-year college, the current average tuition and fees are $1,337 (and a total cost of $5,604 for resident students). At a private, four-year college, tuition and fees average $5,793 (with a total cost of $10,199 for resident students), reports the College Board.

In the 1980s, people are asking if private, liberal arts colleges are pricing themselves out of the market. When that question had occasionally come up before, noted Thomas E. Wenzlau (in *The Crisis in Higher Education*), judging from the tuition hikes the trustees approved, the answer was No. However

Eric Poggenpohl

"The publics are faced with the same motivation to improve their quality that the privates face."

much the institutions believe the increases are justified, at times the public rebels. You hear complaints about the "Ivy-League" cartels controlling prices or claims that college is affordable now only for the affluent.

"When perceptions become accepted as reality, it does not really matter what the data show," observed Terry W. Hartle, a resident fellow at the American Enterprise Institute. His report, released last summer, takes exception to the perception that college costs have been skyrocketing. He found considerable stability in the cost of college over the past decade or so, at least for families with students in college—a group usually at the peak earning power and higher income level. Analyzing data from the U.S. Census Bureau, he concluded, "the bottom line is that for most median-income families with a child enrolled in college, higher education does not require a significantly greater share of family income than it did 10 years ago. The exception is at selective private colleges and universities, where price increases are quite pronounced."

You can see that jump in the figures he cited: In the past 12 years, when the consumer price index rose by 142 percent, private four-year college charges rose by 179 percent, private universities by 199 percent, public four-year colleges by 149 percent, and public universities by 143 percent.

Since 1980, Hartle added, the gap between family income of those with children in college and those whose children do not attend has become wider. But the data he used don't tell precisely how many of those students have had to forego college or attend a less expensive institution because of high costs.

Private colleges traditionally have had special appeal for people willing and able to pay a premium for excellence. The same holds true for institutions educating students for the careers most in demand. Thus, for the nation's top tiers of private colleges and universities, the more they charge, the more attractive they become. "Frankly, we haven't had to do a lot of justifying" to parents about why tuition keeps going up, states Robert Voss, executive director of admissions and financial aid at Worcester Polytechnic Institute (WPI). And at F&M, adds Donald Marsh, associate director of admissions, parents "don't see much difference between institutions in terms of costs" as they and their offspring look for a quality education.

Not only does the "prestige" factor push up college costs, but an economic irony seems to be at work as well. The greatest increases ever in college costs are coming right in the midst of this ballyhooed post-baby-boom drop in the number of 18-year-olds and a constrained era in higher education in general, in which the weakest liberal arts colleges may not survive. And yet quite a few colleges (generally the more selective ones) are finding that freshman applications, acceptances, and aptitudes (based on SAT scores) are on the rise. "Many colleges have had one of the best years yet in admissions," says Rob Ruth, who worked in F&M's admissions office this past summer. That gave him a sense of confidence—at least a short-term one—that F&M and its liberal arts peers face little danger of overpricing themselves.

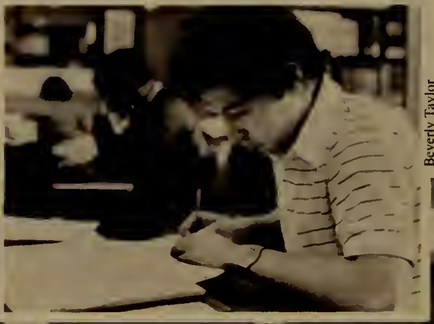
"We're swimming in success," beams Donald Berth, vice president for university relations at WPI. WPI had expected a freshman class of 640 this fall; instead 740 showed up for orientation, or "100 more than we can comfortably handle. It's the relative attractiveness of science and engineering in this age," explains Berth. Villanova University closed its admissions earlier than usual last year (in February), swamped with 8,000 applications for 1,500 spaces, says W. Arthur Switzer, associate director of financial aid. Adds Villanova's dean of admissions, the Rev. Harry J. Erdlen, O.S.A., "I'm beginning my 11th year in this position. Ever since I've been here, I've been told the '80s were going to be the dark days." Instead, there's a silver lining in the gloomy predictions. Applications increased from 5,600 to 8,600 over the past 10 years, and, Father Erdlen adds, "the quality of the applications has increased significantly with us, especially last year."

Faced with a struggle for the survival of the fittest (and fattest-coffered), it's no wonder that there is jubilation among the private colleges experiencing red-letter days in admissions—and even some cheers among those simply holding steady in the level of applications. Amid this encouraging supply of prospective freshmen, it seems there would be little reason to cry wolf.

But the evidence is increasing that the wolf is at the door. Some would slyly suggest that he comes disguised as President Reagan's secretary of Education, William Bennett, a vociferous foe both of what he perceives as abuses in federal financial aid and the deteriorating quality of education at all levels. Others might say the wolf is dressed in sheepskin's clothing: They foresee students flocking away from privates to the best publics to earn their degrees, in search of the green pastures of high quality at a lower price. A recent Carnegie Foundation survey of high school seniors showed 80 percent of the respondents thought the high cost of college was "outrageous."

"We in higher education should be concerned. The tendency to push the market as hard as we can, albeit for noble ends, is gradually and undesirably altering the character of higher education," warned Michael O'Keefe, president of the Consortium for the Advancement of Private Higher Education, in a hard-hitting article in *Change* magazine (May-June). He took colleges to task for tuition increases double—and occasionally triple—the rate of inflation. He urged the privates to show restraint and not to take "excessive advantage of the tendency of parents and students to equate higher prices with higher quality."

College benefits both society and the individual. Who should pay to educate the next generation while it prepares for the future?



Beverly Taylor

Others on campuses have been issuing warnings as well. "I cannot justify the way tuition has increased. When inflation has gone up 4 percent, you can't justify an 8-9 percent increase in tuition. It will backfire on us and we'll reach a point of no return," states an East Coast university admissions official. A financial aid expert adds that he sees this concern over costs showing up "in the expressions of distress from students and parents, guidance counselors, and many others. You see it in the level and volume of unpaid bills—there's an increased pressure on the bursar to go out and *collect* college bills. We have to tell too many students to make some arrange-

ment to pay your bills or you're going to be dropped from classes."

The rhetoric—and reality—of cost containment and quality control have been making themselves known in higher education. The nation seems awash in a rising tide of studies probing why Johnny and Jane can't read, write, and think—or afford college. Secretary Bennett lost no time in cautioning students and their parents "to kick the tires and look under the hood of higher education." His *caveat emptor* to college-goers has been heeded as a caveat in at least a few ivy towers, too.

In response to the continuing challenge to make higher education more affordable, several institutions have launched unusual consumer-oriented pricing policies. Among them is Duquesne University's "zero-coupon education." Parents can purchase for their infants four years of a Duquesne education at today's price, saving thousands of dollars in the long run (if their child opts to go to another college, Mom and Dad will recoup only their initial investment, without accrued interest). Southern Methodist University last year announced a plan to finance four years of a set rate of tuition over a 10-year period, with either a fixed or variable interest rate. Williams College has a popular 10-month installment plan for tuition payments. In spirit at least, such plans have much appeal, even if most institutions haven't jumped on the bandwagon yet. Notes Villanova's Father Erdlen, "I would personally like to say to freshmen, 'This will be your cost, and we will hold that for four years.'" A few institutions have already put that promise into practice.

"The biography of an American family is written in its cancelled checks," is how Howard Bowen so aptly began his book on the costs of college. Today, the collective checkbooks of the families of 12 million college students tell tales of change, challenge, and stress. On one page we read biographies of parents whose own parents put them through college but who now ask their own offspring to pay their way by taking out large loans. On another page we read of the incredible wealth to be found in the upper echelons of American society. Turn the page, and we read the troubling stories of college students forced out because they can't afford to pay.

The stories have a common theme, of coming to terms with just who should assume the responsibility for supporting the next generation while it devotes four years to preparing for a personal and societal future. More and more nontraditional students, among them adults, are going to college, thus adding other complexities to the picture: What about the 30-year-old single mother, trying to meld part-time parenting, studies, and employment into a full life? Who picks up her college tab when financial aid is so limited for continuing education?

Don Berth at WPI points out that, over the past 20 years, the ethic of parents assuming the responsibility of paying for their children's education has generally been abandoned, and not always out of financial exigency. Depriving oneself of consumer pleasures isn't very much in vogue. In years past, he explains, a family would have had almost "a sense of

John C. Phillips

As private colleges become more expensive, their newly won diversity may disappear

"We've simply brought the country club to the campus," says a parent and professor convinced he doesn't like what he sees. David McKeith has taught American history for 25 years at SUNY-Cortland, at Elmira College, and currently, at Ithaca College. He criticizes what he believes are the "excessive expenses" of private education, pricing it out of the reach of the middle-class and "accentuating the lack of sensitivity of people who have money and power for those who don't," he says.

The 1970s, says McKeith, brought a greater diversity of students into the colleges—among them inner-city youths, a wider range of middle-income students, and more minorities—who expanded the collegiate experience for all groups. But he sees such diversity disappearing at private schools, a victim of too little financial aid, as the privates once again become the preserves of the rich. "For all their problems of huge classes, public universities have a much more sensible balance in the classroom," McKeith believes. "So much of this country has been built on middle-class values," he goes on. But those values are becoming scarcer in private schools. "To talk about America's heritage of living on the land and loving it, the rural life, the frontiers, is like talking about some kibbutz in Israel. They've never lived it."

Yet he seeks to preserve the essence of what often distinguishes a private from a public college. He and his wife invite students to their home. He has long office hours. He carries a student load of 85 and refuses to lecture to a class larger than 35. Both he and his wife were educated at private colleges (Colby and Wellesley); their three college-age children have chosen privates as well. Son John graduated from Hartwick College in 1983, some \$6,000 to \$10,000 in debt, which he pays off in his job of producing videos for high schools. Anticipating \$40,000 to \$60,000 in expenses to send a fourth child, now 15, to school, McKeith salts away a considerable amount of money each month. "I don't anticipate any help. I'm glad to do something for my kids, but I can't do it all."

gratitude to a college" for providing a quality education. Now, says Berth, prospective students come to college asking, in effect, "What are you going to provide me in financial support if I come here?"

The pages of that American family biography now attracting the most attention are those spelling out danger signals. High debt levels are alarming many in academe—and in the public. Cutbacks in direct grants hamper the educational futures of students. The doors are closing on those unable to pay for a college degree. Having to work at several jobs to earn money is creating a new category of "invisible drop-outs"—students who get less than they should out of college. Minority enrollments are decreasing at the prestigious private colleges; in general, the number of black students going on to college has dropped 11 percent from its peak in 1976 even though 30 percent more now are graduating from high schools.

More and more, colleges have had to infuse operating budgets with large amounts of scholarship aid; the higher the tuition, the more aid is required, and the more they have to charge full-paying students. Most institutions offer packages of loans, work/study jobs, and outright grants. Villanova, for example, requires students receiving financial aid to contribute $1,200 from a summer job and to work during the school year. Switzer points out that putting in that extra 10 to 30 hours a week, on top of a full academic schedule, "is not something to be taken lightly. There is a point beyond which they should not go."

Tales are rife of the labyrinthine formulas for awarding financial aid. Parents are expected to divulge all of their assets and liabilities—even as far as submitting income-tax forms—when their children apply for financial aid. Explains Berth, "When you look at the parent's confidential statement (a required form for financial aid), it's no question that the parent who is frugal and puts the money into the bank or insurance policy to assure that Suzie or Johnny has the means for college is penalized, versus the parent who has a seaside cottage, is mortgaged to the hilt, has two high-quality cars, and no liquid assets. There are too many abuses of that sort in the system."

The burgeoning rise in scholarships at private colleges has even caused some institutions privately, if not publicly, to ask themselves if those funds could not be invested in more productive ways. WPI is one of only a few private institutions that can still hold to an "aid-blind" policy of admitting undergraduates regardless of their finances. Berth observes that this means the Institute each year must come up with $6.5-million in financial aid. He wonders whether $1-million or so of that could better be spent on recruiting top faculty and otherwise improving quality. He fears: "We may have become more generous than we can fundamentally afford."

The rapid growth in the student loan debt has educators most concerned. Switzer gives as an example a common occurrence at Villanova: a graduate who goes on to law school might come out owing $50,000 in loans. Should she marry someone in similar circumstances, the couple would have "$100,000 in debt before they've earned their first professional dollar." Notes Rob Ruth, the F&M graduate, "I have some friends who have graduated and are very worried about paying off debts. But down the road, they will be glad they struggled."

Others are not so sure. Nationally and internationally, the debt burden "is one of the biggest issues facing us now," Chancellor Hooker states. In 1984, 30 percent of all undergraduates borrowed money for their education; nine years previously, only 11 percent had. A study conducted by the Carnegie Foundation for the Advancement of Teaching found the amount borrowed had increased by 300 percent in that period (in constant 1975 dollars). Colleges and universities, says Hooker, are "turning out students shackled with these enormous debts." Undergraduates, now, for instance, can borrow $2,500 a year under the Guaranteed Student Loan program. Hooker adds that students often have little idea of the responsibility they are taking on by borrowing thousands in loans each year. However, "for the colleges, this poses a moral problem because we know what's happening."

It also poses a philosophical concern. As *Change* magazine put it, loans reinforce self-interest values rather than the concept of education as a public resource, intrinsically worthwhile to society. With heavy debts, this college generation, already more preoccupied than previous ones with earning high salaries in their careers, is looking for tangible returns on the investment in education. In decades past, young men and women might have felt more free to study British poetry, European history, Greek philosophy, or anything else that held a fascination in the world of ideas. They accepted that education had a non-trade value: It encouraged one to become a better citizen and it enhanced our civilization. Explains WPI's Robert Voss, "They used to assume that, if they went to college, of course they'd be part of the elite, managerial class. Now they want to see what's in it for me." Voss's colleague, Don Berth, urges, however, that education also needs to be perceived as a value-added investment in oneself—unlike financing a fancy car, which "five years later will be a pile of rust."

What can be done? Many educators call for more massive infusions of funds from all sources for scholarships—and occasionally for more belt-tightening at their own institutions. The somewhat fractured federal policy needs careful scrutiny, too. Under the new federal income-tax law, most borrowers will no longer be able to deduct interest paid on their student loans. Other provisions of the bill prevent parents from channeling income to their offspring to be taxed at a lower rate. The bill also taxes some forms of financial aid and it inhibits the private sector in raising scholarship funds. *Change* magazine suggested that colleges clarify to students any loan obligation; that loans be limited to upperclassmen who have proven they have an 80 percent chance of graduating; that loans be tailored by discipline, class year, and even intended career.

Rob Ruth, the future physician and dairy farmer's son, says, "I knew my money would be well spent at F&M. The level of liberal-arts education is well worth the money." He believes that businesses are looking for the well-educated liberal arts graduate, the "well-versed individual." Rob chose F&M because it is a private college. He liked the prestige, the small classes, the close contact with faculty committed to teaching. A young man firmly focused on achieving his personal goals, he muses, "As I've gone through F&M, I've wondered, if I hadn't majored in biology, would I have put this much money into it if I had majored in drama or history?" He answers his question with a hesitant Yes.

Donna Shoemaker is editor of the Alumni Magazine Consortium.

Ed Thorsett

Willard Clay

Autumn Fire

A languorous fall
in England,
a dazzling display
in America.
The contrasts found
in these woods and moods
are rooted in climatology.

By Jonathan Richardson

Season of mists and mellow fruitfulness,
Close bosom-friend of the maturing sun. . .

Harvest time. Hives brimming with honey. Fleecy barred clouds and cider presses oozing sweet juices. John Keats's ode "To Autumn" overflows with ripeness, plenty, and contentment. His is a slow season—warm, fulfilled, drowsy—the laziest, most comfortable time of the year.

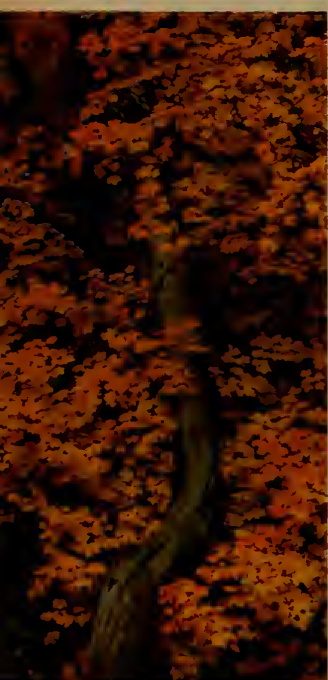
But isn't there more to autumn? Widely spaced memories return me to my boyhood's Connecticut hills, fiery with crimson foliage; to sassafras leaves—half green, half scarlet, still pungent to the nose—scavenged lovingly from Pennsylvania sidewalks by my young daughters; and, near a highway south of Lancaster, to a lone shagbark hickory—a blaze of saffron, still searing my senses like a spicy curry.

Was Keats blind to the vigor of autumn? Had he forgotten the clarity of October sunlight, the air's apple-sharp bite, the brilliance of blue sky glimpsed through painted foliage? Was this most sensuous of poets immune to the exuberance of the season?

Exhilaration, not Keatsian languor, is eastern America's fall theme. To the poet Bliss Carman, New Brunswick-born and New England-bred, "There is something in October sets the gypsy blood astir." In *A Vagabond Song*, it is reveille he hears, not taps:

The scarlet of the maples can shake me
like a cry
Of bugles going by
And my lonely spirit thrills
To see the frosty asters like a smoke
upon the hills.

Why do poets in England and America evoke this season so differently? In this case, comparative climatology illuminates a question from comparative literature. Keats and Carman were capturing very accurately the spirit of the autumn each knew. And these autumns are indeed different. America, unequaled worldwide for brilliant foliage, also is notable for fall's sudden onset, its clear-skied daytime warmth and nightly chill, its swift crescendo to forest splendor and rapid subsidence to dormancy. Keats's English autumn is a gentle, drawn-out, mellow season, joining summer and winter across months of gradual change. If you want "more, and still more later flowers for the bees, until they think warm days will never cease," spend the third season in Keats's part of the world. But stay in America if you seek Carman's passionate autumn, "when, from every hill of flame she calls and calls each vagabond by name."



Willard Clay

From ridges to valleys, autumn in America unveils a multi-hued tapestry. Above: a golden glow of maples weaves its way through Arizona's Chiricahua Mountains. Center: A vibrant display of Vermont's finest fall finery is reflected in Keiser Pond.

Arctic winds, the Gulf Stream, and the botanical diversity of our eastern forests all underlie this trans-Atlantic contrast. Some of our native species turn true exhibitionists in autumn; others don more modest garb. But the sum of all is an exceptionally rich, many-hued forest tapestry.

In Europe the deciduous forests are far less diverse and no species approaches the brilliance of our gaudiest American maples, ashes, and oaks. The autumn tapestry of English forests thus is both thinner and paler than our own.

But why paler? To put this down as a typical illustration of American excess and British reserve begs the question. Let's investigate climatic differences.

In many American forests the heat and dryness of late summer have already signaled the end of the growing season by early September. The chilly northern air masses that successively invade the deciduous region in early fall thus find our trees already approaching winter dormancy, withdrawing nutrients from their leaves, and losing their lustrous green as the metabolic balance shifts from chlorophyll manufacture to chlorophyll decay. More stable yellow and orange leaf pigments—the chemically similar carotenes and xanthophylls—are unmasked by the destruction of chlorophyll. As cool nights come on with a rush, still other pigments—the purple to scarlet anthocyanins, whose manufacture is stimulated by these fall conditions—suffuse the leaves of our most brilliant species. The result of this rush to glory? By early October, foliage pilgrims clog New England highways, and two weekends later most of Washington, D.C., seems to have migrated to the Skyline Drive to see autumn unfurl in the Blue Ridge Mountains of Virginia.

If it is to be unusually brilliant, this autumn must have special weather: Cool, clear, dry conditions produce the finest foliage because lowered temperatures (not so low as to bring early killing frosts), bright sunshine, and moderate drought all favor the manufacture of vivid anthocyanin pigments. But such weather is common enough in an American autumn and anthocyanin-rich species such as staghorn sumac, red and sugar maples, sweetgum, scarlet oak, and white ash seldom fail to delight. In exceptional autumns they do more than delight—they take your breath away.

Western Europe and the British Isles, meanwhile, bask through autumn under the influence of the tropic-spawned Gulf Stream. These lands normally escape Arctic winds until late in the season. Caribbean-born, the Gulf Stream is still warm after thrusting thousands of miles north and east to bathe the shores of Europe. Sea winds, warmed in turn by this mighty current, blow inland with pro-

Willard Clay

found climatic consequences. In autumn, the effect is to keep northwestern Europe moist and mild, favoring deciduous forests but not anthocyanin-rich foliage. Maps depicting the world's vegetation zones clearly demonstrate the Gulf Stream's moderating influence. Although they lie at the latitudes of northern Newfoundland and Hudson's Bay, the forests of England, Denmark, and even southern Sweden are deciduous—the northernmost anywhere in the world. Equivalent latitudes in North America do not receive the Gulf Stream winds and, climatically too fierce for deciduous forests, are home instead to spruce, fir, and muskeg. Because of the Gulf Stream, the chill of autumn comes surprisingly late to Europe's northern deciduous forests, and the trees can safely keep their leaves until the days are very short.

Thus when planted together in city parks and streets, deciduous trees from Europe and America display contrasting fall patterns adaptive to the native climate of each. In New York and Philadelphia, for example, common European species—Norway and sycamore maples, linden, European beech—remain green and leafy far into fall while the American species color and drop early. By quickly entering dormancy, the American species are protected against the early frosts and the unpredictable onset of real winter weather on this side of the Atlantic. But true to their European heritage, the Old World species resist entering dormancy until the days are very short. American city dwellers thus experience a "longer autumn" than do country folk. The latter enjoy only the brief glory of native species, while in town, the bravura performance of "natives" is followed by the paler encore of the immigrants. (Most of these, interestingly, do not produce appreciable anthocyanin even in our climate; like some of our own species, they apparently have never evolved this capability.)

Having not yet entered winter dormancy, the European immigrants are at risk as the American autumn wanes. At home in Pennsylvania, I more than once have seen Norway maples caught in Thanksgiving snowstorms with their leaves still green, fooled by the longer late-autumn days in this alien latitude. Because their leaf-loss timetable is written primarily in terms of day-length rather than temperature, our Norway maples had ignored other indications of the lateness of the season and had kept their foliage. Native species alongside them, however, following day-length timetables evolved in the American climate, were leafless and safe in dormancy long before the snows.

That deciduous trees of both continents use day-length as their autumn leaf-shedding cue is demonstrated by a phenomenon I have often observed: If situated beside bright street lamps, trees tend to keep their leaves later than usual. Sometimes just the branch nearest the light remains clothed. But for those leaves affected, the street lamp evidently mimics a longer day and fools the day-length-activated timing mechanism that triggers leaf loss. If the "perceived" day-length is too long, the hormonal changes that initiate leaf loss do not occur.

Deciduous forests are earth's quintessential litterbugs—the first throwaway society. But before it falls, a leaf in its native climate will have transferred most of its minerals and soluble organic compounds back into the stem and roots—the tree's perennial storage organs. When it falls, the senescent leaf will take with it little more than its cellulose skeleton and its fading pigments. But a severe early frost will forestall this recycling process by killing the leaf prematurely, thus leading to the loss of important nutrients.

American trees in their native latitudes meet this fate relatively seldom because of their genetically programmed early senescence, but this obviously is not true of European species introduced to America. Here, their late leaf retention is maladaptive, and the nutrient losses suffered each fall from frost-killed leaves may be considerable. To be successful in America, these ill-adapted immigrants probably need to be pampered in domesticated landscapes. Here, competitors are discouraged and fertilizers may be applied, helping to restore lost leaf nutrients.

Pamela Zilly

Red maples reward the eye best when cool, clear, dry weather has created just the right conditions. Deciduous trees take their cues from the length of the day and the strength of the light. Before falling, these leaves will transfer their nutrients back to the tree.

Though anthocyanins are the pigments responsible for our most fiery forest hues, species lacking anthocyanin capability are among my fall favorites. Aspen, tulip tree, hickory, the introduced ginkgo, and larch (one of our few deciduous conifers) turn gloriously golden due to a foliar abundance of carotene and xanthophyll. During the growing season these pigments reside with chlorophyll in the leaf chloroplasts, apparently having an accessory light-trapping function in the photosynthetic production of sugar. Another function may be that of screening the sensitive chlorophyll from harmfully bright light: Many of the carotene-rich species grow in exposed habitats or, like aspen, at high altitudes where sunlight is especially intense. In any case, leaf carotenes persist later than less stable chlorophyll, and autumn gold is the result.

Botanists know less about the function of anthocyanin pigments. Adaptive explanations are elusive for the high anthocyanin-producing capability of species like red and sugar maples. Perhaps these pigments, like carotenes, play a shielding role for chlorophyll. But since anthocyanins are produced primarily in the fall, when chlorophyll is disappearing anyway, that explanation seems insufficient. We do know that a deficiency of nitrogen induces anthocyanin production; perhaps this explains the unusually early reddening of sour gum, a species often found on poor soils. Sparse nitrogen supply may also account for the early senescence of bog vegetation: Bogs often form oases of color in still-green September landscapes.

American deciduous species do not march in lock step toward winter dormancy, even though the foliage season is comparatively short. Sour gum often begins its crimson display in August, long before its neighbors show signs of leaf senescence. Another early quitter is witch hazel, a species unusual among trees in postponing its flowering period till fall. Premature leaf loss by this species may make the flowers more visible to fall insects, promoting pollination and successful seed production. Early dormancy also characterizes white ash, whose compound leaves probably have the shortest life span of any in the forest. Appearing late in the spring, ash leaves are gone by early fall, after a few days of bronze and purple splendor. This species must be a very efficient photosynthesizer during its short growing season because it is bare for a remarkable fraction of the year.

As autumn continues, the maples and hickories have their turn, with oaks and beech concluding the foliage parade. Indeed, beech and certain oaks often retain dead leaves through winter, having never fully developed the layer of weak abscission cells that permits aging leaves to break off at their base. The American species, with their subtle, overlapping sequence of autumnal senescence, differ among themselves in latitudinal range and local habitat (such as ridgetops or valleys, dry soils or moist). Each species has thus evolved its own specific day-length timetable for senescence.

Toward the close of the American foliage season, the anthocyanin-rich species have lost their brilliance. A serenity akin to Keats's English autumn brings, at least partly, a new mood. Late last fall, weeks after the foliage pilgrims had departed, my wife and I visited the Berkshire Hills of Massachusetts. As we stepped outdoors on a crisp and sunny morning, waning glory enfolded us. Beyond the low-lying mists of the valley, a mostly leafless forest clothed the slopes in the peaceful bluish-brown hue of bare branches seen through refracted early light. Only two species still bore leaves, and one—red oak, now russet-brown and somber—blended easily with leafless neighbors on the humps of distant hills. Not so the aspen groves! Great streaks of now-pale gold slashed unforgettably through ranks of dormant colleagues. Keats's mood was not complete. Though the fires of an American autumn were banked and dying, the aspens trumpeted one last hurrah.

Willard Clay

Above: A storm stretches over New Hampshire's White Mountain National Forest, dousing for a moment the blazing landscape. Left: On the forest floor, birch branches frame the evidence that trees are the litterbugs of nature.

An ecologist equally at home in forests and tropical lakes, Jonathan Richardson enjoys searching for answers in the great outdoors. He is the Dr. E. Paul and Frances H. Reiff Professor of Biology at Franklin and Marshall College. He is the author of the textbook, Dimensions of Ecology.

Of Father Time, Mother Nature, and a Newborn Idea

Could science be sexist?

A new breed of critics says a male bias in methodology, mindset, and metaphor has hampered the search for scientific truth. This might be the next scientific revolution.

By Leslie Brunetta

Illustrations by Linda Draper

"All of the activities of the scientific method are characterized by a scientific attitude, which stresses rational impartiality."—"Science" in *The New Columbia Encyclopedia.*

And that's precisely what's wrong with science, say a new breed of feminist theorists. Rational impartiality, or scientific objectivity, they argue, is a figment of scientists' imagination because, like any other human activity, science is influenced by its practitioners' culture. The problem is, that culture harbors profound masculine biases.

Science is the last sacred cow among the intellectual disciplines. In recent years, revisionists of many kinds have brought new perspectives to the other academic fields. For instance, it's now an accepted commonplace that "history" is a subjective explanation of events rather than a collection of facts. Society decides what events are important enough to study in the first place, and then in what light they should be seen. The same goes for anthropology, sociology, and all the social sciences. But "pure" science depends upon scientific facts, natural laws, proven models, doesn't it? Where does culture fit in? And how could gender politics affect science?

Easily, say the feminists, especially when gender has something to do with the subject of scientific study. "Science has been used fairly often in the past to justify sexist projects," says Sandra Harding, professor of philosophy and director of women's studies at the University of Delaware. Harding's book, *The Science Question in Feminism,* and her articles are considered by many feminists to be central to the new critique of science. "For instance, when the women's colleges opened in the 1800s, there were scientists who had all sorts of 'evidence' and sincerely believed that intellectual work would physically debilitate women." Women were advised by the nation's top physicians that, since reproduction was the primary function of a woman's body, vital energy routed away from the uterus and ovaries toward the brain would result in a drastic unbalancing of the body's natural equilibrium, and disease was sure to follow.

The male bias can be seen in more contemporary scientific issues, too, as for instance, in theories of human evolution. The widely accepted "man-the-hunter" theory postulates that men were responsible for the invention of tools as aids in hunting. These tools in turn favored the development of bipedalism and an upright stance as well as "male bonding"—men working together without women on the community's most important business. "Such a hypothesis," says Delaware's Harding, "presents men as the sole creators of the shift from prehuman to human cultures."

Harding also notes that the only evidence for man-the-hunter is the chipped stone tools found at hominid living sites. There's no way to tell if these tools were used by men for hunting or by women for digging up roots and preparing meat. In fact there's no evidence that women didn't hunt and men didn't work in the hut. Yet those arguing that men's "natural" place is in active, important work and women's "natural" place is in the home often trot out this theory as proof. "The whole hypothesis," Harding says, "is based on androcentric notions."

From the world of animal biology comes another tale of androcentric bias. Ever since the first observers set out to examine the mysteries of primate life, interest has focused on the "dominant male," who was seen to rule the group, choosing his mates and fighting off other males. Using modified versions of Darwin's sexual selection theory, animal behaviorists saw this male as determining his troop's genetic future: His aggressive behavior ensured that his chromosomes were passed on in greatest numbers to future generations. Females were seen to have a passive, though essential, role in passing on his chromosomes.

But females play just as important a role as the dominant male, anthropologist Sarah Hrdy found while studying langur monkeys in the 1970s. A female would often mate with more than one male, with the result that these males wouldn't attack her young, assuming it to be their own. Females also badger and attack other females and their young, causing spontaneous abortions, injuries, and sometimes even death. This behavior helps to ensure that the attacking female's own offspring face less competition and so are more likely to survive and to reproduce. But because this behavior didn't fit into the dominant male model, say the feminists, early observers either ignored it or treated it as a freak occurrence that didn't affect the ongoing life of the group.

Perhaps those are just examples of bad science, of researchers who haven't followed the rules of objectivity. If scientists would rid themselves of sexism when looking at problems involving gender roles or relationships between the sexes, there wouldn't be any problem with science, would there? And surely gender influences only a tiny minority of scientific problems?

Wrong, say the feminists, who argue that science's masculine bias reaches right to the core of the scientific method. Physics and chemistry, as well as the life sciences, are affected in research areas that would seem to have nothing at all to do with gender. Bad science isn't the culprit; science itself is.

Early observers didn't see female langurs as active players in the genetics game.

Historically, men and *not* women have been scientists. Only recently have women had any real access to scientific work above the technician level. (Princeton, for example, which ranks among the nation's top research universities, did not admit women to the graduate physics program until 1971, to graduate astronomy until 1975, and to graduate mathematics until 1976.) Most people would agree with the idea that women's limited access to the scientific world has adversely affected the lives of women. The feminists argue that it has hampered science as well. Simply allowing women in isn't going to solve the problem.

"Our culture puts men into a hierarchy and so they tend to see nature as a hierarchy," says Harding. "It happens to be a way men are conditioned to think." According to the new critics, scientists—partly because they have been raised as men and partly because men have shaped the ground rules of science—look for hierarchies in nature to explain phenomena and then look to see what at the top of the ladder is controlling the lower rungs. That may mean, as in the sexist projects described above, finding surefire "evidence" that the uterus determined the functioning of all other physiological systems; that hunting led by men shaped the beginnings of human culture; that a dominant male controls the life cycle of a monkey troop.

But, say the feminists, the masculine slant also means looking for the unifying laws of physics that will reveal the cause of all physical events; or looking for master molecules (like DNA) to explain the cause of all surrounding functions; or looking for a single virus to account for an illness. The preference for hierarchy has also led to a ranking of the sciences from hard (physics and mathematics) to soft (anthropology and psychology). It has led to assigning greater value to quantitative analysis than to qualitative work. And it has led to dismissing models that stress interdependencies of functions and events rather than controlling elements.

Take, for example, the case of Evelyn Fox Keller. A mathematical biologist, she became interested in the history and philosophy of science in the 1970s and has gone on to become a central figure in the feminist critique of science. Her book, *Reflections on Gender and Science,* is often cited by other feminists as a central text. In the late 1960s, Keller became fascinated with how and why cells in an organism develop different forms and functions even though originating from the same cell. To examine the problem, she focused on cellular slime mold, *Dictyostelium discoideum,* because it can exist in two states. When there is enough food, it remains a self-sufficient single cell; otherwise, the single cells aggregate into clumps. These clumps eventually crawl away like slugs, erect stalks, and differentiate into stalk and spore cells. The spores finally germinate into single-celled amoebas.

The mystery: How does the aggregation, which signals the cells' differentiation, start? A model already existed proposing that "pacemaker" cells spurred on aggregation: The pacemakers gave off signals, passed on by the other cells, calling them together. Keller and her research partner, Lee Segel, had two problems with this model—there was no evidence that the pacemaker cells existed, and aggregation continued even when the supposed pacemaker center was removed.

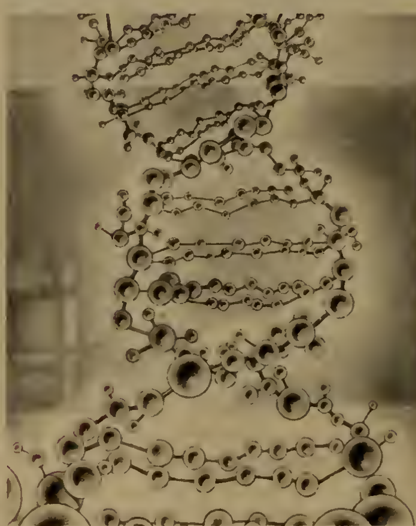
Keller and Segel already knew that each of the undifferentiated cells produces a chemical to which it and the other cells are sensitive. They proposed an alternative to the pacemaker model: before differentiation took place, the cells would either produce more of the chemical or become more sensitive to it in response to a change in their environment. This change in their behavior would upset the cells' spatial stability and cause the onset of aggregation. (Later independent experiments confirmed that these chemical changes did occur and that aggregation followed.) In other words, Keller and Segel believed that the undifferentiated cells' interaction rather than the actions of any master cell lay at the center of the mystery.

The rest of the biology community didn't seem to agree. Even though proof of the pacemaker cells failed to come forward, the pacemaker hypothesis was generally accepted and the search for the pacemakers ended. Keller grants that her model could be greatly improved, given newer, non-linear mathematical equations. But her real complaint, she says, is that the central question—why do the cells aggregate?—was virtually abandoned because the accepted explanation fit neatly into a "central-governor" framework that most scientists were predisposed to accept, even without proof. Keller says in her book: "Such explanations appear both more natural and conceptually simpler than global, interactive accounts; and . . . we need to ask why this is so."

In other words, the critics say, science isn't objective—it's partial. Scientists are predisposed to accept certain ideas as plausible because they fit into the framework of existing masculine experience, which is perceived as reality. Meanwhile, they may be ignoring or discarding more comprehensive explanations and models without even considering them. Scientists may take an objective stance within that framework, but since the framework itself may be skewed, the stance may actually be subjective (albeit unconsciously). Think of the theory of relativity: You may be sitting still in your chair reading this, but since the earth is moving within a moving galaxy, you're moving at a speed and in a direction entirely unfelt and very difficult to determine.

But if the critics are right, why would control be so central to our concept of masculinity that it would carry over into an endeavor stressing objectivity? And would science have been so very different if women had been involved from the beginning? "I question whether wanting to find control is a male-female issue," says Carol Rouzer, a 1976 chemistry major graduate of Western Maryland College who is now a senior research biochemist at Merck Frosst Canada, Inc. "Seeing answers in terms of control may be just a plain human fallibility—some people believe that that's how religion started."

The feminist critics counter that, in the most obvious way, science has been conceived as a pursuit so masculine that



DNA's "master molecule" status is a product of the masculine bias, say the critics.

females have historically been considered constitutionally incapable of carrying out scientific work. From the time of the Greeks, men have been considered rational and women emotional, men objectively interested in the world around them and women subjectively. There's a resulting circular chain of events, the feminists say: Men value objectivity and so "valuable" pursuits must stress objectivity. Once these pursuits stress objectivity, women (and their attendant subjectivity) must be kept out so that objectivity can be maintained. And, the feminists believe, the concepts of objectivity and control go hand in hand: Men can more happily control what happens around them because they are encouraged by our culture to feel very little subjective, emotional relationship with the objects, people, and events around them. They then tend to interpret the world in terms of their own experience.

There's a basic psychological reason why men and women tend to see things in these differing ways, according to Keller. (Keller and the other feminist critics sharply distinguish between sex and gender: Sex is a biological determination and gender a sociological/psychological one. In other words, no man or woman has a biological imperative to approach scientific problems in one way or another.) A man's psychological development in our society stresses the importance of autonomy. A boy grows away from his mother, basing his sense of gender on "not-mother" and on the authority of his father. A girl, on the other hand, is encouraged to empathize with others, to be emotional, as she grows away from her mother and yet identifies with her as a member of the same sex and gender.

The boy's autonomy becomes further pronounced, Keller says, if he enters into scientific objectivity's circular logic. Certain people even may find scientific fields attractive for just that reason. The stress on scientific objectivity will reinforce a man's perception of the importance of his own autonomy. He will be encouraged to distance himself from his subject. As his own autonomy becomes more important, his objectivity—his feeling of emotional distance from his subject—will deepen.

"I think you can make Keller's same arguments without drawing on Freudian theory," says Katherine O'Donnell, assistant professor of sociology and a member of the women's studies committee at Hartwick College. "I do believe that women see things differently even though men and women both have the same potential. We have different historical, cultural, social, and personal experiences."

Other feminist critics say that, because most women are not raised to wield power but instead to respond more emotionally to other members of the family and community, they may be able to offer different insights into investigations of scientific problems. These insights may lead to greater understanding of the world around us. Because most of the few women who have so far entered science have had to buy into the masculine-objectivity-control model, the world hasn't had a chance to see where these insights might lead.

It's very hard to resist that model because it is at the very center of our culture's idea of science. "Many practicing scientists think this whole discussion is ridiculous," says Anne Fausto-Sterling, professor of biology at Brown University and author of *Myths of Gender: Biological Theories About Men and Women.* "They're so convinced of their ideology that the criticism is inconceivable. It's like telling a fish that there's some other atmosphere than water."

In this atmosphere, certain assumptions hold fast and influence all thoughts around them. "You can look at science as a system of discourse," says chemistry professor Stephen J. Weininger of Worcester Polytechnic Institute. He studies the influence of language on the development of science. "Science is a way of talking about the world, and so part of the training of scientists is to learn their field's language. It gives people an internal cohesion, a sense of belonging."

Like any other group, says Weininger, scientists not only add to their own language, they are also in turn greatly influenced by that language. "There's certainly a heavy metaphorical content to most scientific terminology," says Weininger. "And after a while the metaphors, which are just supposed to be an aid to understanding, become entrenched. So when other phenomena occur that don't fit into the discourse, they're often swept under the rug."

For instance, Weininger explains, one of the fundamental metaphors in chemistry is that of molecular structure. These structures are conceived as existing in three dimensions and can therefore be imaginably flipped this way and that to reveal different aspects to the mind's eye. "There are kinds of physical data that seem to connect with the 3-D concept," Weininger says. "The measurements we come up with seem to work well in these terms."

About 30 years ago, Weininger says, a chemist announced that he was going to explain these measurements without using the 3-D model. His article wasn't even accepted for publication, even though Weininger says that there were no real scientific flaws in the chemist's reasoning. Recently, another similar paper was published, but "even though non-molecular explanations of chemistry are starting to become more acceptable now, there's a lot of heavy resistance to the whole idea," Weininger says. "We've been indoctrinated to talk about phenomena in certain ways, and people simply resist other metaphorical explanations."

The feminist critics argue that, since the time of Plato, science has used metaphors to describe science as a project that can be carried out only by a masculine mind. And because the culture quite strictly defines what "masculine" means, science itself has been strictly confined within prescribed definitions.

According to Keller, Plato planted the idea in the Western consciousness that the mind's attainment of knowledge is like a man's attainment of an ideal sexual union. As Plato wrote in the *Symposium*, "When a man, starting from this sensible world and making his way upward by a right use of his feeling of love . . . begins to catch sight of that eternal beauty, he is very near his goal." By the early 1600s,

Individual slime mold cells aggregate when food runs short. But what causes this?

Francis Bacon—whom many reckon to be the "father" of modern science—wrote that science should be "a chaste and lawful marriage between Mind and Nature." The relationship, as Bacon envisioned it, was not one between near equals, but one in which a masculine mind controls and dominates a feminine Nature. Bacon promises a budding scientist that he will "lead to you Nature with all her children to bind her to your service and make her your slave."

The founding of the Royal Society in 1662 marked the realization of Bacon's imperative in the eyes of many of its members, says Keller. A secretary of the Society announced that the group would "raise a Masculine Philosophy . . . whereby the Mind of Man may be ennobled with the knowledge of Solid Truths." Joseph Glanvill, another Society member, warned that it was impossible to discover scientific truth if the mind didn't maintain this masculine standpoint: "The *Woman* in us, still prosecutes a deceit, like that begun in the *Garden*; and our *Understandings* are wedded to an *Eve*, as fatal as the *Mother* of our *miseries*."

The metaphors of contemporary science still support science's masculine bias, Harding says. For instance, Richard Feynman, in summing up his 1965 Nobel Prize speech, said his attraction to his early theories was "like falling in love with a woman." The love sustained him throughout his career, even though the theory has undergone change; the theory he had fallen in love with in his youth, he said, has "become an old lady, who has very little that's attractive left in her, and the young today will not have their hearts pound when they look at her anymore. But, we can say the best we can for any old woman, that she has become a very good mother and has given birth to some very good children."

And the bias surfaces even in the words of younger women in science. A researcher and assistant professor at a prestigious technological university recently said, when asked if she had ever encountered sexism in her studies or career, "I have to say that I've never felt as though I've run into any barriers. But I've always been very mathematically and analytically inclined. I have maybe more of what people consider a masculine mind, so I haven't had any troubles."

The problem with the pervasiveness of this bias in scientific metaphors is twofold, according to Keller, Harding, and others: It not only reveals a basic flaw in science, it perpetuates it. That flaw is that scientists psychologically distance themselves from nature and its processes because they unconsciously accept a formulation of the world as based on a male-female dichotomy: The scientist is masculine and virile while nature is feminine and passive. Scientists are then more prone to see everything in terms of dichotomy: male vs. female; scientist vs. nature; rational vs. irrational. And since things can be divided, they can also be arranged in hierarchies with higher elements controlling lower elements.

There are bound to be troubles if a scientist isn't perceived as having a masculine mind, says Keller. She cites the case of Barbara McClintock, whose genetic theories were considered heretical for more than 20 years before they were recognized as breakthroughs and McClintock was awarded a Nobel Prize. While studying corn seedlings, McClintock had noticed that some of the plants had mutations—patches of color that shouldn't have appeared where they did. She observed these patches occurring in patterns that could be deciphered as exhibiting the plant's underlying genetic history—when and how frequently in the plant's life the mutation had taken place. To McClintock, the pattern revealed that each plant had its own rate of mutation, which remained unchanged throughout its life cycle. This meant something was controlling the rate of mutation, she theorized.

McClintock eventually identified factors on the plant's chromosomes that work cooperatively to move one of the factors to another chromosomal position. This movement changed the course of the cell's development. McClintock saw this not as an abnormal process, but as the normal process of cell differentiation happening at an abnormal time. The implication, as she announced at the Cold Spring Harbor Symposium in 1951, was that interdependent, organized systems of factors in the cell's nucleus, not independent genes alone, determine the cell's future.

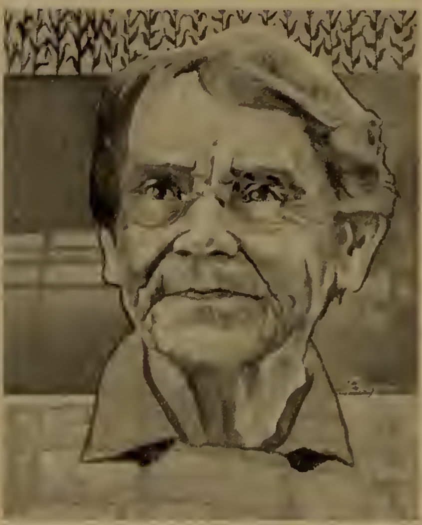
McClintock's colleagues treated her theories with disbelief. Many thought she had jumped the rails, completely abandoning the scientific track. The idea that a regulation mechanism rather than random genetic variation was involved in genetic heredity was at odds with the neo-Darwinian doctrine of the time, Keller says. In fact, it smacked of Lamarckism: McClintock had proposed that organisms evolved by actively responding to their environment rather than by passing on random variations that better equipped them to cope.

Things got worse for McClintock. The big news in 1953 was the Watson-Crick DNA model. Having discovered DNA's structure, the two men proposed that DNA was the cell's ultimate dictator: It passed on orders and information to other components in the cell, but never itself accepted any orders or information. The genetic flow of command was one-way.

Like other biologists, McClintock was excited about the new model, but had more reservations than did most of her colleagues, says Keller. McClintock thought the model tried to explain too much and erred in reducing an incredibly complex function to a small series of relatively simple steps. But despite her reservations, the rest of the scientific community enthusiastically embraced the theory. And that meant that McClintock's models became even more unacceptable.

Finally in the 1970s, when molecular biologists realized that genetic mobility did occur, McClintock's work was recognized as being fundamentally important to a complete understanding of genetics.

Keller argues that McClintock's position as a woman in a nearly all-male field and the obstacles this position presented to her encouraged in her a belief that establishment views were not necessarily correct. McClintock matches a psychological profile Keller describes of a "gender-free" scientist, one without the scientist-vs.-nature dichotomy and hierarchy. McClintock does not believe that science will ever be able to "master" nature, but instead that nature is infinitely more resourceful than our capacity to understand it. In an interview with Keller, McClintock asserted, "There's no such thing as a central dogma into which everything will fit." Instead of imposing models on nature and then discounting phenomena that don't fit, McClintock feels it's necessary to "let the experiment tell you what to do," and to recognize seemingly strange occurrences not as exceptions to the rule but as clues to the larger picture.



Barbara McClintock was branded a heretic. But her theories have gained supporters.

"This is much more threatening than getting women into science and letting them play," says Leslie Burlingame, associate professor in the history and philosophy of science department at Franklin and Marshall College. She says she isn't sure about the validity of the feminist critique. "But even if it doesn't totally revolutionize science, it will shake people up."

That's what the feminists are hoping. They believe science has been allowed to become complacent about its assumptions and methods, practically to set itself up as an infallible institution. "It's a process that modern science itself started—the idea that you want to include a maximal vision, that you don't assume preconceptions are right," says Harding. "But they won't submit to the process themselves. There's a belief that science is a fundamentally unique kind of social activity." The critics' prescription: Scientists, research thyselves. Says Fausto-Sterling, "Science is a social process that requires the same kind of analysis as any other discipline."

Some scientists who may be willing to entertain the idea that there may be basic problems with modern science still have grave reservations about the feminists' critiques. Rouzer cautions that science needs to train young scientists for a truer objectivity. But she isn't sure that gender is the problem: "It's almost as if they're saying that, if you're narrow-minded and controlling you're masculine and if you're imaginative you're feminine. I'm not sure that that's fair."

Rouzer may be right—women might be just as control-oriented as men. "It might be true that women would come up with the same framework as men have," says O'Donnell, "but they might not. The point is that a different approach hasn't been given a chance." Again, the feminists point out that, for all the complaints they have, they aren't proposing throwing out the baby with the bathwater. "We don't stop speaking English," Harding says, "just because we find out it's sexist."

How would science be different if men weren't in control? "Keller and other feminist critics are insisting on permission for difference," says Ruth Perry, director of women's studies at the Massachusetts Institute of Technology. "The alternative is not to replace science, but to exhibit and consider differences in approach." In other words, there is no "feminist science" to take the place of established science. At least for now: "No critic is obliged to come up with a blueprint for the future," says Fausto-Sterling. "These are thoughts that weren't even permissible 10 years ago. We need now to break out of the first generation of questions."

Leslie Brunetta is moving on from the Alumni Magazine Consortium to become a free-lancer in Boston.

The Goal Is in the Striving

Says EE Professor Dan H. Wolaver, WPI's Outstanding Teacher of the Year.

By Shirley Standring
Photos by Michael Carroll

"Teaching is the most mysterious of all the arts," Dan Wolaver asserts, "because the good teacher must constantly examine 'What is thought?' and 'What is the process of understanding?' It's an exciting profession because you're never through learning about it. There isn't any one best way to teach. You're constantly striving for a goal you never reach, but the goal lies in the striving, in bringing a freshness to your classroom."

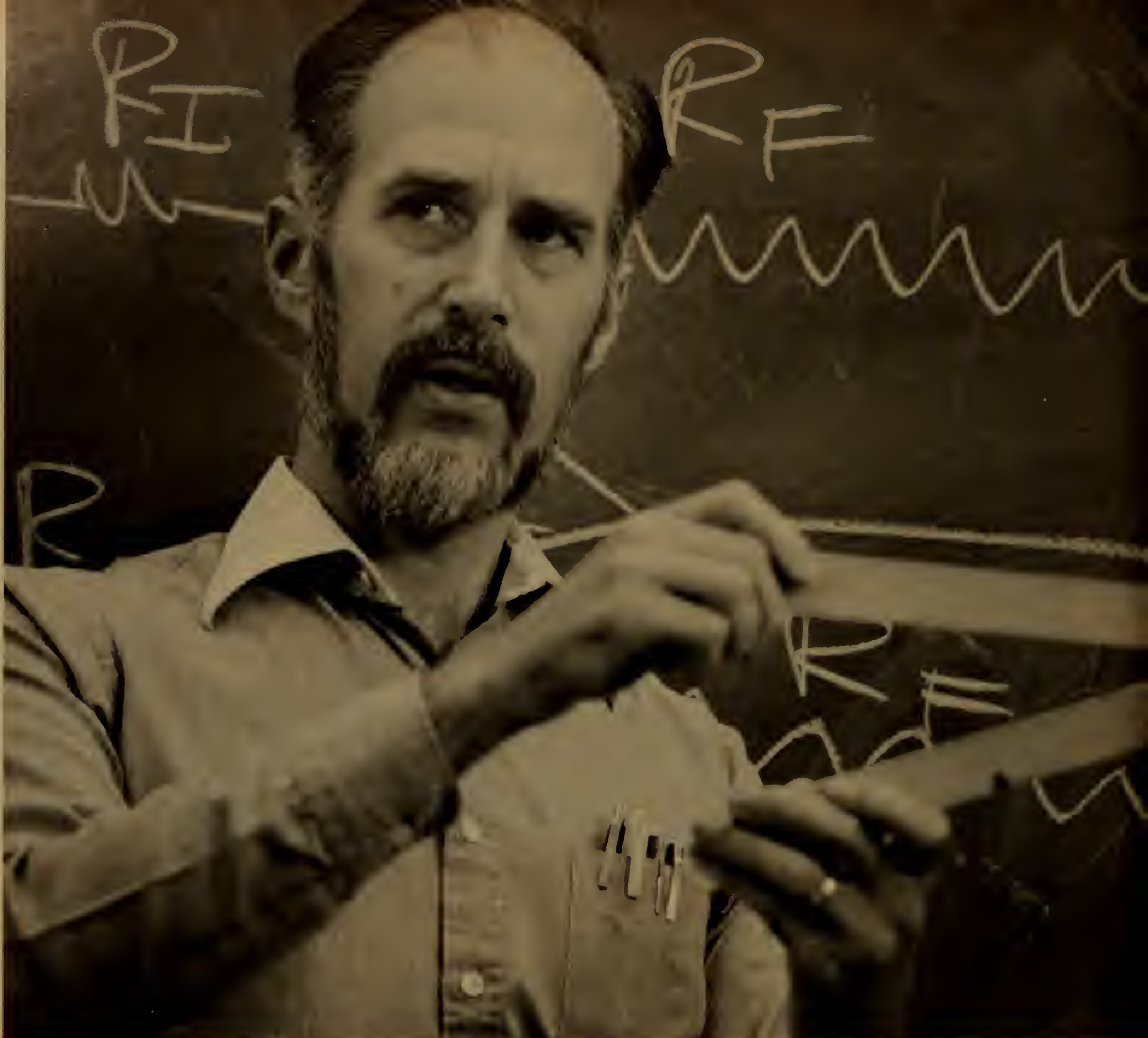
Wolaver has been honored by his students and colleagues with the 1986 WPI Board of Trustees' Award for Outstanding Teaching. "This honor," says William H. Roadstrum, professor emeritus of electrical engineering and a close colleague of Wolaver's, "places Dan on a footing with past recipients such as John M. Boyd, Ralph Heller, and C. William Shipman, to name a few, in the very top of a top class of distinguished professionals."

Adds Roadstrum, "Dan's personality is ideally suited to teaching. He's able to carry his enthusiasm over to the students, he is conscientious about his method, and he knows exactly what he's going to do when he goes into the classroom."

Created in 1960 to honor Professor Hobart H. Newell's distinguished career in education, the award has been given each year to recognize WPI's most outstanding teacher.

In the award's early years, faculty members determined among themselves who would be honored, according to Dean of Academic Advising John van Alstyne (himself the 1970 recipient), who has served on the selection committee many times. But for the last 15 years, the committee's deliberations have included student input as well. The committee is appointed by the dean of the faculty and consists of five faculty members and five students.

Says Robert Long II, associate professor of physics and selection committee



"A hunch can bring students closer to an answer, and they often learn something by going through the process."

chairman for 1986, "It's a thorough and time-consuming process, and we try hard not to let our decision leak to the rest of the campus before the recipient is announced at the annual Faculty Dinner in the spring.

"I read each letter this year looking for the items students seemed to value most. In those letters recommending Dan, they all mentioned his availability outside of the classroom, his style of presentation, his concern for students, and his ability to relate to a situation in such a way that students readily learn new material."

Says Wolaver of the honor, "It says to me that what I have been trying to do is successful, that somebody appreciates it. It's the ultimate to me, to be the teacher of the year."

A transplanted midwesterner who has come to love the Eastern landscape and its beautiful color, Wolaver says he has always been interested in teaching. He was influenced by an uncle, also an engineer and teacher, who worked for General Electric before settling into an academic position. Wolaver obtained a bachelor's degree in electrical engineering from Rensselaer Polytechnic Institute in 1964 and M.S. and Ph.D. degrees from the Massachusetts Institute of Technology (MIT). He then joined the technical staff of Bell Labs. An MIT advisor, Wolaver recalls, had praised Bell's leadership in research as a good preface to academia.

Wolaver remembers his baptism into the business world as "a dip into a cold

stream. I hadn't touched a slide rule in two years, and my research had become unapplied, dealing in theoretical concepts rather than in making things work. It was a difficult awakening when I had to have a project built and working."

The project was a high-speed digital transmission system with an automatic equalizer. "I was in control of the theory, but I couldn't find the bugs that kept the system from working. I avoided the lab, and spent a lot of time at the computer, where I could simulate the processes. It was not an easy time for me. But I kept banging my head against real problems and began to lose my fear of the bugs I couldn't understand. Eventually, I worked it out, and I learned a valuable lesson as well."

Wolaver credits his experience at Bell Labs with instilling in him three important concepts that he tries to pass along to his students: the importance of creativity; understanding how practical constraints influence a project's design; and the need for clear, concise written and oral communication on a project.

Wolaver spent 10 years with Bell Labs, obtaining the practical experience he felt he needed before facing a classroom of eager young students. Several factors, he recalls, convinced him that the time was right to leave industry for academia. "My uncle spent about 10 years in industry, and the timing seemed right for him. My wife deserves a lot of the credit, too. She would clip ads for teaching positions and leave them for me to read," Wolaver laughs.

Perhaps the determining factor was his last assignment at Bell. The project involved a lot of circuit design, and Wolaver approached it with the assurance of a veteran engineer. "I had full responsibility for it," he says. "When I had completed it, and could see the whole picture and make it work, there were no more dark corners of electrical engineering. It gave me a great deal of confidence."

Wolaver's first introduction to WPI was through an article in an IEEE (Institute of Electrical and Electronic Engineers) professional journal about the WPI Plan. "The Plan's emphasis on education through projects intrigued me," he says, and he applied for a faculty position here.

William Roadstrum remembers his friend's introductory lecture to the EE Department: "I realized immediately that Dan was unusual. He gave quite a good talk, but there was something else about him. He was so open and full of ideas. My colleagues must have recognized it as well because an offer was made and Dan joined the faculty."

Wolaver remembers the emphasis his WPI interviewers placed on teaching. "Every other college dwelt on my

"Students believe teachers think in equations because that's what we write on the board. But sometimes pictures explain things best."

"Engineering is a harmonious process, and what you accomplish is more the discovery of order that's already there than the cold process of putting blocks together."

research at Bell. Whenever I brought up education, they dismissed it quickly, commenting that good teaching was expected. At WPI, my interviewers never mentioned research. They wanted to talk about education. I was also impressed with the faculty, particularly John Orr and the late Donald Eteson."

Joining the faculty in 1979, Wolaver immersed himself in his new profession. He set out to impart to his students valuable gifts like confidence along with a thorough knowledge of electrical engineering. He became a student of teaching theory and methods, and gained a reputation for the all-too-often elusive ability to relate information to his students clearly and concisely. It is a skill that Wolaver has painfully scrutinized in others and developed for himself.

"Students have more confidence in what they are being taught if they can see how they would have arrived at the solution by working at it themselves. Students need to be taught in small steps so they don't get lost, but the steps must be logical."

Adds Wolaver, "We must let students experience the mental dilemma of 'Where do I go from here?' long enough to feel the problem, but not so long that they become discouraged." The process is what William Roadstrum speaks of as "controlled agony." "I don't want my students to suffer fear and uncertainty to the extent that I did," says Wolaver.

Standing before a class, he isn't content merely to teach the elements of a circuit breaker, for example, and the process by which it works. He wants his students to know why that circuit breaker has been so designed, and to understand how the constraints laid upon the designer influenced the design.

"Some educators believe that analysis is the most important ingredient to design, that if you analyze long enough, you can design," he says. "But it's an entirely different philosophy when you begin with the problem and work your way through to the solution. Part of this kind of learning is knowing through analysis the many different things that will—and won't—work. But you can't create a design until you know what you want the system to do. That's why the MQP [Major Qualifying Project] is so valuable. Students really learn design here."

Wolaver launches into an explanation of a typical MQP. Ideally, he explains, a student will begin with a loosely defined problem: "Let's say I, a student, want to identify an abnormal heartbeat. I must first decide how to do it. Will I monitor the pulse, the heart sounds, electrical

signals or some other function? Once I've decided on the process, I must determine what features will then define normal/abnormal qualities. Next, I decide on a circuit to seek out those features. This step involves the nitty-gritty of circuit operation. This is the design process emphasized at WPI, and only a fraction of it relies on the ability to analyze.

"Teaching the creative process is much harder than teaching analysis," he goes on. Wolaver believes that truly creative designers have difficulty explaining where their designs come from. At times, he says, they seem to come from nowhere.

"My thinking process includes visualization. I encourage my students to plot their equations. This helps them to get an overview of their thoughts by seeing a picture. Often, students believe teachers think in equations because that's what we write on the board. Sometimes pictures explain things more clearly.

"I also encourage students to try things," he says. "Usually students feel they need to go straight to a solution; they feel that playing around with an idea is unprofessional. I don't care if the

"Students have more confidence in what they are being taught if they can arrive at a solution by working at it themselves."

answer they arrive at is wrong. Their hunch may have brought them one step closer to the answer that works, and they may have learned something by going through the process."

Beyond all of the preparation for working as an electrical engineer, Wolaver feels he must introduce students to the enjoyment of being an engineer. "If they don't enjoy it, there's no point in playing the game. Creativity is the necessary ingredient for enjoying the adventure of engineering. There's also joy in interacting with others involved with the enterprise and in identifying a practical need of mankind and providing a working answer.

"WPI is very strong on encouraging students to maintain their sights on the use of a product or a process. They should ask themselves what the benefits to society are of transportation, stereo televisions, and missile guidance systems, for example. If, in their efforts as engineers, they feel it's more important to make transportation safer, they should do that instead of designing stereo TVs. WPI offers students opportunities to examine issues of social awareness."

Wolaver says he loves to see ideas that at first look strange and complex begin to make sense. "Engineering is not terribly different from the arts," he contends. "Whether you're designing a system or composing a piece of music, rules must be followed. The way in which things fall together is harmonious, and it seems that what you're accomplishing is more the discovery of order that's already there than the cold process of putting blocks together."

His mind seems to race to all facets of a question. Yet Wolaver answers slowly when asked about future goals. He admits that he's looking forward to publishing a new book, *Electrical Engineering for All Engineers,* which he co-authored with William Roadstrum, and, of course, to teaching better.

Also, he sees the need for more communication with his colleagues in both EE and other departments: "If I can say to my students, 'This follows from what you learned from Professor X,' I can build on that concept. But I have to know what's being taught."

He suggests several avenues of interaction with colleagues: more team teaching, joint appointments between departments, giving the faculty opportunities to work together on research projects, and hosting more retreats and workshops.

But, he says, the most effective interaction comes from having the time available for just this purpose—at convenient places on campus such as lounges and the faculty dining room in Higgins House,"We have to continue to make this kind of atmosphere available to both faculty *and* students."

A believer in WPI, the Plan, and the mission of the Institute, Wolaver is not shy in expressing his dismay over the research/education schizophrenia with which many universities grapple.

"Many students don't realize the benefits of an institution that emphasizes education over research because often they don't know anything else. But students who have gone on to other institutions have commented to me on the difference. At research-oriented institutions, they say the faculty can become almost invisible. Researchers need time to do their own work, which is appropriate, but at what expense to the majority of their students?

"The whole issue of research vs. education is a question of balance," Wolaver asserts. "Presumably, the balance can be different for each individual. The Plan did a lot of advertising for WPI, but you can't be famous due to a single initiative for very long unless you continue the experiment.

"Research doesn't have to be only in engineering, science or the humanities. It should also be in teaching. We should be writing more articles about new methods in teaching. These ideas should be given at least equal weight with articles about new technologies."

Beside his faculty appointment, Wolaver continues to consult on outside projects, something he enjoys very much because it keeps his understanding of the field current. Often, he says, some element of his consulting projects becomes source material for his teaching.

It has been said that "Those who can, do, and those who can't, teach." Wolaver prefers it this way: "Those who can, do; and those who are aware of how they do it, teach. The doers do, and the teachers explain how the doers did it.

"To be a good teacher," he believes, "you have to *enjoy* the doing or you don't have the motivation to *teach* the doing."

Shirley Standring is a freelance writer living in Spencer, MA.

"The whole issue of research vs. teaching is a question of balance. Presumably, that balance can be different for each of us."

INSURING SUCCESS

Frederic A. Stevens '61 first made his mark providing insurance companies with software. Now he's delivering their mail.

By Michael Shanley

Each letter is like a guided missile, whistling down the center of the room-length sorting machine at an outrageous rate of speed, then slamming into a zip-coded cubbyhole.

Fred Stevens '61 raises his voice to be heard over the constant din in the shop at Mail Processing Systems Inc. (MPS) in East Hartford, CT. "We presort 5 million pieces of first class mail a week," the MPS vice president notes proudly. "A million a day."

Stevens, who knows more about mail than your mailman, explains the workings of various folding, stamping, scanning, sealing, and wrapping machines. He seems genuinely to like these machines because he understands how each works—appreciates, for example, the elegant simplicity of an automatic letter-folding machine. He is equally at home in the sleek high-tech room where a bank of sophisticated computers and high-speed laser printers churns out letters by the thousands.

"If you have enough mail," says Stevens, explaining MPS's basic premise, "you can send it first class for 18 cents instead of 22. But it has to be properly sorted. So what we do is take a company's first class mail, sort it, and send it off."

MPS is *the* national-mail presort service bureau in the Northeast. The company deals with major mailers in Boston, Hartford, and New York, many of them insurance companies like Travelers, Aetna, Connecticut General, and John Hancock. "There are other companies like ours," Stevens says, "but we've pretty much got the national mail locked up. Nobody else in the area can presort mail to all 50 states."

The company also offers electronic printing and data-processing services—developed by Stevens when he joined the company two years ago—that can create a piece of mail from a company's magnetic tape. Consider, for example, statement processing for a credit union, a growing new MPS service. The traditional procedure is for a credit union to produce monthly or quarterly statements in-house—a time-consuming and labor-intensive process. MPS, on the other hand, can reprocess a company's data and print the statements on a state-of-the-art laser printer, producing the entire document in an instant. Headings, logos, numbers, gray panels, whatever, are laser-generated, at one time, in one pass, on both sides of the paper. Clients save on paper as well as postage costs. The operation then moves to MPS's mail shop, where the statements are folded, inserted in window envelopes, and presorted.

"We offer one-stop shopping," says Stevens, who in June won WPI's Robert Goddard '08 Award for outstanding professional achievement. "You send us the tape, and we take care of everything else, including mailing. And we do it in less turnaround time than you could do it in-house."

Some of MPS's clients, however, use only the mail shop

Frederic A. Stevens '61, computer pioneer for the insurance and bulk mailing industries, sits outside Sanford Riley Hall, his residence during his WPI days. Stevens won this year's Robert Goddard '08 Award for professional achievement.

"If you're persistent enough to get through a drought, then one day something will click—and business will flourish."

service. "They send us their mail with 18 cents postage and we sort it in one of two ways. Either we'll use the presort machine, which 'reads' only certain type fonts, or we do it by hand." Despite all the high-tech hardware at MPS, fully half the sorting is done the old-fashioned way—by hand. Many of the 400 employees who work on one of the company's three shifts simply sift through mountains of mail, arranging it in zip code order.

MPS is much more than just a printing and mailing house, however. And the crucial difference is the combination of data processing and electronic printing.

As Stevens says, "There's a big advantage for us in massaging the data and getting it to print in a unique manner. One of our credit union customers, for example, can't just get up and walk away. We print some pretty complex material for them, and if they want to stay with that capability, they've got to stay with us because nobody else can do it.

"If they were to take what we're doing to some other printing company that has a Xerox printer and say 'Here, we want you to produce this format statement like Mail Processing Systems does,' they wouldn't be able to do it because without the data processing end, you can't do what we're doing. We've put a lot of investment into building computer programs and we've got a proprietary product."

Total sales for MPS are currently at about $6 million, up from about $3.5 million when Stevens came on board two years ago.

In 1970, back when the word entrepreneur was hardly ever used off Wall Street, Stevens and a colleague, Robert Maltempo, left the comfortable fold of Aetna Life and Casualty to form Vantage Computer Systems. They had $12,000, borrowed from a friend of Maltempo's.

Vantage would go on to enjoy unprecedented success in the writing of software programs for insurance companies, but not before going through some hard times. Stevens, a physics major at WPI, chuckles when asked if there was ever a time when he was unsure Vantage would be a success. "I had no conception it would ever work," he admits.

"The environment was much different then," explains Stevens, who currently lives in South Glastonbury with his wife, Guerri, a programmer and systems analyst who occasionally does work for MPS. "The whole idea of software firms hadn't been established. Most corporations had their own data processing divisions and developed their own software. They wouldn't buy any from outside."

Struggling against tradition, Stevens, Maltempo, and a handful of employees kept at it for several years, working for individual companies on a time plus materials basis, or, as Stevens puts it, "for whatever it took.

"Those were some lean years," Stevens recalls with a smile. "There were times when you almost felt like giving up."

Basically, Stevens was the technical expert and Maltempo the salesman. But in the early years, they each did a little of everything. "For a while there," Stevens says, "I was chief systems designer, programming manager, operations manager—anyone on the technical side of the business reported to me. And in many situations, you're not only the chief manager but the chief doer as well."

In 1977–78, things started to come together. "We finally developed an actual product," Stevens explains, a prepackaged computer program, aimed at insurance companies, that would handle the complex bookkeeping involved in variable annuities. A hot new product at the time, variable annuities allow customers to vary the premiums paid on retirement savings and give them shares of investment funds separate from an insurer's general fund.

Vantage's computer software was so good that it made all the insurance companies' in-house programs virtually obsolete. Soon all the biggies were at little Vantage's door.

Stevens and Maltempo then added computer programs for other non-traditional insurance products—flexible premium retirement annuities and universal life policies. Such products require enormously complex accounting procedures. As an insurance executive puts it, "It gets hairy. You're carrying lots of buckets. If you change interest rates, you can have three or four buckets for each year carried forward forever."

Stevens once calculated that the 25,000-line variable annuity program took the equivalent of four man-years of effort to produce. By the same token, it took 50 man-years to perfect a 5,000,000-line universal life program. The insurance companies paid accordingly.

A second major development in Vantage's growth came with the advent of the individual retirement account, or IRA. IRAs were first developed around 1976, Stevens recalls. "At the same time we were trying to sell our variable annuity system to John Hancock in Boston. They told us about this new product they were trying to get on the street right away. It was a fixed annuity for the IRA market.

"We changed course and modified our variable annuity system to be primarily a fixed interest annuity system and installed it for John Hancock. Then we sold a number of other programs to different companies. That got us well on the way to becoming a major vendor in the annuity market.

"Eventually we made a crucial change to the annuity system and we became *the* vendor. If you wanted a system to process annuities for the insurance business, you called Vantage. It was that simple."

While discussing these Vantage boom years, Stevens takes the time to point out a crucial aspect of the entrepreneurial spirit. "People say to me, 'You were pretty lucky to be there when the IRA product came around.' And I say, 'Well, you can look at it as luck or you can look at it as persistence.' If you're persistent enough and you can live through these things, then probably one day you're going to find something that clicks and you'll be in business.

"The IRA opportunity was there for a lot of people, but there weren't many who were in a position to take advantage of it."

Stevens also notes the importance of a broad-based knowledge of a given field. In the same way that he's learned more about mail processing than seems necessary for his position, he once studied every aspect of the insurance business.

"My background was primarily in the technical end," he says of the Vantage days, "but if you're going to be successful in software you've got to understand the business you're dealing with. So I got to know a lot about life insurance. For example, I had to learn enough actuarial mathematics to talk to actuaries in their own language. With insurance products, you're dealing with very complex situations. You have to be able to understand what these people are telling you, and often what they're telling you isn't explainable in any other way except the mathematics. So you study it and you learn it."

Ironically, it was Vantage's success that ultimately caused Stevens to leave. "It got too big for me," he says of the company that now employs about 150 people, most of them professionals. "I prefer smaller companies, watching them grow. MPS has more employees overall, but only a handful are in the professional end."

"To be successful in developing software means you've got to know a *lot* about the industry you're dealing with."

Stevens did, however, retain a major interest in Vantage until last spring, when he sold his remaining stock and resigned as a director.

"I like the challenge of building an operation," Stevens says of his decision to join MPS. He had taken some time off and served as a consultant after leaving Vantage in December of 1983. "I like learning new things. I think of myself as a technologist in that I can understand technology and put it to work. And I've got a broad enough background so that I can understand a lot of different fields. Here at MPS I'm getting interested in desktop printing and electronic publishing—the whole process of getting words on paper. We've only just begun to go in that direction."

Stevens traces the direction of his own career back to WPI. "There was a very small computer in the math department," he says. "I was using it for some of my work in physics, and got very interested in programing. So when I graduated, I got a job as a programer with Aetna."

That job lasted all of about four months, as Stevens was drafted. But after spending two years as a health physicist for radiation safety at the Army Chemical Center in Maryland, he returned to Aetna as a programer and systems analyst.

Those were the pioneering days of computer science, Stevens recalls. "The first computer I worked on at Aetna was an IBM 1401 with 8K memory. Today's personal computers would run rings around the mainframes of the '60s.

"Back in those days, we learned as we went along. It was all on-the-job training. Actually, in my first few months at Aetna, they handed me some manuals and asked me if I wanted to go to school. I said, 'No, I'll wing it.'"

That attitude has served him well. "I've never had a really good plan for where I'm going to be at any given point in time," says the East Hartford native. "I've just never really given it that much thought."

Given Fred Stevens' track record, why should he start now?

Michael Shanley is a free-lance writer living in Holden, MA.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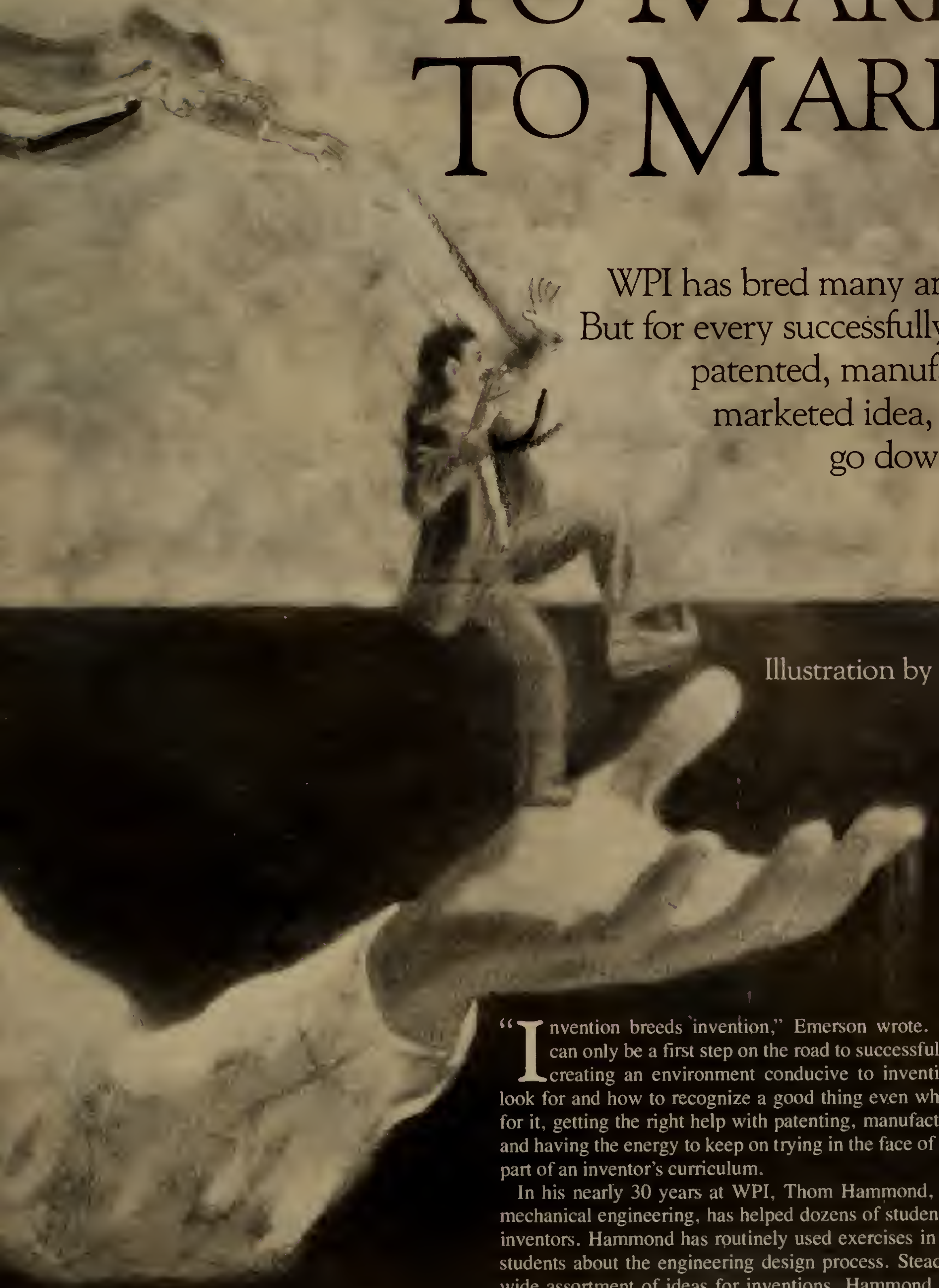
To Market, To Market



WPI has bred many an invention. But for every successfully conceived, patented, manufactured and marketed idea, many more go down the drain.

By Paul Susca
Illustration by Richard Giedd

"Invention breeds invention," Emerson wrote. But formal education can only be a first step on the road to successful invention. Finding or creating an environment conducive to invention, knowing what to look for and how to recognize a good thing even when you're not looking for it, getting the right help with patenting, manufacturing, and marketing, and having the energy to keep on trying in the face of disappointment are all part of an inventor's curriculum.

In his nearly 30 years at WPI, Thom Hammond, professor emeritus of mechanical engineering, has helped dozens of students get their feet wet as inventors. Hammond has routinely used exercises in invention to teach his students about the engineering design process. Steadily coming up with a wide assortment of ideas for inventions, Hammond passes them on to his students, who then pursue the design, fabrication, and sometimes the ultimate patenting of the gadgets. The inventions have included a front-wheel drive electric tricycle, a device to control the pressure of cranial fluid in

> "Corporations have become so large and conservative that there's much less invention going on than there ought to be."

patients after brain surgery, and a wheel chair controller designed for one-armed patients.

Hammond often has greater faith than his students in their ability to develop useful apparatus. He especially likes to tell about the ones that got away, the inventions he urged his students to patent but that later showed up on the market patented by someone else. In one case, 12 or 15 years ago, when Hammond was teaching senior design, he pointed out the need for an after-market device that could be fitted to cars, allowing them to move sideways into tight parallel parking spaces. He suggested how his students could go about designing and building the device, and they did.

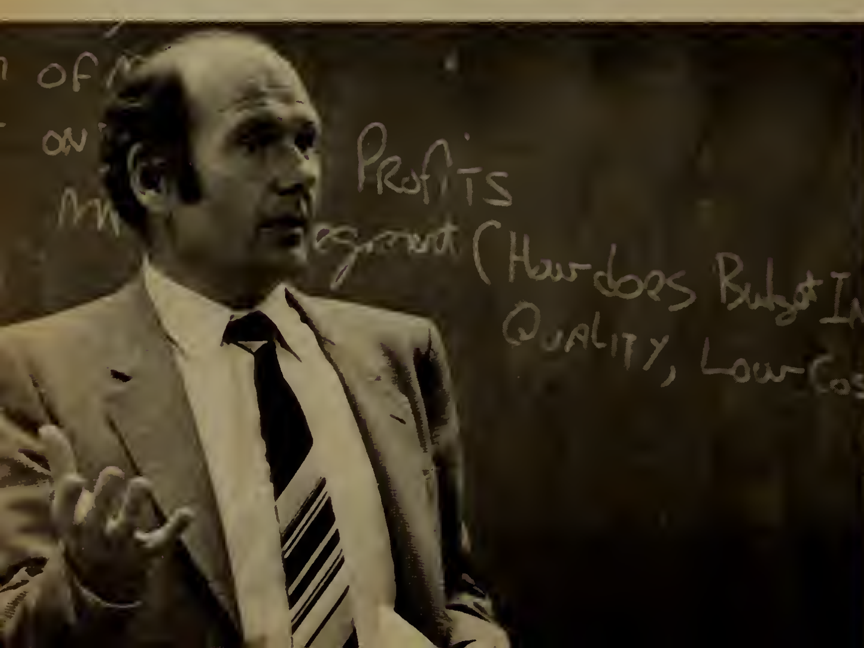
"But three years after they graduated they sent me a clipping from a British newspaper describing how an almost identical device was being marketed," Hammond relates. "I was delighted. I said they should have patented it when I first told them to!"

If invention breeds invention, then simple inventions also breed more complex inventions. Henry S.C. "Pete" Cummings Jr. '50 has spent years improving on the lowly ratchet as president of Lowell Corporation in Worcester. Founded when Cummings's great grandfather, Professor John Sinclair (once head of WPI's Mathematics Department), bought a ratchet patent and set out to become a "master of ratchetry," Lowell Corp. has pinned its survival on ratchet innovations.

Cummings himself has been awarded five patents in his 32 years with the company. His innovations include a layout that increased the number of teeth in a ratchet without decreasing their strength, a quick-release device for changing ratchet gears, and a handle-less ratchet, or ratchet clutch.

Cummings says that the simplicity of the ratchet, which he considers to be the sixth basic machine after Archimedes' five, is what makes further innovation so challenging. "If there was all that development potential in [basic machines like] the wheel or the screw or the lever," he contends, "then by gosh there's got to be that kind of development potential in ratchets."

Hans J. Thamhain



Michael Carroll

Breeding grounds for inventors and inventions must offer more than development potential, more than an idea that serves as a focus for further invention. Gordon B. Lankton, a WPI trustee and president of NYPRO, Inc., in Clinton, MA, believes in creating the kind of environment in which inventors can flourish. You have to expose future inventors to those who are already inventive, says Lankton, who has been managing inventors for 20 years at NYPRO. "It's a supporting role, a coaching role. You bounce up and down as their moods change," Lankton says about the job. "It's a recognition that you can't impose hours of the day." Inventors tend to be loners, he says; they're also hard to manage, and they don't easily fit into the structured environment typical of most corporations.

Once inventive types emerge, the next challenge is to keep them happy, Lankton says. Inventors in an organization don't generally respond to the usual monetary rewards that corporations bestow; they often crave recognition. Lankton tells about one of his company's inventors who thrives on recognition in the form of ever-escalating titles.

But inventors can't be expected to make effective managers and presidents, Lankton says. "There comes a point when you have to take a project away from the inventive types and hand it over to the business types if you expect to get things done."

Managing invention in large organizations has occupied a good deal of David E. Monks's time, too. Monks, Class of '64, once director of the photographic science group of Eastman Kodak and now president of Kodak subsidiary Eikonix in Bedford, MA, was part of the team that developed Kodak's disc camera. The concept of disc film was developed as far back as the 1920s, Monks says, but his team applied additional knowledge about camera design to develop a camera that he says is all-around more capable than those employing roll film.

The disc camera illustrates the difference between discovery and invention. Invention, Monks says, is the process of bringing together known principles in a new form, whereas discovery involves finding knowledge that is completely new. One engineer who worked for Monks was an example of the classic inventor—most effective at putting together existing building blocks in new ways. It was he who invented the mechanical brain that controls processing in the disc camera, based on a differential gear train.

Since thinking about old things in new ways seems to be the essence of invention, conventional wisdom can have a dampening effect, in his experience. You have to put inventors in an environment where they can spread their wings, he says, but American companies are failing to do that with their often overly bureaucratic organizations.

Another reason why we aren't producing inventors the way we used to, Monks says, is that we

Michael Carroll

Arthur Gerstenfeld

tend to think in terms of applying new technologies rather than taking a step back to consider the fundamental scientific and engineering principles supporting those technologies. His experience indicates that inventors tend to think in terms of applying those underlying principles to new needs.

Management Professor Arthur Gerstenfeld, the author of two books on invention, also has some thoughts on what has happened to America's inventive genius. "The independent inventors sitting in their basements doing invention are quickly disappearing," he says. Despite the sometimes stifling atmosphere of large companies, these organizations seem to be the source of many of today's inventions. One reason, according to Gerstenfeld, is the expensive equipment needed to push ahead with the new technologies. Another reason is the nature of our organizations. Says Gerstenfeld: "One of the big problems facing the nation is that our organizations have become so large and so conservative about risk taking that there's not as much invention taking place as there should be." Corporations should not be so well organized that inventiveness gets trampled upon, he says. Some of the better inventions developed in large companies have to be bootlegged—people work on them in their spare time, with extra or "borrowed" materials, no budget, no program.

But bootlegging is just part of what we call "Yankee ingenuity." Gerstenfeld, who makes frequent trips abroad, says, "In Japan they always talk about Americans as the great inventors and the Japanese as the great copiers. That's partly because we're taught from day one to be very independent thinkers, even to be rule breakers."

Gerstenfeld, who holds a baccalaureate degree in mechanical engineering, did his doctoral dissertation on innovation in large companies and now teaches a course on innovation. He also has several inventions to his credit, holding four patents with two more pending. Gerstenfeld thinks of himself as the atypical inventor: he has pursued inventions on his own, rather than relying on the backing of a corporation. But one thing he has in common with other inventors is the source of his motivation. He talks about a spark, a desire to document his ideas and to leave a legacy: "I've known many inventors," he says, "and very seldom do they invent and say 'Boy, I'm going to be a millionaire.' It's more the opportunity to see your own ideas come to fruition." He likens it to other forms of artistry—music, writing, and the visual arts.

Gerstenfeld is now working on an invention that employs artificial intelligence to control air traffic around airports, drawing on his experience as a radar technician in the Navy. "If you watch people in a radar room at an airport, air traffic control is done the same way now as it's been done for the last 20 or 30 years," he says.

> "Product development normally requires an iterative loop, racing between research, marketing, and the customer."

Making that kind of observation, recognizing a need for improvement, is the essence of the kind of inventing that Gerstenfeld has done. He refers to his inventing as demand-pull: responding to a perceived need. Technology-push inventions, in contrast, are prompted by the emergence of new technology and the drive to find applications for it.

"Invariably, demand-pull inventions have enjoyed greater success than the technology-pushes," Gerstenfeld says, explaining the results of his study on innovation in Germany. Research carried out by Gerstenfeld's students a few years ago, focusing on small inventors, came up with the same conclusion. "But on the other hand," he adds, "sometimes the technology-pushes are the really great inventions. My stuff is much smaller but has a greater chance of being used."

Serendipitous inventions, those conceived by accident in the search for something else, generally fall into the area of technology-push, according to Gerstenfeld. Robert A. Rowse '49 knows all about serendipity. As a research sci-

Thom Hammond

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"Inventors need agents who have the imagination, honesty, and ability to know which ideas are worth pursuing."

entist at Norton Company, Rowse always regarded research results with an open mind because that's what it takes to recognize the value in what appears to be an accident or a failed experiment. Once, for example, looking for abrasives boasting high strength and durability, one of Rowse's subordinates grew discouraged when he found only weak, brittle substances. But Rowse, as director of a broader research effort, recognized their value, and now those same abrasives are used in sandpaper and grinding wheels.

But successful invention takes more than perspective. It takes a great deal of persistence. Inventors often rejoice when they make that long sought-after find, Rowse says, but it's a long way from invention to marketing, and you have to be committed to your ideas. "You find that at times you have to bootleg in order to keep it going," he says, "That can be very frustrating and—careerwise—may be rather precarious at times."

Rowse speaks from experience. When Norton's domestic marketing people balked at putting newly developed grinding wheels into field trials, Rowse went out on a limb by sending the wheels off to Sweden for testing. More than once, he says, he came close to being let go because of his stubborn attachment to ideas. But that's what it takes to get your inventions through the mill: "It's an inner drive that makes me crazy. I always react when somebody says something can't be done."

The toughest part of invention, he says, can be dealing with resistance within your own organization, when people don't pick up the ball and run with it the way you think they should. "In a small company it's usually a problem of finances to keep it moving," Rowse says. "In a big company it's the interfaces of one department and another department and another as the idea progresses from conception to commercialization."

Yet things have usually seemed to work out for him in the end. When Rowse retired as vice president of Norton's High Performance Ceramics Division after 35 years with the company and nearly 60 patents to his credit, a colleague trotted out this line: "The unfortunate thing about being ahead of your time is that, when people finally realize that you were right, they will say it was obvious all along."

Rowse's successor at Norton, Dick Allegro (Institute of Industrial Management '67), holder of 11 patents himself, has had nearly 30 years to observe invention at Norton. He says that inventors are commonly perceived as Ph.D.s in cobwebbed laboratories toiling for years and finally coming up with something. But invention as he knows it, ultimately leading to commercialization, is a repetitive process that calls for close cooperation between inventive types and marketing people. "Products rarely work the first time or the second time," he says. "There is a loop that needs to be cycled many times, racing between research, marketing, the customer—you have to have undying faith that your technology or your product is going to win."

Several of Allegro's patents deal with ceramic armor. Illustrating his point about the iterative nature of turning inventions into products, he tells of Norton Company's rapid development of ceramic armor vests for helicopter crews during the Vietnam era. The state of the art in 1964 was flat tiles, he says, which developed into curved tiles, 14 to a vest by May of 1965. By September Norton engineers had it reduced to five pieces; by February 1966 it was down to three pieces with raised edges for joint protection, and by November of that year the one-piece ceramic armor vest was ready.

One of the keys to the successful development of the vest, Allegro says, was the ability to assemble a team and commit considerable resources to the task. But inventors outside large companies don't have those luxuries; they often have to go to bat alone.

"Lone inventors need help but sometimes try to carry the ball too far themselves," says patent lawyer Paul Kokulis '45, senior partner in the Washington, DC, firm of Cushman, Darby & Cushman. Some think they can commercialize their inventions without any assistance, he adds. Other inventors know they need help but don't know where to find it. Often that's because such help is hard to find.

Kokulis sees a need for agents who can help inventors license or commercialize their ideas, but as yet there are few places where inventors can find "the imagination and the honesty and the ability to assess a spectrum of ideas and recognize which ones are worth pursuing." He thinks patent firms and engineering schools like WPI might be able to develop such practices in the future.

Management Associate Professor Hans J. Thamhain, who specializes in studying product development, probes the middle ground between the lone inventor without resources and the sometimes oppressive environment of a bureaucracy. "For an individual without any support system, there's a tremendous amount of individual drive

Robert L. Norton

and accountability and commitment, but without resources it's *very* difficult," he says.

"At the other end of the spectrum are inventors with all of the resources but in addition all kinds of procedures and sign-offs and checkpoints. Because of this, they lose the entrepreneurial spirit; they lose that special magic and commitment. Somewhere in between, maybe closer to a small company, is the optimum as far as entrepreneurial output is concerned."

That means more than creative output; entrepreneurs have to know when to make business decisions, too. Gerald Finkle '57, president of Wachusett Molding Corporation of West Boylston, MA, has seen many lone inventors make fatal business mistakes in commercializing their ideas. Finkle, whose company makes custom-designed molded plastic parts and helps its customers—individual and corporate—in the design of those parts, says the greatest disincentive afflicting individual inventors tends to be lack of capital. "Nowadays most individuals just don't have the financial punch that's required to bring products to the marketplace," Finkle says. "The process is too involved." Advertising, packaging, distribution, and building inventory all cost money.

Each of the individual inventors his company has worked with has failed, Finkle says, because they lacked capital, marketing skills, or the willingness to hand over their inventions to large companies on a royalty basis. That's why Wachusett Molding no longer deals with individual inventors, he adds.

Finkle tells the story of an individual who invented a new method of fabricating dental prostheses such as caps. Based on plastics technologies, the manufacturing method was fast, relatively inexpensive, and very precise—where precision counts. But the inventor was undercapitalized and tried to save money on tooling costs. As a result his demonstration products, made on the cheap, lacked the precision that was so important, and the product failed.

The heartaches of inventing can be too much for those with more design expertise than business acumen or time. Mechanical Engineering Associate Professor Robert L. Norton swore off design consulting 10 years ago because the rewards didn't make up for the headaches. Once a junior member of a research team that developed a biomedical product some years ago, Norton watched as incompetent managers brought in by venture capitalists drove the venture bankrupt within four years.

"Inventors won't be successful unless they are good at business," Norton says. "What it all boils down to is the marketing of the product." And being an inventor for a large corporation may even be worse, he contends. "You see most of your designs in the trash can not because they're bad designs but because somebody changed his mind about what he wanted," he says. The alternative, going it alone, calls for 18-hour days for three or four years, Norton says. Because of the demands of WPI's project-based system, he says, it becomes nearly impossible for faculty to usher their ideas into the market.

Pamela Weathers

But bringing a new idea to market isn't totally impossible, not for Biology and Biotechnology Assistant Professor Pamela Weathers. Weathers expects to bring a new plant tissue cultivator to market within the next 18 months—after more than five years of effort. Maybe her edge was working part-time at WPI at the beginning, or the guidance she received from Helen Vassallo, associate professor of management, but Weathers still has war stories to tell.

Arising from outside research work carried out before 1982 by Professor Kenneth Giles, then head of the Biology and Biotechnology Department, the idea for a new plant tissue cultivator immediately appeared to offer the promise of saving substantial amounts of labor, time, and materials over existing methods of tissue culture.

Giles, who now directs R&D efforts at Twyford Plant Labs in Baltonsborough, England, as vice president of Twyford International, teamed up with Weathers, then a post-doctoral researcher at WPI. Some of their first efforts toward commercializing the cultivator involved investing in business consultants "who didn't really know what they were doing," Weathers says. "They had put together restaurants but they hadn't put together high-tech firms."

Weathers' next step was to contact firms specializing in patent law. But at that time, she says, biotech was so new that the law firms didn't have anyone who understood the innovativeness of the cultivator. "They kept thinking it conflicted with existing patents," Weathers says. After spending nearly $2,000 of their own money at a well-known Boston law firm, Weathers, who had been running the whole effort since Giles left for Twyford, was running out of places to turn for help.

Then Giles suggested she contact Gary S. Winer '81, a biotechnology graduate who had gone on to earn a law degree. "Gary spent five minutes listening to me explain the technology, and he said, 'I'm absolutely confident you have at least one—

"Nowdays, most individuals don't have the financial punch required to bring new products to market."

Kenneth McDonnell

Helen Vassallo

maybe more—patents,' " Weathers recalls. "He said, 'You have found something really fantastic' because he understood what we were talking about."

Shortly after that conversation with Winer, Weathers and Giles had a patent filed. Now they are developing new applications for their tissue culture method and device, with a new research program that started this fall. Weathers says they hope to have a product on the market—with virtually no competition—by the end of 1987.

Weathers and Giles have high hopes for their cultivator. Plant tissue culture is normally a tedious, labor-intensive process, and their cultivator promises to cut the labor and materials costs by as much as 75 percent, Weathers says.

"In the end, there are very few products that are so unique that there are no substitutes."

Prospects look good now, but Weathers says she might not have come this far if she had known the headaches beforehand. "We probably would have said 'Forget this,' published a paper, and let it go at that!" she says. Sticking it out through the tough times took perseverence, some spare cash, and a support network consisting of Giles as well as Vassallo, who provided Weathers with invaluable business advice. There were difficult financial times and days when her patience wore thin, and she could have used help in making business contacts in the beginning. But the whole experience has given Weathers a good education in the "hard knocks" school of business.

What's the most important lesson Weathers learned? "Be fiscally conservative." Finding a competent attorney who understands the technology is also important. Weathers hastens to add that there are resources at WPI that inventors can turn to for help, such as the Management Department and Reference Librarian Joanne Williams, who helped Weathers with her patent search.

Vassallo, who also holds an appointment in the Biology and Biotechnology Department, had experience both in biological research and in management to draw upon in offering advice to Weathers. Directing research on local anaesthetics at Astra Pharmaceutical in Worcester and Framingham until 1982, Vassallo was part of a team that won a patent in the use of extremely powerful nerve toxins as spinal anaesthetics.

Saxitoxin, the deadly poison found in red tide, and tetrodotoxin, a sister material found in Japanese puffer fish (which kills a number of gourmet diners every year), were the subjects of Vassallo's work. The patent arose out of a brainstorming session in which she marveled at the toxins' remarkable ability to pass through membranes, leading to the idea of using them as spinal anaesthetics. But that experience was atypical, she admits, since such a short time elapsed from the "light bulb going on" to doing the key experiments to getting the patent. These toxins, which are 300,000 times as powerful as currently used anaesthetics, are still somewhat unpredictable and hence are not yet used in humans, Vassallo reports.

Getting the patent was as easy a task for Vassallo's team at Astra as it was fraught with disappointment for Weathers and Giles. But there's more to the game than just getting a patent. Paul M. Craig Jr. '45, a Washington, DC-based patent lawyer, stresses that possession of a patent is worth less—commercially—than many people think. "There are very few products that are so unique that there is no substitute available," he says. A patent can help the inventor in selling an idea, but it is seldom salable by itself. Know-how associated with the patent and its application are the real keys to successfully selling an invention.

For many, inventing is only the beginning of the entrepreneurial dream of building a company around one's own inventions. Alfred A. Molinari Jr. '63, president of Data Translation, Inc., of Marlboro, MA, brought his considerable marketing knowledge to bear in getting his computer peripherals company off the ground 12 years ago. Already familiar with the market for data acquisition equipment, Molinari started off with a data acquisition module that measured sensor inputs for process control computers and for medical and scientific applications.

His first unexpected challenge was the months-long delay in getting publicity from trade magazines. Molinari also found that he had to order certain integrated circuit chips months ahead of time. Those initial disappointments taught him the importance of factoring timing into his market planning.

Successfully going public with his company a year and a half ago was a big hurdle for Molinari, the result of 10 years of planning and hard work. But now he is used to taking a long-term approach to marketing inventions. Molinari's maxim of entrepreneurship: "Today is just a report card on what you did two years ago."

Editor's note: For more accounts of inventors and entrepreneurship, see "The Entrepreneurial Spirit," an ongoing series that began in the August 1985 issue of the *WPI Journal.*

Paul Susca is a free-lancer living in Rindge, NH.

LETTERS

Editor: In the fall of 1979, I received an unsolicited brochure in the mail from WPI. My parents and I read the brochure and were interested in the Plan. I applied to WPI and was accepted to start in the fall of 1980.

In the four-year period that I attended WPI, I watched the Plan slowly become dismantled. First there was the infamous ABET [Accreditation Board of Engineering and Technology] visit which triggered the Plan changes. As a result of that visit distribution requirements were added. Then around the time of my graduation the AD/AC/NR grading system was replaced by a A/B/C/NR system. I was dismayed by this as I felt the AD/AC/NR system led to less competition and more cooperation among the students.

In the August issue of the *WPI Journal* I was shocked to learn of the dropping of the Competency Examination! The Comp had a very special purpose. It proved that you had learned something in your classes and had not just squeaked by. I feared my Comp as it approached, but in reality it was not as bad as I had thought it would be. After completing it, I felt I had truly accomplished something!

By altering the Plan, WPI, in my opinion, has lost its advantage over other well-known engineering schools, both in the Boston area and nationally. Students have less reason to consider WPI in today's competitive college market. I would not have attended WPI under today's modified version of the Plan! I also do not feel I can unhesitatingly recommend WPI to future students!

Leslie Arlene Schur '84
North Reading, MA

1986–87 WINTER SPORTS CALENDAR

WRESTLING

DECEMBER		
3	at Boston College	7:00 p.m.
5–6	at Coast Guard Tourney	10:00 a.m.
10	at Plymouth State	7:00 p.m.
13	Harvard/UNH/NYU	7:00 p.m.
JANUARY		
14	Amherst	7:00 p.m.
17	RIC	1:00 p.m.
20	WNEC	7:00 p.m.
24	at U. Lowell	1:00 p.m.
25	N.E. Invitational (at MIT)	10:00 a.m.
28	MIT	7:00 p.m.
31	at Bowdoin	1:00 p.m.
FEBRUARY		
3	at Coast Guard	7:00 p.m.
4	Williams	5:00 p.m.
7	at Brown/Princeton/ Boston U.	1:00 p.m.
14	Wesleyan/Trinity	1:00 p.m.
26–28	NECCWA (Amherst)	TBA
5–7	NCAA III Nationals (U. Buffalo)	TBA

MEN'S WINTER TRACK

DECEMBER		
3	at Tufts	6:00 p.m.
6	at MIT/Brandeis	1:00 p.m.
FEBRUARY		
4	at Holy Cross/ Worcester State	7:00 p.m.

MEN'S BASKETBALL

NOVEMBER		
21, 22	Worcester 4-T at Clark	6:00 & 8:00 p.m.
DECEMBER		
2	Babson	8:00 p.m.
6	at Bowdoin	4:00 p.m.
9	Amherst	8:00 p.m.
11	Wesleyan	8:00 p.m.
13	at NYU	4:00 p.m.
JANUARY		
9, 10	at Union Tournament	TBA
15	Worcester State	8:00 p.m.
17	at Bates	4:00 p.m.
22	at Brandeis	7:30 p.m.
24	Kings Point-U.S.M.M.A.	8:00 p.m.
27	Trinity	8:00 p.m.
30	at CGA	8:00 p.m.
FEBRUARY		
4	at Williams	8:00 p.m.
7	Tufts	8:00 p.m.
12	MIT	8:00 p.m.
14	at Salve Regina	7:30 p.m.
17	at Nichols	7:00 p.m.
19	SMU	8:00 p.m.
21	Anna Maria	8:00 p.m.
25	Suffolk	8:00 p.m.
28	Clark	8:00 p.m.

MEN'S SWIMMING

NOVEMBER		
21	Holy Cross	7:00 p.m.
24	Babson	6:00 p.m.
DECEMBER		
3	at Boston College	7:00 p.m.
6	at RPI Invitational	Noon
9	at Clark	6:00 p.m.
JANUARY		
17	at Connecticut College	2:00 p.m.
24	CGA	2:00 p.m.
28	at U-Mass Boston	6:00 p.m.
31	SMU	2:00 p.m.
FEBRUARY		
5	at Trinity	7:00 p.m.
7	Colby	2:00 p.m.
11	Bridgewater State	6:00 p.m.
14	at Keane State	1:00 p.m.
18	Brandeis	7:00 p.m.

WOMEN'S BASKETBALL

NOVEMBER		
21–22	City Championship	6:00 & 8:00 p.m.
DECEMBER		
1	Fitchburg	7:00 p.m.
5–6	Chuck Resler Invitational NYU/ Worcester State/ Rochester	6:00 & 8:00 p.m./ 1:00 & 3:00 p.m.
9	at Bridgewater	7:00 p.m.
11	at Framingham	7:00 p.m.
JANUARY		
17	at Bates	2:00 p.m.
20	CGA	7:00 p.m.
27	at Wheaton	7:00 p.m.
29	at Nichols	6:00 p.m.
31–1	New England Invitational Colby/ USM/U. Mass	TBA
FEBRUARY		
4	Brandeis	7:00 p.m.
7	at RIC	7:30 p.m.
10	Amherst	7:00 p.m.
12	MIT	6:00 p.m.
14	Western New England	2:00 p.m.
17	Emmanuel	7:00 p.m.
19	SMU	6:00 p.m.
21	at Anna Maria	2:00 p.m.
24	at Trinity	7:00 p.m.
26	at Bowdoin	7:00 p.m.
28	at Clark	6:00 p.m.

WOMEN'S SWIMMING

NOVEMBER		
23	Regis Invitational	Noon
24	Babson	6:00 p.m.
DECEMBER		
10	Clark	7:00 p.m.
JANUARY		
17	at Connecticut College	2:00 p.m.
23	at Southern Connecticut State	7:00 p.m.
28	at U. Mass Boston	6:00 p.m.
31	SMU	2:00 p.m.
FEBRUARY		
3	at Regis	7:00 p.m.
11	Bridgewater State	6:00 p.m.
14	at Keane State	1:00 p.m.

THE SCIENCE OF LIGHT

FACULTY & STAFF ATHLETES

WPI Journal

WORCESTER POLYTECHNIC INSTITUTE

WINTER 1987

THE PRESIDENT'S MESSAGE

Why a Campaign for Excellence?

When we went to the trustees last fall to secure their support for our $52.5-million Campaign for Excellence, Howard Freeman '40, chairman of the board, asked me to portray my dreams for the future WPI that justify and explain the extraordinary effort required to raise these monies. Subsequently, the trustees suggested that I share these thoughts with the entire WPI family through the *Journal*.

Let me begin by describing briefly how we make the decisions that help our college continue to evolve and grow. This should well illustrate why the Campaign for Excellence is vital to WPI's future.

The future vision of WPI is not born exclusively within the administration or the Board of Trustees. Rather, Richard H. Gallagher, dean of the faculty, and I lead best when we help focus and articulate the plans and dreams of the faculty, staff, students, trustees, alumni, and friends who comprise the WPI family. This is, after all, what collegial governance is all about.

Facilitating this process involves understanding not only what new initiatives these groups desire, but also the emphases already in place. How these two factors merge, and whether they are in sync with external issues, must also be considered.

With this collegial spirit in mind, and in order to assess where the college stands today, we have in the past year examined how WPI is carrying out its educational mission. In so doing, we found what appears to be a curious dichotomy.

On the one hand, we often characterize WPI principally as an undergraduate teaching institution, and we offer a first-rate undergraduate program—the WPI Plan—with sound philosophical roots.

By most measures, the Plan is a resounding success. Students and alumni are enthusiastic, and our graduates are highly sought by employers and graduate schools. The Plan, as it has evolved, already contains many of the key elements called for in the recent Carnegie Foundation Report, *College: The Undergraduate Experience in America*.

However, the professional and scholarly careers of many members of the faculty have suffered relative to those of their peers at other institutions due to the demands of initiating and maintaining the Plan.

Because of the drain on faculty scholarship during the Plan's 15-year building period, WPI has lost public recognition relative to such institutions as Lehigh, Carnegie, and RPI.

On the other hand, we offer a graduate program with nearly 400 full-time and another 1,000 part-time students offering the master's degree in 15 disciplines and the Ph.D. in 10.

We have tried, however, to construct this program as an adjunct to our undergraduate program. Some 120 of these graduate students are supported as teaching assistants and only 45 as research assistants. Most well-recognized graduate programs would be characterized by the reverse ratio.

The average research sponsorship per engineering and science faculty member is less than 25 percent of the mean of the other institutions in the Association of Independent Technological Universities (AITU) and less then 10 percent of schools such as RPI and Carnegie.

Indeed, our graduate program is woefully "underresourced," in dollars, space, and faculty, and draws heavily on an undergraduate program already expensive—in both dollars and faculty energy.

On the surface, it would seem that this dichotomy could be resolved by either:

- Resetting our sights to offering only a first-rate undergraduate program, i.e., to become the Amherst, Bowdoin, or Oberlin of the AITU.

OR:

- Pursuing the goal of *broad-based, scholarly excellence* and gaining recognition for this excellence while maintaining and enhancing the extraordinary undergraduate program that is our heritage and our hallmark.

It should be clear from our public statements on this issue that Dick Gallagher and I do not believe the former course of action to be viable. As technologies change at an increasing pace, our engineering and science faculties must be more than teachers if their work is to remain current and exciting. They must also be scholars, actively involved in the generation and interpretation of new knowledge. But, as I've pointed out, it is not enough for the administration to be convinced of a certain direction for WPI. Rather, we must look to the faculty and other members of the WPI family who will actually develop and implement plans for enhancing WPI's future.

Where in our current activities are we to find the focus for the WPI of tomorrow? What are the plans and goals of the WPI family for the Institute? How do we bring these elements together to characterize a major fund-raising effort, and to what end? Recent actions by the WPI faculty provide part of the answer.

As relative newcomers to WPI, Dean Gallagher and I were recruited with broad-based faculty input to lead a movement emphasizing scholarship and intellectual excellence.

The Faculty Committee on Educational and Professional Development (CEPD) completed an extensive report in the spring of 1985 recommending renewal of scholarship and increased attention to sponsored research. The faculty adopted this recommendation almost unanimously.

A Faculty Goals Committee, chaired by Professor Paul Davis, secretary of the faculty, has produced a Goals Statement stressing the importance of creating knowledge through scholarship and research as well as disseminating knowl-

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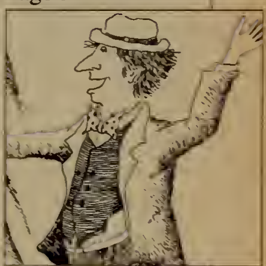
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Cover: A late autumn snowfall blankets Washburn Shops and Stoddard Laboratories atop Boynton Hill. Photo by Michael Carroll.

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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, Hartwick 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.

Staff of the Alumni Magazine Consortium: Editor, Donna Shoemaker • Wrap Designer and Production Coordinator, Amy Doudiken Wells • Assistant Editor, Julia Ridgely • Core Designers, Allen Carroll and Amy Doudiken Wells.

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

Diverse views on subjects of public interest are presented in the magazine. These views do not necessarily reflect the opinions of the editors or official policies of WPI. Address correspondence to the Editor, The WPI Journal, Worcester Polytechnic Institute, Worcester, MA 01609. Telephone (617) 793-5609. Postmaster: If undeliverable please send form 3579 to the address above. Do not return publication.

Alex Emanuel: Bringing Harmony to Power Engineering

by Tammi Harbert

Alexander Emanuel in the electromechanical energy conversion lab of Atwater Kent Laboratories.

Alexander Emanuel likes to tell his students the story of his first engineering design job in the United States. Working in 1970 for High Voltage Power Corporation of Westboro, Mass., he designed the world's first insulation barrier for a 765 kV, 100 MVAr shunt reactance. This device is a huge coil of wire that, when connected to a high-voltage transformer, stabilizes voltage just before it reaches the customer's lines and thus regulates power surges that are potentially hazardous to household appliances. Having no models to follow, Emanuel gave his imagination free rein and came up with a delicate, oil-immersed pressboard structure that resembled the thin, layered skins of an onion.

A visiting French engineer, seeing the partially built prototype, exclaimed, "You crazy Americans! I've never seen such a thing in my life!" Emanuel says he was flattered, not to be considered crazy but to be mistaken for an American just one year after his arrival in this


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Letting your imagination roam, dismissing no possibilities—this is how Emanuel believes problems are best approached.

country from Israel.

The high-voltage barrier that so astounded the French engineer is still operating today. And despite its "crazy" appearance, it has logged a better record of performance than later models that were modified to make them easier to transport, Emanuel says.

He tells his students the shunt reactance story to illustrate the benefits of using imagination to approach problems and of not dismissing any possible solution, no matter how outlandish it seems. This spirit of creativity spills over into other aspects of Emanuel's life.

"He's an artist in more than one sense of the word," says David Cyganski '75, associate professor of electrical engineering. Emanuel's office is not only strewn with the tools of power electronics — bits and pieces of components, oscilloscopes, the guts of switching supplies — but is decorated with an impressive collection of paintings and photographs done by Emanuel himself.

His originality and dedication to his work were recognized officially last fall when he received the WPI Trustees' Award for Outstanding Research and Creative Scholarship. The citation commended his "outstanding level of consistent scientific accomplishment . . . [which] has been a key factor in developing WPI's reputation in the field of electric power engineering." Emanuel is the only faculty member in the history of the Institute to receive both this and the Trustees' Award for Outstanding Teaching, which was presented to him in 1982.

Emanuel's work in power systems harmonics is known worldwide. This specialized field involves measuring and finding ways to eliminate voltage distortion created in modern power systems. The distortion, which Emanuel named "harmonic pollution," causes a multitude of problems; it interferes with telephone and computer lines and generates excess heat that causes premature wear in equipment. The heat from these harmonics has caused cables and capacitors on power lines to explode, he says.

In the 1970s, advances in electronics led to increasing use of microprocessors in power systems. Many products, including large industrial power systems, began incorporating these computer chips to allow more precise control. However, the devices used to control the power flow have been found to distort the electrical waveform, Emanuel says, creating harmonic pollution.

Through research papers and work with industry, Emanuel was among the first to demonstrate the damaging effects of harmonics and devise ways of compensating for them before they caused widespread and serious problems.

In 1974, Alex Emanuel joined WPI as an associate professor after five years at High Voltage Power. Says Harit Majmudar, former head of the department, "Alex's supervisor at High Voltage told me that he had come across about four or five first-class electrical engineers in his lifetime, and that Alex Emanuel was one of them." Majmudar, now a professor of electrical engineering, says Emanuel has proved that statement "100 percent correct."

Emanuel, his wife, and his son arrived in America from Israel in 1969, drawn by glowing reports from colleagues at the Israel Institute of Technology who had taken sabbaticals in the U.S. He began his academic career in Israel after leaving Romania, his birthplace, when it became part of the Soviet bloc in 1948.

As a teenager, he spent his days attending an electrical engineering vocational school; some of his spare time was devoted to using his active imagination to devise schemes to escape Romania. "One plan was to make hydrogen by combining zinc and sulfuric acid to fill a balloon that would allow me to float across the border," he says, adding that his parents worried he would try to carry out one of his many schemes. But while letting his imagination roam, he restricted his actions to the practical.

In 1958, after hearing rumors that the government was going to loosen emigration restrictions in response to international criticism, Emanuel stood all night in a half-mile-long line to file for an exit visa. As a result of this public display of discontent, he says, the government pressured the dean of the Polytechnic Institute to expel him, even though he was only a year short of earning his bachelor's degree. He believes that officials also circulated rumors about his political views to damage his professional reputation: "They accused me of being a traitor, of planning to use my engineering knowledge to help the West build weapons to fight against them."

Finally, in 1961, after three years of working as a technician at a government plant, he was allowed to emigrate to Israel. He finished his education at the Israel Institute of Technology, earning a doctorate in electrical engineering. Although he had worked in industry during his schooling to support his family, Emanuel found that academe was the place for him. While working as a graduate assistant, he says he discovered that "there's nothing that can give you as much fulfillment as a good day of teaching." He notes that academe provides greater freedom to explore ideas, since it is not bound by the need of industry to make products faster, better, and more profitably.

Emanuel also places a high value on time spent nurturing young minds. "It takes time to grow the seed, but you always have the satisfaction of looking at the plant," he says. If the enthusiasm and the knowledge he cultivates in his students take root, he will have created an "indestructible link with the future; my students will continue my work when I'm gone."

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He acknowledges that he can't teach his students all they will need to know; technology is progressing much too rapidly to permit that. Instead, Emanuel tells his students they must learn to "know what they don't know" so that they can ask the right questions and continue learning throughout their careers.

His colleague, David Cyganski, says Emanuel's enthusiasm, creativity, and intelligence allow him to excell in both teaching and research, one talent enriching the other: "I think he actually figured out one day what he could do to make the greatest contribution to the world." Majmudar calls Emanuel "a classical electrical engineer—a Renaissance man."

"When I teach, I give everything that I can to the students to help them learn and grow," Emanuel says. At the same time, he feels an obligation to develop his research. "There's a detective in me that wants to unveil certain secrets of Mother Nature."

Yet underlying his dual dedication to research and teaching is a debt he owes to a Romanian professor who sparked his interest in power systems: "It's a commitment to myself to continue the work of my professors, the way I feel my students are committed to continuing my work."

New England Electric, which has an obvious interest in avoiding the effects of harmonics, has been a primary supporter and beneficiary of Emanuel's research. Edward Gulachenski, manager of relay and control engineering at the firm, says the company wasn't very concerned about harmonics until Emanuel started to talk about the problem in the mid-1970s. "At that time, nobody was really cognizant of the damage that these harmonics could cause." Because of Emanuel's work, the company now has several methods to reduce harmonics.

Emanuel's ultimate research goal is to devise a new circuit that will distort the voltage waveforms, thereby avoiding harmonics. One of his graduate students, Kalyay Sen, is at work on a promising prototype.

In 1984, Emanuel arranged for WPI to host the first International Conference on Power Systems Harmonics. The success of the conference —it drew more than 120 participants from around the world— is a direct result of Emanuel's reputation in the field, Cyganski says. Emanuel considers the conference one of his most important accomplishments. He notes proudly that it is now firmly established as a biennial event; 150 people attended the conference in Winnipeg, Canada, last fall. The 1988 meeting is planned for Purdue University.

In an effort to learn more about the effects of harmonics and other phenomena generated by power systems, Cyganski and EE Professor John Orr will soon begin a study funded jointly by New England Electric and the Electric Power Research Institute. In 1986, New England Electric installed photovoltaic panels in approximately 30 homes in Gardner, Mass. Early this year, the researchers will begin measuring the effects of having a high concentration of such systems in a neighborhood. The information will help electric utilities foresee, and thus avoid, problems that may arise when solar power becomes more common.

Not only has Alex Emanuel worked to make industry aware of harmonics, he has also helped everyday consumers of electric power. Several years ago, there appeared on the market a small disk that its maker claimed would save energy when placed in the bottom of a household light-bulb socket. Suspicious of this assertion, Emanuel tested the device and found that not only did it save little energy, it also produced a high level of harmonics. He wrote to consumer activist Ralph Nader and to utility companies as well as to several engineering and trade groups. He also published several papers on the problems produced by the device.

"Nothing can give you as much fulfillment as a good day of teaching."

"Some people thought he was making a mountain out of a molehill," says Cyganski. "But it was just his humanitarianism — he worries about all of us, all the time. To everyone's surprise, one of Emanuel's papers won the IEEE Industry Applications best paper award for 1986. The Power Engineering Society is currently working on standards that would eliminate such faulty products.

Emanuel tells his students that they, too, have an obligation to use their knowledge to make responsible contributions to society. He says he hopes to send his students into the world with "the intellectual strength to be able to grow, on their own, professionally," a feeling of responsibility for their communities and, perhaps, the memory of an eccentric professor who set their imaginations free.

Tammi Harbert is a freelance writer living in Dorchester, Mass.

Lighting the Way

Light chemistry: It's not a new course with one-third less work than regular chemistry. But it is ushering in a new way of understanding atoms and molecules—and life itself.

By Paul Susca
Photos by Michael Carroll

It all began billions of years ago: life on earth, when the first high energy, or ultraviolet, reactions from the sun "excited" simple molecules in the earth's atmosphere. These substances were converted by photochemical reactions to form polypeptides and nucleic acids, the necessary ingredients for initiating the living process.

Yet, says James W. Pavlik, Chemistry Department head, the dramatic role that photochemistry played in our earliest beginnings was just starting to unfold. For only when the first few photons of light were absorbed by a primitive photosynthetic unit could carbon dioxide and water be converted to carbohydrates and oxygen released into the atmosphere.

By then, says Pavlik, nature had learned how to store the light energy of the sun. Photosynthesis had been born, paving the way for the development of all higher life.

Only within the last 25 years has photochemistry been investigated extensively. To do so, chemists had to develop sophisticated research technologies and techniques, together with a theoretical framework. Chemical spectroscopy, for example, an essential tool in this research, embraces techniques that enable chemists to monitor the events that take place when a molecule enters an excited state.

If computer chips are the brains of today's powerful spectrometers, lasers are its eyes. Lasers are capable of delivering light of extremely high intensity and spectral purity and of incredibly short duration—sometimes less than a *trillionth* of a second—a feat essential to much of the work of photochemists.

Pavlik and four other professors, along with about a dozen graduate students and undergraduates, are hard at work on the frontiers of this remarkable science, describing and assembling the pieces of one of life's most fundamental puzzles, uncovering new knowledge about chemical reactions, and opening new pathways in the synthesis of medically and industrially useful compounds.

Today, in fact, it is sunlight's effects on the chemistry of our environment that play a crucial role in the quality of our lives. The atmosphere's ozone, which normally protects humans and other living things by absorbing the ultraviolet element of sunlight, is being depleted as a result of worldwide use of CFCs, or chlorofluorocarbons, the now infamous refrigerants and aerosol propellants. For ozone is destroyed by free chlorine atoms that are produced when CFC molecules absorb ultraviolet light. It is sunlight, too, that helps convert smog from the automotive and industrial pollutants we dump into air.

For members of the Photochemistry and Spectroscopy Group, the things that make light such a potent force in atmospheric chemistry—especially the selective absorption and emission of light frequencies—are also what make it an interesting research tool for examining phenomena that go far beyond atmospheric quality.

In order to understand these processes, it is necessary to recognize the importance of selective absorption and emission of light frequencies. Ordinary, or "dark," chemistry, taking place without the aid of light energy, proceeds with electrons in an unexcited or "ground state" configuration. These chemical reactions often involve the absorption or giving off of heat energy as part of the reaction. Electrons (the negatively charged subatomic particles that orbit the atoms' nuclei) remain in a low-energy state. However, there exist higher-energy orbitals that the electrons can occupy when excited by the absorption of a photon, which is a packet, or quantum, of light energy. A molecule is said to be in an excited state when its electron configuration has been altered by absorption of light.

Electrons can occupy excited states for a limited time before "decaying" to a lower energy state. And when that decay occurs, a molecule gives off a photon whose energy corresponds to the magnitude of the molecule's slide from higher to lower energy. By carefully measuring those light emissions using spectrometers, physical chemists can gain detailed information about the molecule's excited states. Associate Professor Robert Connors explains these complicated processes clearly; this ability seems to enhance his rapport with students, particularly undergraduates, which explains why most of his published research in recent years has been done with MQP students.

Since a molecule's chemistry—its ability to react with other molecules—is determined by the structure of its electrons' orbits, Connors explains, molecules with electrons in excited configurations have different chemical properties than molecules in the unexcited state. "That's the real appeal of photochemistry," he says. "You can do chemistry in these higher energy states that you cannot do in the ground state using only heat as the source of energy."

While photochemists are interested in the chemical properties of molecules in their excited states, spectroscopists like Connors are interested in the electronic and structural factors that govern molecules' absorption of light and in characterizing the structures of molecules in those excited states. They carry out their work using spectrometers, which measure the intensity of light emitted by a molecule at various frequencies. Virtually every chemistry student is familiar with spectrometers, since they are commonly used to analyze the composition of unknown substances by comparing their spectral characteristics with those of known chemicals.

Previous Page: Professor James W. Pavlik (left) and undergraduate Ciro Dimeglio work on phototransposition research. Right: Assistant Professor James P. Dittami with apparatus used in the organic synthesis of natural products.

Connors has been doing spectroscopy at WPI for 10 years, studying the photoactive properties of several classes of organic compounds—the diverse carbon-rich substances that make up living things—including chlorophyll, the green, light-harnessing workhorse of the food chain. One project, being conducted in Connors' lab by grad student Veeradej Chynwat, focuses on the excited-state properties of cumulative double bonds in a class of chemicals called butatrienes. Bonds hold atoms together to form molecules, and are made up of the atoms' electrons in much the same way that a handshake, made up of the fingers of two hands, holds two people together.

Butatrienes interest Connors and Chynwat because they contain three double bonds in a row, a type of structure whose photophysical properties are poorly understood. One interesting finding that the two scientists are pursuing is that the intensity of light emitted by tetraphenylbutatriene is highly temperature dependent. Connors demonstrates: exposing a sample of butatriene to a carefully selected frequency of white-looking light, he shows that the sample has no visible glow in the dark.

He then walks over to a large cylinder and cracks open the valve, releasing a trickle of liquid nitrogen, which boils over in a cloud of vapor, and freezes the sample at 77K (about −320 degrees F). After being held in the light beam, the frozen sample glows blue-green. Connors explains that at room temperature the excited double bonds have the freedom to rotate into a formation that can give off the energy as heat, but when frozen in position at ultra-low temperatures, the molecule has to fluoresce, or emit visible light, to settle back to the ground state.

Located next to the tank of liquid nitrogen is James S. Mochel's desk. Mochel, a senior doing his MQP under Connors, was originally attracted to WPI because of the work going on here in photochemistry and quantum chemistry. Mochel has aspired to an academic career since he transferred to WPI from Simon's Rock of Bard College, and says now he hopes to do graduate work using lasers to bring about reactions of biomolecules. Right now he is trying to find a way to imbed butatriene molecules in a polyethylene film, so that by stretching the film he can align the molecules in order to study their absorption of ultraviolet light. Says Mochel of the pace of project work at WPI: "It seems similar to that of the work I did during 18 months of co-op experience in industry. There's no problem that's nice and neat outside the lab!"

While Connors' team is concerned primarily with what happens when light-excited molecules return to their original ground states, Pavlik focuses on how excited molecules return to ground state as a different molecule. That's the difference between spectroscopists and photochemists.

Phototranspositions, the reactions that interest Pavlik, are photochemical rearrangements that permute—or scramble—the order of atoms in cyclic compounds. These reactions result in deep-seated structural changes that have no counterpart in dark organic chemistry. As the atoms change positions there are numerous changes in the chemical bonds within the molecule. Many bonds are broken; others are formed. These bonding changes reveal information about the structure and reactivity of the molecule's excited state, Pavlik explains.

As with other photochemical research topics, Pavlik's work may turn up reaction pathways that later prove to be useful in synthesizing new or otherwise interesting molecules, as well as providing basic scientific knowledge about the light-excited state itself.

This was the case with Pavlik's previous work on the phototransposition chemistry of 4-pyrones and hydroxypyrylium cations. In these studies, Pavlik and his research group discovered new phototransposition processes that have proven useful in synthesizing several classes of organic compounds that are difficult to prepare by classical organic chemistry techniques. "I've been very fortunate to have had a number of highly motivated undergraduate students work with me on these studies," Pavlik says. Many of these students have gone on to earn doctorates and now hold important academic and industrial positions.

> "There's new chemistry in every stage of the synthesis."

Considered by some students to be demanding in the classroom, Pavlik demands the same rigor of his colleagues that he does of his students. His appearance is less than daunting; the unruly light brown hair and glasses bring Woody Allen to mind.

But Pavlik is no comic, and there's nothing funny, he believes, about the way many photochemists are making unjustified assumptions about phototranspositions. Most work with these reactions, Pavlik explains, assumes the existence of temporary, intermediate molecular structures as a necessary part of the transposition event. But many of the intermediate structures that phototransposition researchers assume have never been proved to exist! "They come up with imaginative explanations of how you can get from Worcester to Boston directly, but in fact they were going by way of Providence and they didn't even know it," he gripes. Pavlik won't stand for that kind of guesswork.

Transposition reactions can be examined statistically, he says. There is a limited number of ways that a ring of atoms can be bonded together, just as there is a limited number of ways that a circle of people can hold hands, even if they each have three hands. Each distinct way constitutes a permutation pattern.

According to Pavlik, a permutation pattern is really a map of the reaction that shows where each ring atom in the product originated in the reactant. Pavlik's approach is to define experimentally all of the distinct permutation patterns that are actually occurring during a phototransposition. "It's like experimentally determining the total number of ways of getting from Worcester to Boston. This is important because it allows us to determine the actual route followed by the molecule," says Pavlik.

Chemically speaking, the route provides a precise definition of all the bonds that are broken and all the bonds that are formed during the transposition. This information narrows the range of mechanistic pathways and helps define the structures of possible reaction intermediates. If a suggested intermediate is to have any experimental validity, it must be consistent with the experimentally defined permutation pattern, he adds.

To pursue this kind of approach, Pavlik's research team has to synthesize different heterocyclic reactants (ring structures with at least one non-carbon atom in the ring) in which each of the ring positions (atoms) is uniquely labeled. The chemist's way of labeling atoms is to attach atoms or groups of atoms that are small enough so that the molecule's chemistry will be unchanged. That means replacing hydrogen atoms with methyl groups or deuterium, an isotope of hydrogen.

While on sabbatical last year at Oxford University, Pavlik planned the current phase of his phototransposition research. During that time he realized that it is also possible to learn about phototranspositions in a given compound by labeling ring positions with atoms that will change the molecule's chemistry, such as by replacing hydrogen with fluorine. Following those lines, Ciro Dimeglio, an MQP student in Pavlik's group, is pursuing experiments that will probe the phototransposition chemistry of fluoroimidazoles, adding another piece to Pavlik's puzzle. Dimeglio found that he responded well to Pavlik's demanding style in the experimental lab course. He points to a cartoon on the wall that says it all for him: "Motivation and endurance seem to count for at least as much as intelligence in producing superior scientific work—Harriet Zuckerman."

Pavlik's experiments also require the

Prof. David Statman (right) demonstrates for student James Shea the alignment of optical components for picosecond spectroscopy.

synthesis of each of the statistically possible products so that their mass spectrographic and gas chromatographic fingerprints can be compared with those of the products produced in his actual phototransposition reactions. "In this way, you can tell not only which products are being formed, but also which ones are *not* being formed within highly defined experimental limits," he says. Following that approach, doctoral student Prapapan Techasauvapak is working on the synthesis of six different compounds as part of a photochemistry study related to Pavlik's work. These studies promise to reveal new knowledge of the chemistry of excited organic molecules.

Assistant Professor James Dittami, another photochemist who recently joined the Photochemistry and Spectroscopy Group, uses light in the synthesis of natural products or naturally occurring compounds. In fact, he is fond of finding ways to make molecules writhe and contort in cool, lighted conditions the way they usually do in hot acid.

When he leans back and calmly answers question after question, what pours forth is just a small sample of the photochemistry knowledge he has absorbed in the 15 years since he first attended College of the Holy Cross as a chemistry major.

A year ago Dittami came to WPI after completing a Harvard University postdoctoral fellowship focusing on the synthesis of ovalicin, a natural product with immunosuppressive activity and hence of interest in preventing transplant patients from rejecting their new organs. At Harvard he also worked on the synthesis of compounds found in Gingko trees, of interest for their anti-tumor properties.

One of Dittami's current projects involves the synthesis of koumine, a substance that occurs naturally in the Chinese medicinal plant kou-wen. Kou-wen has been used for many years by Chinese herbalists, he says, as a remedy for complaints such as migraine and neuralgia. In addition to his course in organic synthesis and an organic chemistry lab, Dittami will soon teach a course in the synthesis of alkaloids, a class of nitrogen-containing compounds—including koumine, the opiates, caffeine, nicotine,

and cocaine—that are extracted from plants.

Dittami says that while pharmaceutical companies are rarely interested in such complex molecules as koumine because they are so difficult and expensive to synthesize, he works with natural molecules for that very reason—the challenge. "When you develop a synthetic methods project your results are not limited to natural products synthesis; they could be used for polymer synthesis, for heterocyclic synthesis," he explains. Synthesizing these molecules can also have more immediate benefits, like earning you a job. Senior William R. Perrault, doing his MQP under Dittami, says he wants to apply his project experience to synthesizing organic molecules in the pharmaceutical industry.

Organic chemicals, natural molecules among them, often contain one or more ring structures, which are made up of several atoms bonded together in circular fashion, although the angles of the bonds often contort the ring into a three-dimensional shape. Koumine contains five such ring structures, says Dittami, and no one has ever succeeded in synthesizing it. He recently received a two-year grant from the American Chemical Society Petroleum Research Fund to work on the problem.

Why put so many years of effort into making a molecule that occurs in nature, especially if the process is too involved to be of industrial use? "There's new chemistry involved in every stage of the synthesis," Dittami says. "We're trying to get something out of each step."

For example, one of the building blocks of koumine is a tetrahydrocarbazalone that is usually synthesized under very hot, acidic conditions. But since the molecule is very unstable and tends to fall apart in that kind of environment, Dittami is looking for a gentler method, and one of the possibilities is to bring about the carbazolone-forming reaction with light. So, finding new synthetic methods is the real aim of Dittami's attempt to synthesize koumine. "That's always the case," he says, "because what good is all that effort to just be able to make one compound?"

Light can be particularly useful in the synthesis of complex molecules. Dittami is interested in using light to bring about intramolecular reactions, which involve chemical transformations that occur within a molecule or between two parts of the same molecule. They differ from intermolecular reactions, which result from the combination of two separate molecules to produce a third system.

Along these lines Dittami is studying

Associate Professor Robert Connors (right) and graduate student Chynwat in the spectroscopy lab.

the heteroatom-directed photoarylation reaction, in which a molecule containing two rings linked by a heteroatom (a non-carbon atom such as nitrogen) forms a third ring containing the heteroatom, all as the result of the absorption of light energy. The resulting three-ring molecule passes through an unstable, electrically polarized intermediate on its way to a stable structure. Dittami hopes to incorporate a trap in his molecule that can swing around and react with this dipolar intermediate in an intramolecular sense.

"Ultimately," he says, "we hope to use this method to form synthetic morphine," adding, "but that's a long way off." First he has to get his method to work with intermolecular reactions before attempting to accomplish the intramolecular reaction, which would in effect make the molecule fold over on itself and snap shut.

Inducing invisibly small molecules to perform such gymnastics takes more than just shining light on them. Sometimes you have to carefully control the kind of light used, Dittami explains. "And if you use too much light then you'll cause other [unwanted] reactions to occur," he says.

Also seeking to shed light on factors affecting the rate of light-induced chemical reactions is another relative newcomer to WPI, Assistant Professor David Statman, who came to Worcester after completing his post doc as part of a prestigious team at Texas Technical University in Lubbock. Statman's team at WPI has assembled a state-of-the-art picosecond spectroscopy laboratory in Goddard Hall to look at how molecules in a solution physically interact with surrounding molecules.

Statman's black eyes widen and his entire body animates his explanation. When a molecule in a solution absorbs a photon, he says, the resulting higher energy state of its electrons makes it "uncomfortable"; it can't stay in the same shape, and it tries to get closer to another molecule that can take an energized electron off its hands. But the surrounding solvent molecules create friction as the excited molecule begins to twist and move toward the electron-accepting molecule. As a result of the friction, the reaction takes time. And by using an ultrafast laser to drive the reaction, Statman's team can observe the changing orientation of solvent molecules around the excited molecule.

The technique of picosecond spectroscopy involves first arranging a series of lasers and associated optics to create pulses of ultraviolet light lasting as short as 800 femtoseconds (less than a trillionth of a second). The molecules absorb the light and begin to reorient themselves because of their excited state. But before the molecules can make themselves comfortable, he explains, the light stops, the excited molecules return to ground state, and the light they give off is examined to provide clues as to the orientation that the molecules achieved in those few trillionths of a second.

By doing the experiment over and over again using different solutions, Statman can see exactly how different conditions affect the molecular-level physics of reactions. And that information can be used in the design of light-induced chemical processes, such as the operation of photovoltaic (solar) cells.

Statman's lab is one of only two dozen in the country set up to do these experiments, representing a frontier area of chemistry. Over the past 30 years, chemists have built a body of knowledge about molecular structures and reaction equations relevant to equilibrium conditions, or those conditions that exist after a reaction has settled down. Now, using techniques such as picosecond spectroscopy, chemists are beginning to find out about what happens in chemical reactions over time, especially in the time frame of trillionths of a second or less. The ability to fine tune the control of chemical reactions is the hoped-for result.

Statman came to WPI in the fall of 1985 because, he says, of the Chemistry Department's increasing emphasis on photochemistry and spectroscopy, but also because he was impressed with the Institute's undergraduate program. Because he feels that education is such an important aspect of society, Statman is glad to be involved in an undergraduate program that does what it should do: "teach students to think creatively, as well as morally. If there are potentially harmful side effects to what you are working on, then you morally have to deal with those side effects."

Sunlight's effects on our environment play a crucial role in the quality of our lives.

One aspect of the WPI program that especially impressed Statman was the Interactive Qualifying Project (IQP) requirement. When Statman was a visiting professor at the University of Hartford, he would invite students to his home for informal discussions on the social aspects of science and technology. The discussions, which featured guest participants with relevant experience, were a big hit among students. "They ate it up!" he says. "They were starved for that kind of thinking," which they weren't getting in their courses.

Statman isn't advising any IQPs right now, but his team includes two undergraduates in addition to M.S. student Michael P. Collette, who says Statman's enthusiasm helps cut the tedium of lab work. Peter J. Chinigo got interested in computer simulation of chemical reactions while taking a physical chemistry lab course from Statman, and then became interested in Statman's use of lasers to study ultrafast phenomena. James Shea was also drawn into Statman's lab by the state-of-the-art laser setup. The three of them have transformed Statman's high-tech ground floor lab into an all-hours headquarters in the heroic search for molecular secrets. Complete with clearly labeled Statphone and Statcomputer, the Statcave is the preferred hangout for this research team.

One floor above Statman's basement hideout is Professor Alfred Scala's laboratory, where he confines organic molecules in crystal cages forcing them to reveal photochemical secrets. The centerpiece of the lab is a gas chromatograph-mass spectrometer (GC-MS), a tandem arrangement of two key instruments for the identification and measurement of chemicals.

Together, the GC and MS are about the size of a desktop copier. A sample injected into the machine first goes through the gas chromatograph, which separates the different constituents according to their respective boiling points. This takes about 10 to 15 minutes, and the results are seen as peaks on a graph. The associated mass spectrometer scans the gas coming out of the GC every two seconds, exploding the constituent molecules and then measuring the sizes and relative amounts of the resulting molecular fragments.

That's what goes on inside the machine, but the casual observer just sees a small liquid sample injected into one end and reams of graphs and tables produced by a computer at the other end. Scala uses the GC-MS so heavily because "our methods are such that we have to identify and quantify small amounts of chemicals."

Right now Scala and his students are using the GC-MS to study the photochemistry of certain organic chemicals absorbed in zeolites, a class of mineral crystals used, among other things, as catalysts in the production of gasoline and other high-octane fuels.

In Scala's experiments, small organic molecules are trapped in pockets in the surface of the zeolites, and while they are trapped there they can be exposed to light or reacted with other chemicals. "Smaller molecules can get into these channels [in the zeolites' surfaces] while larger molecules cannot," Scala explains, "so different sized molecules behave differently in terms of absorption properties."

Scala's aim is to uncover how molecules interact with light while they are trapped in zeolite cages. In order to do

Professor Alfred A. Scala and research assistant Prapaipit Chamsuksai study reactions between zeolites and organic substances.

this work, Scala had to develop new techniques so that his data would be reliable and, therefore, meaningful. "There's nothing worse than doing a bad experiment and then spending a lot of time trying to understand lousy data," he advises. "How to put the organic chemical in zeolite, how to do the photochemistry, which wavelength of light to use, how to remove the organic from the zeolite, and how to analyze the results" are all part of the long-suffered initial stages of the work, Scala says.

Now his team is starting to collect data on the photochemistry of two compounds, one of which, cinnamonitrile, is a component of cinnamon. Now the work focuses on bringing about a *cis-trans* isomerization of the chemical, twisting one of its double bonds 180 degrees without changing its chemical composition. His work is not geared toward applications, but Scala says it could provide information useful in regenerating catalysts used in chemical filters.

Catalysis is extremely important in industry right now, says Prapaipit Chamsuksai, a doctoral student in Scala's lab, who made the switch from natural products chemistry to photochemistry and catalysis. She came to WPI four years ago partly because she liked its friendly atmosphere compared to larger universities, and because of the access grad students have to professors.

And Chamsuksai, or "Pete" as she is usually called, is doing her best to preserve the Institute's friendly character. Because she enjoys teaching and always takes time out for students, undergrads in her lab sections voted her last year's Teaching Assistant of the Year. In addition to her TA and Ph.D. work, Pete operates and maintains the lab's expensive GC-MS and HPLC (high performance liquide chromatography) equipment.

The brightly lit, spanking new, fully automated GC-MS setup stands in cold contrast to Scala's office. Near the doorway stands a stack of dusty instrumentation from another era. His surroundings and greyish cardigan contrast with his dark hair and beard slightly streaked with white, and the almost faraway gleam in his dark eyes. They belie his reputation as a masterful lecturer, always fast on his feet in general chemistry and his chemical dynamics course.

"Scientists in general would like to have a practical system for converting sunlight into usable and storable energy," Scala says, reflecting on the practical potential of photochemistry. One idea has been to use sunlight to split water molecules, generating hydrogen gas, but an economical process has yet to be developed.

One drawback, he notes, is that using light of a specific wavelength in chemical processes is still more expensive than using heat, although photochemistry is already being used in such commercial processes as the production of acetone, a widely used solvent. But even now photochemistry and spectroscopy are invaluable research tools.

"In terms of furthering our knowledge about nature and atoms and molecules, photochemistry has made great strides in the last 25 years," Scala says, "and will continue to do so."

Paul Susca is a freelance writer living in Rindge, N.H.

TECHNOLOGY AND GOVERNMENT IN CONFLICT

A personal view of the uneasy relationship of scientific progress, privacy, and the Constitution.

By Kenneth P. Ruscio
Assistant Professor of Social Science and Policy Studies

Last September, a group of political scientists interested in science and technology formed a study group within the American Political Science Association. That the event did not receive the attention of the national press is no reflection on its importance. For at last, those who claim expertise in the processes of government had, by attending, acknowledged that science and technology influence the way we govern ourselves. Moreover, they were saying, many of the issues facing government now have a scientific or technological component. Government is deeply immersed in scientific and technological controversies, while research and development are constrained by the political system.

It is no secret that the worlds of science and politics do not mesh perfectly. Politicians often seem to misunderstand technical questions. Scientists and engineers rarely appreciate the intricacies of government.

Standards for clean air, the siting of a nuclear power plant, the feasibility of a weapons system, the health risks of a certain substance—these and many other apparently technical decisions must pass through a filter of democracy. In the United States, this filter is one in which the political and economic interests of individuals lead them to interpret facts differently and often, if not usually, arrive at conclusions that reflect their personal interests.

My scholarly interests center on the Constitution and science. This year, our Constitution will turn 200 years old. This document and the ideals underlying it have guided the nation miraculously through civil war, industrial revolution, dramatic urban growth, and emergence as a world power. Yet as we celebrate this remarkable bicentennial, we face a host of dilemmas unimagined by the visionary minds of Madison, Hamilton, Franklin and their peers. And most of these challenges are and will continue to be linked unavoidably to our scientific and technological initiatives.

To understand why these fields of endeavor are so closely tied to the national conscience, we must first acknowledge that science and technology are "quasi-public" activities. Government supports, regulates, or indirectly influences all of the nation's research and development. In the classic movie, "It's a Wonderful Life," Jimmy Stewart's guardian angel allows him a glimpse of what life would be like in his home town if he had never been born.

To understand government's influence on science and technology, update Stewart's microcosm for a moment, and expand it to global proportions. Suppose that, 40 years ago, our political system had decided to ignore any policy problem related to science and technology. Imagine the medical questions that would still be unanswered, the industries that would no longer exist or would never have been born. Imagine the state of today's universities or of our national defense. Imagine, perhaps most unrealistically, that the courts and legislatures had avoided such medical questions as abortion and euthanasia, issues that go on straining the moral fiber of society.

Science and technology are quasi-public activities because they raise issues that the political system cannot ignore, even though individuals and organizations outside of government perform most of the activities.

As science and technology mingle with the political system, they come closer to the centers of political and economic power. And in so doing, they run headlong into the Constitution. For if there is any common definition of "constitutionalism" among political scientists, it is that power in society must be limited. Science and technology are increasingly obvious sources of power. They must, therefore, be folded into our constitutional structure.

Examples abound of how this mingling occurs, but I'll focus on two. The first embraces the complex questions raised by advances in the life sciences and medicine. The second centers on the conflict between information technologies and individual freedoms. In both cases, it is necessary to balance society's interests with individual rights. But technology, we have found, usually requires us to recalibrate the scales.

"Our talent for developing technology far exceeds our capacity for absorbing it."

Progress in medicine has preceded some of the most painful moral, ethical, and political issues of our time. Each day we learn more about the biological and chemical processes of life, yet society seems to move farther away from agreement on what is meant by *life*.

In 1973, when asked to rule on the legality of abortion in the case of *Roe vs. Wade*, the Supreme Court carefully and deliberately avoided the question of when life begins by dividing pregnancy into trimesters. As a result, each trimester introduced a different set of considerations for balancing the rights and interests of the fetus, the mother, and the state.

In the first trimester, the court ruled, the mother's right to privacy and therefore her freedom to choose an abortion is paramount. In the second trimester, when the abortion procedure poses a greater risk to the mother's health, the state's interest in ensuring safe medical care allows government to place some restrictions on the mother's choice. In the final trimester, the fetus becomes viable outside the womb, and its right to life takes precedence over other interests.

The court drew the lines between trimesters on the basis of its answers to two scientific questions. First, at what point in the pregnancy does the fetus become viable outside the womb, given the capacity of neonatal technologies to sustain the life of a very premature baby? Second, at what point in the pregnancy does the abortion pose a significant medical risk to the woman? The answers were derived from the available scientific evidence. But if the evidence changed, we could argue that the policy should be subject to change.

The evidence has changed. Since 1973, the abortion procedure has become safer, presenting less risk to the mother and weakening the rationale for limiting abortions in the second trimester. But neonatal care has also improved, thereby strengthening the case for limiting abortions earlier in the pregnancy. Hence, technological progress pulls the trimester model in opposite directions.

In 1983, the court acknowledged the new medical evidence, but reaffirmed its reliance on trimesters. However, Justice Sandra Day O'Connor wrote in a separate opinion that the model was "on a collision course with itself . . . [It is a] completely unworkable method of accommodating the conflicting personal rights and compelling state interests that are involved in the abortion context."

President Reagan's appointees, Justices O'Connor and Scalia, have indicated that they share the president's strong opposition to abortion on moral grounds. The new Chief Justice, William Rehnquist, was one of the dissenters to the 1973 decision. As a result, a challenge to the *Roe vs. Wade* decision seems likely in the near future.

Last spring, the court voted 5–4 to overturn one state's restrictions to access by minors to abortions. In writing the decision, retiring Chief Justice Warren Burger practically invited a challenge to *Roe* with his remark that it "should be reexamined." Technological change is almost certain to be one basis for the reexamination.

Consider a very different case. In October 1983, Baby Jane Doe was born in a New York hospital; she suffered from serious, multiple handicaps. The baby's parents had to choose between extensive surgery, which doctors estimated would enable the child to live another 20 years (although she would be severely retarded) or treating the baby conservatively with antibiotics and good nutrition, which would enable her to live for only an estimated two years.

The parents chose the conservative treatment. Shortly thereafter, an attorney with no connection to the family or the hospital, acting on an anonymous tip from someone at the hospital, began a legal proceeding to require surgery. He charged that the hospital and the parents, by denying surgery, were discriminating against the baby because she was handicapped.

The federal government intervened and demanded the hospital's records. The hospital refused, and the case proceeded rapidly through the judicial system. In the end, the hospital retained its records, and the decision for treatment was left with the parents. But as a result, the federal government began to fashion new and controversial regulations for the care of newborns.

This was a particularly wrenching story of individuals taking strong moral stands on completely opposite sides. Regardless of the argument's outcome, some fundamental tenet of our democracy would be offended.

On one side was the principle that individuals are best able to make choices in their own interest, and when they are incapable of conveying their wishes, as is the case with newborns, those closest to them are the most appropriate substitutes.

On the other side is the principle that sometimes those best able to make life or death decisions for an incapacitated person are those who are emotionally *detached* from the situation. In this case, government (usually through the courts) is asked to weigh and balance all the considerations on behalf of the affected person.

It would be convenient if technology presented us with clear, simple decisions and only positive consequences. But it doesn't. What if, however, the question were not the ending of life or even life's quality, but rather one of selecting desirable traits for individuals?

Consider this example: Society is but a few technological steps away from giving parents the ability to choose the sex of their child prior to conception. Americans on the whole may prefer to leave the choice to nature. But even if parents frequently exercised the option, the proportion of males to females might well remain nature's "preference"—roughly equal.

On the other hand, significant disruptions in society might occur, raising the question of whether government should regulate the practice. Recently, I asked students in one of my WPI classes to propose a policy to respond to this question. Some leaned on the Supreme Court's 1965 ruling in *Griswold vs. Connecticut*. In that landmark case, the court, in overturning a law which forbade the sale or promotion of contraceptives to married couples, recognized a qualified right to privacy and reasoned that, if anything is private, it is the decision of how to build a family. Government should stay away from such intimate private decisions, the court advised, and the choice of a child's sex, some students inferred, was likewise a private decision.

Other students predicted an imbalance in the ratio of males to females and, as a result, unfavorable social change. They welcomed either an outright ban of gender pre-selection or mild regulation (e.g., parents can choose the first child; the rest are up to nature). Still other students welcomed a ban for a slightly different reason: if the practice were permitted, society would begin a slide down a slippery slope as later technological developments opened the door to choices such as height, looks, and even intelligence.

Suppose several kinds of procreation decisions are distributed along a continuum. At one end are decisions about contraceptives, which are now constitutionally protected. At the other extreme are as yet unrealistic decisions such as ordering the custom-made baby. In between are variations, such as choosing a child's sex, height, or whatever.

At what point do the public consequences of these decisions become so significant that they compel government regulation? Among social scientists, some of our most frustrating efforts center on forming the very questions we hope to study. Normally, the answers are even less clear-cut. Both emerge slowly and usually only after great effort.

Many technologies are developed for the purpose of making more efficient the collection and management of information. It's hard to argue with new developments that encourage an informed citizenry. But these technologies can also make it easier to control information. Most of us assail endeavors of the latter kind as dangerous to democracy. Information is vitally important to an open political system, but government has no business gathering and prescribing the uses of information that should be accessible to the public.

But today, the information game has moved to a new playing field that favors government. Without protective legislation, individuals will find themselves at a greater and greater disadvantage.

The problem becomes evident when we frame it as one related to privacy. Nowhere does the Constitution mention the word privacy, but several of its provisions imply at least a qualified right to privacy. How can we read the Fourth Amendment's protection against "unreasonable searches and seizures"?

One legal scholar defines privacy as the claim of individuals "to determine for themselves when, how, and to what extent information about them is communicated to others." For government to collect information on individuals, it must overcome this presumption of privacy by setting forth a clear justification, such as the preservation of law and order. Once again, it is a matter of balancing individual rights against some interest of society.

Consider the example of "computer matching." In 1974, 46 percent of the American public believed that personal information was being kept in a file somewhere for purposes not known to them. By 1983, 69 percent had the same opinion and 51 percent believed that computers posed a serious threat to personal privacy.

One of the earliest responses to these concerns was the Privacy Act of 1974. Among other things, it required that information collected by government agencies be used only for its original purpose. Separate agencies could not merge their files to find, for example, a student loan defaulter who was reporting a substantial income to the Internal Revenue Service.

The Privacy Act did allow agencies to match their files for occasional routine cases, but this legislated exception has now become the norm. Moreover, Congress has passed several laws that actually require specific matches. The Deficit Reduction Act of 1984, for example, permitted more income tax information to be merged with data on

"We learn more about the science of life every day, yet we move farther from agreement on what life really is."

Social Security and other benefit programs. In short, despite public aversion to computer matching, Congress and federal agencies have repeatedly found justifications for the practice.

The federal government's use of information has been affected by three changes, according to a report by the Congressional Office of Technology Assessment. First, nearly 60 percent of all major record systems are now computerized. Second, telecommunications has made access to the records simpler and has made the process of matching almost effortless. Third, the proliferation of microcomputers allows thousands of officials potential access. Monitoring becomes difficult. Security of records is jeopardized. It is hard to tell retrospectively who has obtained what information.

Policy makers have, however, instituted a few protective practices. When agencies score a "hit," for example, they do not automatically assume the individual is at fault. Instead, they usually allow the person an opportunity to make his or her case. In addition, agencies must disclose, where appropriate, when the information collected from a person might be used for other purposes. Perhaps most significantly, Congress is considering legislation to revise and strengthen existing laws.

If the legal framework has not kept pace with computers' record-keeping abilities, the law is even less adequately prepared to deal with electronic communications. Cordless phones, cellular phones, electronic mail, and a host of other telecommunications methods that use digitalized impulses fall into a legal no man's land.

The 1968 wiretap law requires a warrant to listen in on "aural" conversations. It says nothing about whether law enforcement officials can pick up electronically transmitted conversations or whether they can obtain the records of an electronic mail company. (First class mail, in comparison, is fully protected.) A consequence of this ambiguity is that the courts have handled cases inconsistently. As the number of cases increases, so will the confusion.

Democracies can be judged by the sensitivity with which they handle information, allowing some kinds of information to flow freely through society while preventing improper uses of other kinds of information. Two principles should guide government's decisions. First, information on individuals should be presumed private unless there is a clear exception, such as a legitimate suspicion of criminal behavior and thus a need to institute surveillance.

Second, all information about government and its actions should be presumed public, unless there is a clear exception, such as national security. The exceptions to both principles should be narrowly construed. The dilemma is that technological barriers between the principles and the exceptions have been lowered. The solution is to *fortify* the remaining constitutional and legal barriers.

Thomas Jefferson advised that "laws and institutions must go hand-in-hand with the progress of the human mind. As new discoveries are made, institutions must advance also, and keep pace with the times."

In America, that is easier said than done. We promote science and embrace technological progress, but we have designed our political institutions to act slowly. The Constitution divides, checks, and balances power. But rapidly advancing technology places great stress on a political system built not for swiftness and efficiency but for careful deliberation and limited action. Society's talent for developing technology exceeds its capacity to absorb it.

The seductive solutions are either to remove some of the checks and balances on public authorities, allowing them to act decisively, or to give power to scientific experts.

Both solutions are unsatisfactory to me. I share the Founding Fathers' skepticism about governmental power. And, like them, I believe that the government that governs least governs best. I welcome the presence of a Constitution between me and government. I want public officials to feel constrained and, to paraphrase a noted columnist, I think I'd rather be governed by the first 50 names in the Boston phonebook than by a group of scientific experts.

I do not have the solution to the issue of technology versus government, but I do have a suggestion. If my prediction that technology will cause us constitutional headaches down the road proves to be correct, then society will need citizens who, first, are sensitive to our constitutional heritage and, second, are well-informed about innovations in technology.

We hear a great deal about promoting technological literacy among the population. It is an admirable objective, especially when recent polls show that many Americans equate electricity with magic. But I am just as concerned, if not more so, with promoting constitutional literacy among scientists and engineers.

We need technologists who can anticipate and interpret the constitutional issues raised by their work, who understand concepts such as privacy, and who appreciate how difficult it is to balance the rights of individuals against society's need for order and stability.

EUREKA!

Presenting the World's Greatest Inventions

LAST AUGUST, we encouraged readers to nominate the one invention the world couldn't possibly do without. As we thumbed through the 150 contest entries, we could tell the phone was a favorite. In fact, electronic and electric gizmos had lots of fans. But champions of frozen food, blue jeans, language, safety pins, bumper stickers, bubbles, Tony's Hoagies, credit cards, and Coke all defended their choices eloquently. Several of you praised the invention of invention itself.

We didn't mind when some entries stretched the definition of invention to accommodate the church, the circle, education, fire, and the human mind. But that didn't make it any easier to pick the winners. We only regret that we haven't more room for your ingenious replies.

Illustrations by Shaul Tsemach

The idea you can count on What would the world be like without numbers? Children would be forced to expand their budding vocabularies.

"How old are you?"

"I'm a pre-adolescent. But my brother's neonatal."

And for older folks?

"What birthday is this?"

"Why, I'm celebrating my prologue to maturity."

("Ha! More like the sequel to senility if she's a day!")

Getting a raise might be tough.

"Boss, I've been with the company a spell now, and I'm still only making a good bit."

"So? What's your point?"

"Well, sir, I was hoping you might be able to give me a pretty good raise."

"Out of the question! But I might consider a tad more."

"Well, how about a not-too-bad raise?"

"I'll think about it."

How about Congress without numbers?

WASHINGTON—Congress ended its session in a flurry of legislation today, agreeing to tax citizens a whole bunch more. Lawmakers noted the deficit was "really getting up there," and vowed to "blow it away."

Republicans claimed defense required "a whole passel o' bucks," warning, "The Russians have lots o' missiles. We should, too."

But the Democratic side prevailed. Sen. Twitt Barley, in an emotional address, won the swing votes. "Spending for social programs," he said, "is gettin' to be lower than a snake's belly in a wagon rut."

Imagine being caught speeding.

"License and registration, please."

"What's wrong, officer?"

"We clocked you going too darn fast, sir, in a take-it-slow zone."

"I thought this was a good-clip zone."

"Tell it to the judge, sir."

Off to the traffic court.

"How do you plead?"

"Guilty, I guess."

"Have you ever gone too darn fast before?"

"No sir."

"How about too damn fast?"

This was a tough judge.

"Have you ever taken off like a shot? Gone like a bat out of hell?"

"No sir. Never."

"Good. Due to your record, I'll reduce the charge of going too darn fast to moving at a pretty good clip. Pay the cashier a trifle."

O.K., I have to agree we need numbers. I'd hate to fly aboard an airplane built without exact measurements. Figuring out who won on "Wheel of Fortune" would be impossible. It's just that we often use numbers when words will do. They allow us to quantify, rather than individualize, people.

Does going to the registrar make you feel like an equation?

"Johnson, Richard? 245-08-9933?"

"Yep. That's me."

"In 6/85, I see a 3.2 in course 1.009, a 3.6 in 33.55, and a 4.0 in 222.887."

Even with a 3.6, you feel like a zero. It could be so much better.

"Richard Johnson? From Cedar City?"

"Yep. That's me."

"I see last year you did pretty darn well in French, outstandingly in American history, and hey! You aced that nasty pre-ionics. Good job!"

Now that would make you feel like a million bucks.

Steve Gasque
Hopkins '76
Kensington, Md.

Two insider nominees My candidate for the world's best invention: the Thermos bottle.

It keeps hot things hot
and
cold things cold.
But how does it know?

Kenneth F. Holman
Villanova '63
Kenner, La.

Standing in my kitchen and looking around for useful inventions, I am astonished to find that every counter, wall, and shelf carries a variation on an ancient theme. Long before we could write, we passed down through our generations the concept of and skill to make an elegantly simple object. Essentially unchanged, this invention quietly permeates our lives, enriching those who meditate with a gentle perspective on our place in the universe.

Without it we could not have lived as we did. We could not live without it as we do today.

The object on my counter is a bowl. It is a flat surface (the bottom) that has been curved on every side. The space within the embracing walls enables us to contain, to carry from place to place, and to handle in a variety of ways.

Make it of wicker, it's a basket. Stone Age monuments were built with deer's antlers and baskets. Make it of clay, and the bowl is a pot, the staple find of archaeologists. Perch the bowl on a stand and it becomes goblets and stemwear. Put a handle on a bowl and it is your coffee cup. Pull up the sides of a simple bowl and bring them close and you get an urn for burial, a jug for liquor, a sealed container.

From baskets and pots of the past to containers for nuclear waste, bowls have served us well. And yet, is it not a strange thing that it is the part we did *not* invent that makes it all work? The space within, the emptiness, is the essential element. A full bowl is no longer useful until emptied again. And so our place in the universe is defined. We invent the outline, and Mother Nature does the rest.

Dawn Campaigne Miller
Western Maryland College,
Class of '72
Crownsville, Md.

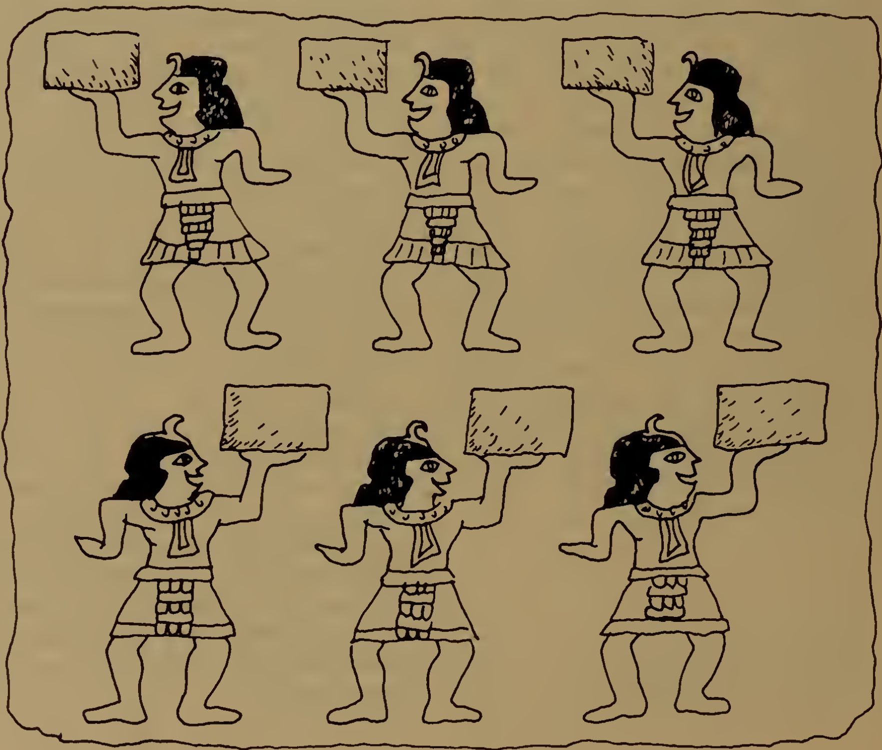
Did you hear the one about . . . Lump together the computer, the internal combustion engine, lasers, television, and pantyhose, and make what arguments you will about their merits. Plead the case for the Salk vaccine or instant cake mix, and you still won't have man's greatest invention. Before such advances could be possible, man had to first find the means of coping with a terrifying and hostile environment. It was in this search that man found his greatest invention: the joke. After that, everything seemed, well, trivial.

Think back to our Neanderthal ancestors. Life was rough, what with living in caves and foraging for berries, under the ever-present threat of attack from a saber-tooth tiger or other less-than-affable predator. Take in the full picture—climate, food supply, life expectancy—and you'll see that extinction appeared a viable alternative to this stressful existence. It was the option of choice for the dinosaurs, and everybody knew it.

What, then, eased the tension and made it possible for man to take the great step forward that led to the development of tools, weapons, and agriculture? One significant day, early man dreamed up the first humdinger: "Hey, Oog, why did the wooly mammoth cross the road?" Oog wasn't sure why, but he liked the answer. He laughed and felt better. Progress began.

As humor progressed, so did history. The construction of the pyramids has always raised the question, "How did they get all those slaves to move all those big blocks?" One theory suggests that an ingenious overseer invented "Pharoah's wife" jokes that kept the slaves amused, and kept the crews moving ever higher, just so they could pass the joke along to the next group up.

All went well until 816 A.D., when Pope Leo III banned humor throughout the Holy Roman Empire and so kicked off the Dark Ages. Sensing unrest, and altogether tired of the Crusades, Nicholas IV lifted the ban in 1291. What fol-



lowed was the Renaissance, known for Dante's *Divine Comedy*, Boccaccio's smutty little stories, and a general atmosphere of good-natured creativity.

A careful reading of history will show that such creators as da Vinci, Franklin, and Edison were the great kidders of their day. Find war and repression and you'll encounter a dour and humorless lot who have sadly overlooked this greatest of man's achievements. Looking to the future, do we face peace and prosperity or certain doom? It all hinges on whether or not our leaders can take a joke.

Kim Kleimo
F&M '76
Lancaster, Pa.

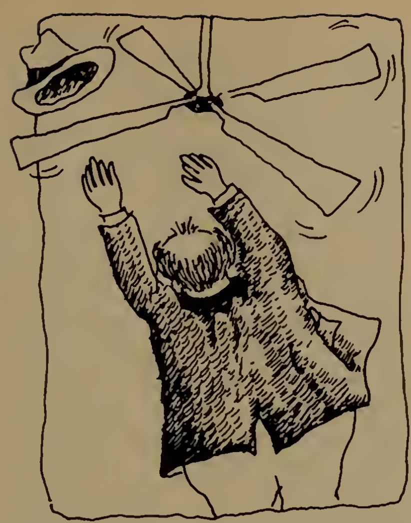
A place to learn and yearn From Pisistratus and Aristotle to Medici and Franklin, the library has flourished since its inception some four millennia ago. The only place where the potential exists for all men to be equal, it is both the maker and the mark of civilization, epitomizing the ideals of social man. A record of our mistakes and a monument to our achievements, the library is a window into the past and a portal from which to imagine the future. It is a place of dreams, where the collective consciousness of man fuses into an amalgam of unequalled strength and power for all those who use it wisely.

David C. Creasey, PhD
Hopkins School of Hygiene and Public Health
Baltimore, Md.

Artificial wind Beauty in an invention is a function of three factors: simplicity, versatility, and, of course, utility. On the basis of the first requirement, then, we can immediately disqualify all electronic equipment from the competition.

Let me nominate a less spectacular, though equally useful, invention: the rotating fan. For me, more fascinating than any of the newer, complex electronic toys, weapons, or machines is the survival of this simple invention through it all. Somewhere in nearly all space-age machinery lurks a fan, cooling the expensive equipment according to its primitive principles.

Though there is nothing remotely high-tech about an electric motor rotating three or four blades on an axle, that same basic design has, no doubt, at least as many applications as the computer. Progeny of the windmill, which is nothing more than a fan in reverse (that is, driven by wind instead of driving it), fans of a sort are also used to propel ships and airplanes. But their most familiar function has always been cooling, and they perform this task consummately. Even air conditioners, which threatened to replace the fan, only resulted in increasing the production of fans; no air conditioner can work without one.



Personal experience is perhaps not the best way to measure the utility of this instrument, but, unfortunately, I'm no scientist or engineer. My box fan and I have been together for years. I purchased it in Baltimore and became attached to it during the sweltering summer nights as I sat at my desk contemplating a half-baked dissertation. In my migrations ever southward, I have brought it with me to Panama to help me brave the deep tropics.

Ceiling fans are the more prevalent version of this invention, and despite their purely decorative function in restaurants and bars in North America, these machines perform a much more vital service here—that of making buildings habitable—and they do that silently and efficiently. Their only drawback is the risk of decapitation or depilation that they afford exceptionally tall guests.

Inventions such as cars, TV sets, and computers are encumbrances even when they are working properly. They are designed to solicit our undivided attention, thereby complicating, rather than simplifying, our lives. The fan, at least, remains one of the few useful objects in my house that I can gratefully ignore.

Carol Gardner
Hopkins PhD '85
Panana City, Panama

At the sound of the tone . . . Since the early 20th century, when Alexander Graham Bell triumphed in revolutionizing the communications industry with his immortal plea, "Watson, come here, I need you," the telephone has been a source of intrigue and worry like few other technological wonders. It dominates the human mind as Pavlov's bell dominated his dogs, and in much the same fashion. Until, that is, the emergence of the world's greatest invention, a product infinitely more remarkable than its more famous predecessor.

Now we are capable of censoring our calls, a feat only dreamed of two decades ago. The answering machine has so infiltrated the professional and private sectors that most people turn them on even when they're in. This negates the possibility of accidentally answering the beckon of a bill collector, a perverted caller, even a great-grandparent hungry for conversation.

And it's so easy. Just program a message. Then sit back and watch the action. The magic box does the rest! You can turn the volume up to hear the jokers on the other end trying desperately to invade your life with their thoughtlessly timed calls, calls that previously had caused you to miss countless third-and-one plays. Or turn the volume down and revel in the silence. This incredible servant to humanity also answers the phone when you're not home and when you're asleep.

There appears to be only one catch to this nearly perfect contraption: The owner doesn't have an airtight excuse for not returning calls. Time was when the IRS auditor would leave his name with your little sister. Later questioned, you could say, "Oh, my little sister's an idiot. She must have forgotten to give me your message." But it's difficult to call your answering machine an idiot with any reasonable degree of convincibility.

I recently bought an answering machine and I haven't answered the phone in weeks! But I've also noticed that, when I'm away from home, I'm not missing much, like the call from Cheryl Tiegs I dream of getting.

Still I'm in awe of the telephone answering machine, a gadget that expands our horizons by narrowing our responsibilities. History's greatest invention imparts peace and quiet by proctoring one of history's loudest inventions, the phone. And this thought inspires a theory I've formulated: Could it be that the inventor of the telephone answering machine is a direct descendant of Dr. Bell's faithful servant, Watson?

Nelson Thacker
Western Maryland College '82
Annapolis, Md.

Perfect fit In the earthy, down-home department, consider the fitted sheet. It has been around for 32 years and is a godsend to the harried housewife (especially she who is wife, mother, and breadwinner); to the male coping with domestic chores; and to the child faced with learning to make a bed. Slip the elasticized corners around the mattress ends, and you're off to a neat and tidy start. The rest of the process is up to you, but if your foundation is smooth and anchored, you should finish the mundane task in jig time.

In a lifetime of, say, 72.4 years, during which someone—your mother, most likely—makes your bed for you perhaps eight of those years, you will probably make your own bed 21,506 times. This, of course, does not take into account the times that you're too ill or injured to get out of bed, or lolling about in a hotel, or unfortunate enough to be spending the night in a sleeping bag, or if you're an inveterate slob who doesn't make your bed. Give or take the several hundred chances you have to avoid making your own bed, and you're stuck with the job about 20,000 times. If it takes maybe five minutes to make the darned thing (and that depends on the bed's size, the dexterity of your hands, the length of your arms, and your standards of neatness), bed-making will take a minimum of 166 hours and 40 minutes of your life. Without the fitted sheet, it would take much longer.

The fitted sheet is a simple object, but its appearance had to wait for two inventions—elastic and then synthetic, heat-tolerant elastic that would snap back into shape after repeated washings. Rattier Guibal in 1830 invented elastic in a suburb of Paris. But it was not until March 1954 that the people of Glen Raven Mills in North Carolina introduced the fitted sheet, made with nylon tricot, which had an unpleasant, sleazy feel to it. In 1959, Du Pont introduced Lycra spandex fiber, a synthetic elastomer, thereby paving the way for a marriage of more natural fibers with a heat-resistant band.

For those of you who think that the younger generation is getting soft, be heartened to learn that the Armed Forces still make the beds with plain old flat sheets. Some hospitals have adopted fitted sheets; some, including Hopkins, have not. So relax, purists, the dreaded hospital corner may be endangered, but it is not extinct.

For the rest of us, better bed-making through chemistry.

Ann Egerton
Hopkins '68, MLA '74
Baltimore, Md.

A haven away from the monsters Middle-class suburbanite teenagers: We live in nice houses in nice neighborhoods. Our parents drive nice cars. We wear nice clothes and have nice things. Let's face it—we lead nice lives. In all this nicety, what could we simply not live without? Is it the microwave? our stereos? or perhaps the family VCR? This renegade suburbanite thinks not. My choice: indoor plumbing. Overlooked and underappreciated, but very, very necessary, wouldn't you say?

My earliest recollections of the outhouse are from the camping trips our family took in my toddlerhood. I remember Mommy sitting me precariously atop "the hole." Mommy daren't have let me go or I would surely have fallen into that dark, smelly pit where monsters live (or so said my terrorizing older brother). In all seriousness, I think it was a reasonable worry. It certainly was a large hole for my four-year-old behind. By the way, has anyone found statistics on outhouse casualties?

In recent years, even my dumb brother has conceded that monsters don't really live in "the hole." Besides the obvious, what's really down there? The sight and smells are deceiving. My personal opinion is that the whole outhouse thing is a cover-up. Actually, all the sites are toxic waste dumps; the outhouses are just there to throw off all those public activists.

That brings me to the most important argument against outhouses: location. They're always yards and yards from the nearest campsite or building. A person could get lost. Why, that has happened! In the early 1920s, the Oliver family was having a picnic on Zorber Mountain. My grandmother's four-year-old cousin, little Elizabeth, went off to the outhouse.

She never returned. Legend has it that she was carried off by a bear. That, however, is not the point. The point is that a lot of things could happen to a body trying to find a far-off outhouse.

The lowly toilet will never be heralded as one of man's greatest inventions. It is, then, our duty to right the wrong and sing the praises of indoor plumbing for all the world to hear.

Nicole M. Wallace, age 14
F&M Gifted Program
Columbia, Pa.

Marvelous simplicity By fiddling with a thin piece of metal many decades ago, someone invented an object so pragmatic that today it thrives in desk drawers and in every office and home. It remains the same year after year, even as computers, cars, and compact discs undergo yearly revisions.

The stapler remains its closest rival in popularity, but as staplers have been known to grow feet during the course of the night and quietly walk away from their designated spot, the stapler's reliability is always in question. Also, corrective action on a faulty stapling job is tedious at best.

The simplicity of the paper clip is what makes it so marvelous. When was the last time you saw someone staring dumbfounded at a paper clip, exclaiming, "How does this work?" It is complete in and of itself—Maslow's "self-actualization" at its best.

The last aspect that sets it apart is its inspirational quality. How many sociology majors could invent a laser beam? However, anyone could have twisted that thin piece of metal and turned a simple concept into a reality. It makes one wonder how many other needs could be met so easily and completely.

Jim Denny
Villanova '83
Seattle, Wash.

Ever since 1899 when Johan Vaaler invented the paper clip in Norway, it has influenced the world far beyond its size.

Government and legal documents in England used to be tied together with red tape. The paper clip came along, and presto, red tape was eliminated.

Where would the pipe smoker be without a paper clip? Just today, while ensconced in my favorite recliner, I extracted a clip from my pocket, unwound it, and reamed my pipe.

More than once when traveling, I have forgotten cuff links or a tie clasp. Paper clips held the cuffs together and kept my necktie out of the gravy. Once I could find no way to attach the loop of my academic hood to my gown. A large paper clip on the gown with the loop through the clip held the hood in place, and I was spared strangulation.

During the Nazi occupation of Norway, the paper clip was a symbol of national unity. "Loyal Norwegians wore the clip proudly," writes Bent Vanberg in *Of Norwegian Ways*, "knowing full well that they risked arrest, deportation, imprisonment, and even execution by displaying this simple sign of their true feelings."

Without the versatile paper clip, life would be less rich and 20th-century progress impeded.

Leslie G. Rude
Hartwick College Hon. '74
Decorah, Iowa

They lit up our lives Many ingenious inventors improved on candle production, on kerosene lamp efficiency, and on whale-oil lamps of early times. But not until the electric light did mankind transform life at night into an easy continuation of daytime activities.

Two inventors from the Connecticut Western Reserve within six months of each other combined to invent the electric light: Charles Brush on April 29, 1879, produced the arc light and Thomas Edison in October produced the incandescent lamp.

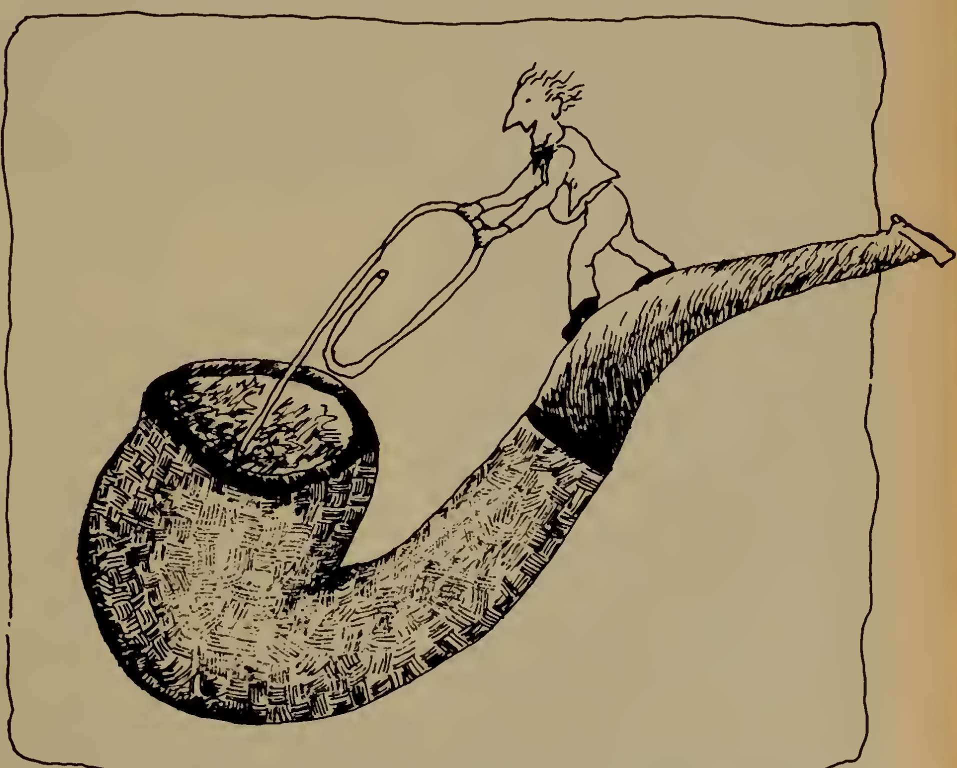
Both inventors helped to revolutionize the way mankind lives: The arc lamp for street lighting, powerful searchlights, and movie projector illumination, among other uses; the incandescent lamp for floor lamps, ceiling fixtures, and countless other applications.

Clay Herrick, Jr.
Adelbert College '34
Case Western Reserve University
Shaker Heights, Ohio

You don't know me, but . . . Just think of what it must have been like for prehistoric man to use a stick to make an abstract mark on the ground to share his thoughts. The step from not recording ideas to recording them is as much a quantum leap as the jump from counting on one's fingers to using a giant computer.

Today, we might be awed by supersonic flights, computers, television, and a host of everyday marvels that we take for granted. Yet these would not exist without a system of recording the many languages necessary to communicate one person's thoughts and ideas to another.

The recording of thoughts and ideas is an invention each one of us carries within us, locked up in our potential.



Each one of us can add or modify the original discovery or invention to suit our needs.

While you are reading this, even though you don't know me, I am sharing my thoughts with you. Just think what a powerful invention the recording of ideas is. You are able to benefit from such great people as Moses, Aristotle, Socrates, Plato, Emerson, Thoreau, and Einstein by reading their recorded ideas.

The accumulation of knowledge is what separates humankind from the rest of the animal kingdom. We would still be back in prehistoric times if we had to learn everything firsthand.

Sidney Madwed
WPI '49
Fairfield, Conn.

Right in front of his eyes There were many possible explanations for the absence of stars from the night sky, air pollution being the most likely, in the small factory town where I lived as a boy. But why was the moon so big? Like a fuzzy, yellow beachball that blocks out the sky just before you catch it, the moon dominated the heavens.

Indoors my surroundings had a dreamlike quality. In church, pictures of fluffy, white clouds floated across the sanctuary, illuminated by the glow of candles with enormous flames that could have been breathed only by enormous dragons.

I might have continued living in this peculiar atmosphere had I not realized that my sixth-grade teacher wasn't writing on the blackboard with invisible chalk. Now, no self-conscious 11-year-old looks forward to wearing eyeglasses, but when I was fitted with my first pair, a whole new dimension of experience opened up for me. I saw that there were stars, however faint, in the night sky. The moon grew smaller but more distinctly bounded, and the man reputed to live there smiled hello. The white clouds on the sanctuary wall turned into sheep and the candles did their work without the help of dragons. My sixth-grade teacher used real chalk to list real homework assignments on the board.

I corrected these old misperceptions and discovered new worlds of color and form. For months, I made excuses to go to the supermarket, where I must have looked like a visitor from Mars staring at the endless rows of brightly colored packages that no longer blended together in dull orange clusters but stood out in

bold displays of individuality.

Nearly three decades later, I would be tempted to take my almost perfectly corrected vision for granted were it not for the fact that I scarcely recognize the fellow whose face I shave every morning—until I put on my glasses.

From my own myopic point of view, when I think about millions of us running around bumping into one another by the light of a fuzzy, yellow moon, I can't imagine how we ever got along before they invented eyeglasses.

Alan Bodnar
Villanova '69
Wellesley, Mass.

From output back to input Feedback is one of the most powerful concepts of all time. It has been applied not only to the machine but to the mind, the person, the group, and the society. Edwin Armstrong's positive feedback amplifier made early radios much better by increasing the gain and narrowing the band width. Two decades later, Harold S. Block did the reverse, using the same negative feedback concept that was regulating the speed of steam engines a century before.

Perhaps we were slow to start applying feedback, but today it is basic to our machines, our systems, and our learning

What 8th-graders couldn't live without

Our special thanks go to two 8th-grade teachers who opted to assign the contest topic to their gifted classes: Donna (McCubbin) Moulton at Lake Braddock Secondary School in Burke, Va. (she attended Western Maryland College), and Karen Randlev, at Albany Middle School in Berkeley, Calif. (she's a graduate of the Hopkins Writing Seminars program).

Bubble gum, TV, telephones, computers, Teddy bears, deodorant, and comics were some of the youngsters' favorites. But plastic, pencils, paper, aspirin, and microwaves caught their fancy as well, among many other things. Here's a small sample of the creative energy unleashed.

The link between two points Rope is essential to many basic ideas. It helped build the pyramids, it helps build houses, cross valleys, build bridges, and it helped to conceive wire. Without wire, we wouldn't have computers, electrical appliances, stringed musical instruments. Rope also spawned wicker. Thread for clothes and sewing wouldn't have come about without rope. Insulation for wires wouldn't be needed if there were no wires.

Then there's the pulley. That's a pretty important piece of equipment in any building environment. Cowboys wouldn't have anything to "head 'em up" and "move 'em out" with. What need is there for a knot when there is nothing to tie a knot in! Shoelaces are made from thread that wouldn't have come about without rope. We would all still be using loafers and sandals if we hadn't thought of rope.

Brett Boessen
Lake Braddock Secondary School

The model for a better world Have you ever sat down to do some serious work and found yourself absorbed in the complexity of a bucket of Legos? Time and time again, young children and their elders alike have pondered the endless building capabilities of these tiny materials, little plastic bricks ranging in size from a centimeter to a couple of inches in length.

Because of their plain, generic design

and ability to be interchanged, they could prove extremely useful in our world today. Laugh at my conjecture, but the world could be using modernized, plastic furniture next time you turn your back. These marvelously plain, plastic blocks and things could also prove useful in designing communities. If changes were to be made on a typical architect's layout, the set would need to be totally redone, whereas a Lego layout would need only an interchange of blocks and a coat of paint.

In conclusion, the Lego, although thought of as a mere toy designed to stimulate the mind of an 8-year-old, has extensive possibilities in the fields of architecture, interior design, and many, many other fields to come.

Scott Matthews
Lake Braddock Secondary School

When you haven't got a goat Do you remember back in the days of renting goats to trim grass? Well, I do. On the Fourth of July, 1892, we were having a party and no goats were available where we usually rented. So we had a choice. We could rent cattle, and have cow patties. We could rent horses, but they were too big. Or we could rent goats from a different farm. We decided upon cattle, but the extra hours spent cleaning were not rewarding because Aunt Betsy stepped in the patty we forgot to clean up.

Oh, and if someone should ask the question, "Why do we mow our lawns?," just tell them this. First of all we like to mimic the British. Second, we don't like grass tickling our legs when we walk through it. Third and finally, mowed grass, in our culture, is a prettier sight than unmowed grass.

What if people couldn't afford to rent goats? Then what did they do? They clipped it by hand. Just imagine crawling on hands and knees for eight hours, cutting grass in the back yard with three-inch scissors. I don't think I could do it.

Why do we need power lawnmowers anyway? We need them because, as our world develops and becomes more advanced, we have less time to spend doing yardwork and mowing the lawn. So think about it—the power mower is a big improvement. I think it is a gift from heaven!

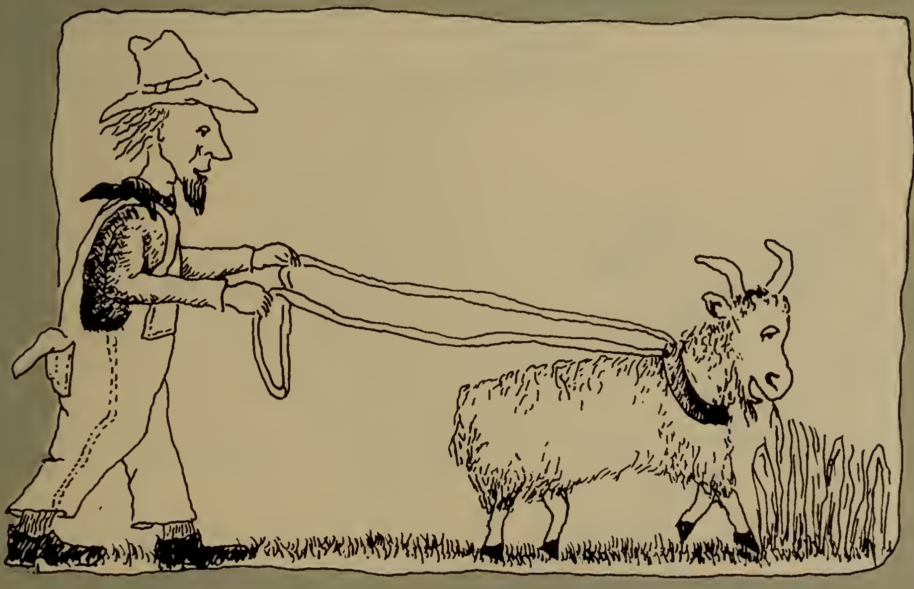
Rachel Sours-Page
Albany Middle School

Light years ahead of the rest The light bulb. An object we use with little thought. It is a steady and powerful source of light that can be moved around at will, that can't blow up in your face. Entertainment would be completely different if we didn't have the light bulb. No night sports games, no movies, no lights on your stereo, no photography, etc. No warning lights on dangerous machinery, no landing lights at the airport.

Some people, like backyard astronomers, thieves, and film developers, wouldn't mind if the light bulb hadn't been invented. But most people like the light bulb. It allows you to do your homework late at night. It allows you to work on something outside until it is real late. Light lets you see small differences in the color of objects. There are so many reasons to like the light bulb.

You may say electricity is more important than the light bulb, but it was discovered, not invented. The wheel was important, but there are other ways to get around. The computer could also be given up. There was life before television and radio were around. There are other ways of communicating than the phone. None of these would change life as much as the light bulb.

Mike Plumpe
Lake Braddock Secondary School



Putting teeth in the American Dream "Oops! Sorry, my upper teeth just fell out," is something that might have been an everyday expression if it weren't for the toothbrush. A toothbrush is of great importance even though you may not know it. We depend on them to get the remains of our previous meals off of our teeth and down the drain. Can you imagine what a beautiful shade of yellow our teeth would be after 20 years of not brushing? Actually, they probably wouldn't be yellow; more like a beautiful shade of brown—wood brown. That's right, if it weren't for toothbrushes, 99 percent of our population's teeth would rot away and we would all have to get wooden teeth (probably). But actually, it probably would have been better for the dentists.

Can you imagine how our world would change if, instead of some kids complaining about getting fluoride treatments, it would be: "Oh no! I just remembered! I have to go to the dentist and get my teeth varnished today."

In fact, kids' grades would have to be adjusted for all the time when they had gotten a coating on their teeth and had to leave them at home to dry. When their teachers called on them, they wouldn't be able to answer, so they'd get bad marks. Not to mention the thought of how bad our breath would smell after 10 or 12 years of not brushing. We probably couldn't even talk to each other. The smell would be so bad, we couldn't even have school! Young America would be stupid and uneducated. Once the older generation died off, America would crumble! I hope you see the importance of the toothbrush, and don't forget to brush twice a day, for America's sake.

Kristi Kimball
Lake Braddock Secondary School

process. Applying feedback will continue to solve engineering and other world problems.

F.G. Toce
WPI '60
Clay, N.Y.

Getting a handle on daily life After prehistoric man loosened up a boulder in the ground with a tree branch, he later found that the task became easier by using a longer branch. Thus leverage was born. This was man's first power tool.

And it still thrives today. Let us look at a jutting crane as it hoists up a weighty steel beam to be placed at the top of a new building. Such a procedure is the result of a long history in building construction that commenced at least as early as the pyramids, the Easter Island statues, and Stonehenge—all requiring feats of power.

Advancing to the 20th century, we see examples of leverage in automobile transmissions that provide various powers and speeds. House painters easily pull up their heavy scaffolds through means of several pulleys. In 1936 Frank Lloyd Wright employed cantilever principles when he built Fallingwater, the house that straddled a waterfall.

As to the saving of lives through leverage, consider tourniquets and emergency hand-brakes for motor vehicles.

Leverage can help a handicapped person, such as my wife, who has Lou Gehrig's disease. As her degenerative condition progressed, she could not turn handles, knobs, or dials. I came to the rescue by adding leverage. With a little imagination, I made 20 devices around our house. Now my wife can turn faucets, TV dials, doorknobs, locks, burglar-alarm keys, lamp switches, the attic exhaust fan switch, and the rheostat of the broiler. Also, with the help of leverage, she now can open the automobile door from both the inside and the outside and she can even press down the flush handle of the toilet.

Theodor Podnos
Peabody Conservatory '33
Teaneck, N.J.

One thing led to another When we first think of the word "thing," we may not be overly impressed by it. But without it, I contend that the English language would be crippled. A noun is a word that can be classified as a person, place, or thing. The "thing" classification is by far the largest. The word itself provides a neat solution when we do not know what word we are looking for. When we have a jar that we cannot get the lid off of, we all reach for that round rubber "thing" that gives us the strength of 10 men.

Our teachers always told us not to use the word "thing" if another word would suffice. However, even Shakespeare's Hamlet could not resist: "The play's the thing wherein I'll catch the conscience of the King." Even though we claim not to like to use the word, we just cannot leave it alone. Sometime back, somebody, somewhere, asked someone to hand him that thingamajig. The person who handed it over must have known what the other one wanted, for the giver started using the term, too. The rest is history.

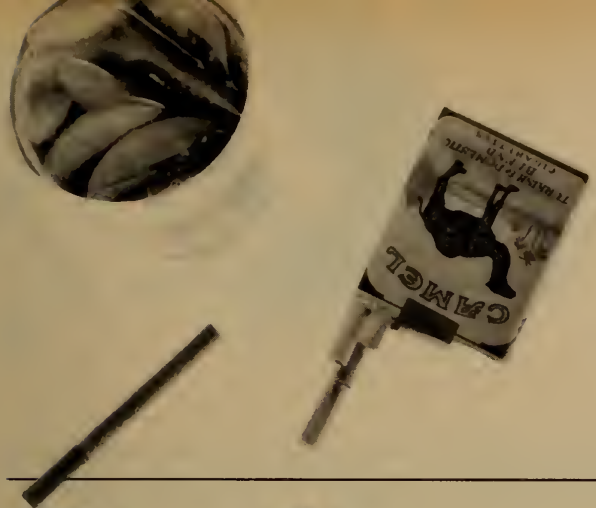
Over the years, "thing" has also taken on a frightening quality when used in certain contexts, largely due to the sense of the unknown that it connotes. We have a pretty good idea what the classic horror movie, *The Thing* is about. By definition, however, it could be about a killer paper clip, a nasty wing nut, or a macabre melon-baller. The title of the movie, *The Swamp Thing* loses much of its intended impact if it is changed to *The Swamp Guy.*

We all take the word "thing" for granted, but it is an integral part of our language. Before its invention, people must have really floundered when they wanted to refer to an as yet unnamed object. If nothing else, I have proved that some people can go on about anything.

Rob Funk
Villanova '80
Downingtown, Pa.

Paper!
No paper
No da Vinci drawings
No birthday cards
No *New York Times*
No Matisse collages
No origami
No *Johns Hopkins Magazine*
No "Far Side"
No print-outs
No folding money
No envelopes
No letters
No stamps
No contest

Loreen Barry
Hopkins '66
McLean, Va.



Ordinary Addictions

Nicotine and alcohol are a part of daily life. They're also dangerous drugs.

By Joseph Alper

Photographs by William Denison

Cigarette smokers and alcoholics, along with junkies and coke heads, are addicts in every sense of the word. "Because alcohol and nicotine aren't illegal, because they are so common, because we don't connect them with crime, we don't think of them as addictive drugs," says Charles O'Brien, chief of the department of psychiatry at the Veterans Administration (VA) Medical Center in Philadelphia. "But they are just as addictive as cocaine and heroin, and their abuse costs this country far more in terms of increased health care costs and human suffering than all other drugs combined."

According to the National Institute of Drug Abuse, there are 500,000 heroin addicts and between four and eight million cocaine addicts in the United States. But there are more than 50 million cigarette smokers in the U.S., according to the Congressional Office of Technology. The National Clearinghouse for Alcohol Information estimates that there are approximately 10.6 million alcoholics.

Comparing nicotine to heroin, for example, may seem like comparing apples to oranges, but consider this: Of the two drugs, says Andrew Weil, professor of psychiatry at the University of Arizona College of Medicine, nicotine is far more addictive. Nicotine addiction kills an estimated 350,000 people every year, compared to roughly 3,000 deaths related to heroin addiction. Heroin causes human suffering, but the two-pack-a-day smoker, riddled with emphysema, suffers as well, as does his or her family. "If you want to talk about the death penalty for drug pushers, why not start with tobacco industry officials," he says.

In a position paper on chemical dependence, The American College of Physicians makes no distinction among addictions to social drugs (alcohol, nicotine, and caffeine), licit prescription and over-the-counter drugs, and illicit drugs. People can become physically and psychologically dependent on any of them, and that, states the report, is bad from both a medical and social standpoint. And according to the U.S. Center for Health Statistics, alcohol and drug abuse costs over $50 billion yearly, and cigarette smoking another $22 billion, in health care costs, accidents, violence, and loss of productivity. Other estimates tally the toll even higher: Alcoholism and alcohol abuse may cost as much as $120 billion each year in increased medical care; work time lost; and losses from crime,

fire, and auto accidents.

Illicit drugs grab most of the headlines, but nicotine and alcohol head the list of addictive substances taking the highest toll in social terms. Next come such legal drugs as over-the-counter diet aids, antihistamines, cough medicines and prescription stimulants, sedatives, and narcotics. In fact, the General Accounting Office has identified licit drugs—often taken initially at a physician's recommendation—as one of the fastest rising causes of death in the United States.

What ties together such seemingly disparate substances as nicotine, Valium, and heroin into this dangerous class of addictive compounds? They have little in common chemically, and they work by different biochemical mechanisms. But they do share some common properties important in leading to abuse and addiction, according to Donald Jasinski, director of the Center for Chemical Dependence at Francis Scott Key Medical Center in Baltimore.

All addictive drugs are psychoactive euphoriants—they work in the brain to produce feelings of well-being and elation. A drug's euphoric effects, which can last from a few minutes to a few hours, are what get a person to take the substance in the first place. The speed with which a drug produces its characteristic high is often related to how quickly it gets to the brain.

Sooner or later, says Jasinski, a person develops tolerance to the drug's effects and has to take more of the drug to get the same sense of well-being. In some cases, such as with cocaine, the person can never experience the original high no matter how much of the drug he takes. At the same time, however, the person develops a physical dependence, too—he or she will feel rotten without it. The person has become an addict.

Over the past decade, researchers have attempted to learn what biochemical changes occur to make an addict out of a casual user. Although most of the details are still unclear, studies in hundreds of laboratories have shown that many addictive drugs work in the brain by interacting with large, complex molecules called receptors. However, receptors do not exist merely to bind addictive drugs.

Dozens of different types of receptors reside in nerve cell membranes and are involved in transmitting information between nerve cells. Each type of receptor binds to a specific chemical, called a neurotransmitter, produced in the brain. For example, certain nerve cells produce a neurotransmitter called methionine enkephalin. Other nerve cells contain a receptor that binds methionine enkephalin in much the same way that a key fits into a specific lock. When one nerve cell wants to communicate with another, it releases a tiny amount of methionine enkephalin, which travels to the second cell, binds to its receptor, and in doing so delivers its message. Methionine enkephalin has been found in areas of the brain associated with pain perception and mood and, together with other similar endogenous compounds, has been called "nature's opiate."

Addictive drugs can fit into this system by mimicking a neurotransmitter and binding to its receptor. Nicotine binds to receptors for acetylcholine, one of the most common neurotransmitters in the brain; among its many roles, acetylcholine is involved in memory storage, in learning, and in maintaining general alertness. Opiates—morphine, codeine, opium, heroin, and others—bind to the enkephalin receptor, also known as the opiate receptor. Amphetamines, or "speed," bind to receptors for the neurotransmitter dopamine, which controls movement.

Other drugs interfere with the release or destruction of the neurotransmitter. Cocaine, for example, interferes with a neuron's ability to get rid of dopamine once it has transmitted its message. Then the nerve cells remain stimulated far longer than normal, producing euphoria.

Recently, researchers at the National Institute of Mental Health discovered the receptor for Valium and similar sedatives. Although the details are not known yet, this receptor is involved in some way with the neurotransmitter gamma-aminobutyric acid (GABA). Alcohol and barbiturates, or "downers," also affect GABA's actions, but according to Jasinski, "alcohol, Valium, and barbiturates seem to work at different sites in the brain." He adds, however, that the three substances must share some biochemical properties because Valium and barbiturates can help a person through alcohol withdrawal.

The ability to interfere with a neurotransmitter-receptor system is not all that makes a drug addictive, however, since many drugs, both useful and harmful, bind to brain receptors. What sets addictive drugs apart is that they profoundly alter the brain's response to the molecule that is supposed to bind to the receptor. For example, repeated doses of morphine turn off the brain's production of enkephalins, perhaps because the enkephalin-producing cells are fooled into thinking they are making too much neurotransmitter. But the brain needs something to operate the enkephalin receptors. So once this shift has taken place and the natural molecule is lacking, morphine must continue to fill the void. The nerve cells, and thus their owner, are addicted to morphine.

When an addict goes through drug detoxification, the brain must adjust biochemically. During opiate withdrawal, for example, the brain must start producing its own enkephalins. This takes two to three days, however, and the system does not return to normal for up to five weeks. During that time, and occasionally thereafter, the addict feels intense cravings for the opiate. According to Jasinki, researchers have few clues as to the biochemical causes of craving.

Researchers also do not know enough about the interaction between addictive drugs and receptors to develop effective means of preventing or alleviating drug addiction. But they are making progress. Heroin overdoses, for example, can be countered in a matter of seconds by a compound that displaces the opiate from its receptor; the drug does not end the addiction, however. Similarly, Yale University researchers have found that antidepressant drugs, which affect the dopamine neurotransmitter system, can block cocaine's euphoric effects and greatly reduce a person's cravings for the drug.

Besides the basic physiological mechanisms at play in addiction, most researchers believe there are common psychological components that are just as important in perpetuating a person's habit, whether it be heroin or cigarettes. Until a few years ago, psychologists believed that people hooked on any behavior had an "addictive personality," a basic and unchangeable psychological flaw that left them unable to show restraint in the face of temptation. But this would imply that a nicotine or heroin addict could just as easily be an alcoholic or a junkie or even a compulsive eater. According to Richard L. Solomon, psychology professor at the University of Pennsylvania, "Studies show this is not the case. Most people have specific addictions. Individual biochemistry is very important and each individual seems to have one drug, or at most a few, he or she prefers."

Current theories on the psychological aspects of addiction place heavy emphasis on learned, or conditioned, responses—the addict learns to engage in the addictive behavior in response to some stimuli. The VA's O'Brien says this is very similar to the classical conditioning first studied by Pavlov many years ago. "Besides the physical compulsion to take a drug, the addict has often learned to use that drug as a response to a

ALCOHOL: America's favorite drug

Costing as much as $120 billion annually and affecting at least 10.6 million Americans, alcoholism may be the country's most serious drug abuse problem. Yet most of its victims will suffer needlessly from chronic health, social, financial, and legal problems without ever guessing they are addicted to the nation's most popular drug.

Most people who drink will never develop a drinking problem, yet each year thousands of "social drinkers" slide into alcoholism, developing a chemical dependence. Tolerance appears, so that it takes more alcohol to achieve the same effect. Early symptoms emerge slowly and subtly. Alcoholics drop activities that interfere with drinking, or friends who disapprove. They may complain of vague physical problems, such as tension, diarrhea, insomnia, or unexplained bruises. The brain is affected, even when the person is not drinking. Alcoholics may become more forgetful, irritable, and impulsive, more prone to accidents. In general, drinking causes the person recurring trouble, first to relationships with friends and family, and finally on the job.

Warning signs can go undetected because, until recently, few doctors have been trained to look for signs of chemical dependence in patients. Close friends or family may avoid confronting alcoholics or even help them to conceal the evidence of their problem. Alcoholics often deceive themselves by imposing restrictions that give the illusion of control, drinking only beer or wine, only at home, or only after a certain hour.

The ability to control completely one's drinking habits, rather than when or how much is drunk, separates the normal drinker from the alcoholic. Members of Alcoholics Anonymous (AA) often recommend this test: Can you have one drink—no more, no less—every day for 30 days? A normal drinker can, with no exceptions at parties or after a hard day at work. An alcoholic cannot.

Treatment for alcoholism is the same as for other types of chemical dependency: detoxification, support from family and peers (as in AA), and complete abstinence from alcohol and psychoactive drugs, including tranquilizers. Withdrawal is physically and emotionally difficult, but those who break the habit notice sudden, often dramatic improvement, even in health problems they had no idea were tied to their drinking. Treatment succeeds in about 75 percent of people.

Untreated, the disease can easily progress to the point that physical and social symptoms become devastating. Alcoholics can become depressed, anxious, and quick to anger; can experience heart palpitations, hypertension, sexual dysfunction, nightmares, and digestive problems; and can get into fights and auto accidents. The liver, heart, and brain are especially vulnerable, but no body system escapes. Between slow poisoning and sudden catastrophe, alcoholics die an average of 11 years younger than the general population; one in 10 deaths in the U.S. is thought to be alcohol-related. A recent hospital survey showed that 30 percent of patients were alcoholics.

For the normal drinker, it is relatively simple to avoid trouble by being alert to the warning signs of alcohol abuse. For the abuser, it is difficult—but potentially lifesaving—to take immediate steps to stop.

—Julia Ridgely

certain situation to the point where it becomes automatic," he said. Cigarette smokers, for example, often light up—without realizing they are doing so—when confronted with stressful situations.

On the basis of this theory, O'Brien and others around the country are trying to develop methods to disconnect the stimulus-response situation that can make breaking an addiction harder than just overcoming physical dependency. "It's fairly straightforward to break a person's physical addiction to a drug," says O'Brien. "But it's the psychological factors that account for the high relapse rate among addicts of all types. Those are what we have to learn to change if we are going to be successful at curing drug addicts of their addictions."

Jasinski says that an alarming trend has been for people to have multiple drug dependencies. He does not believe this supports the old "addictive personality" theories, but rather is a function of the widespread availability of a large number of drugs. "It used to be that the only drug that was easily available was alcohol, so people became alcoholics," he says. "But now, there's Valium and speed and pot and crack and just about any drug you want."

The notion that legalizing drugs will reduce the number of drug addicts is "just plain stupid," he adds. "Look at cigarettes—they're legal and we have 50 million cigarette addicts. Look at alcohol—it's legal and we have 10 million alcoholics." The greatest influence that makes people experiment with addictive drugs, whether cigarettes or heroin, is peer pressure. "Legalizing drugs will not end peer pressure. Only good educational programs that start early in life have a chance of keeping people from trying drugs and getting hooked on them."

Joseph Alper is an award-winning science writer who lives in Baltimore.

CAFFEINE: The cup that cheers

For four-fifths of the world's people, no day is complete without a cup of coffee or tea. They look forward to the fragrance and taste, the feel of a warm cup in their hands, the chance to take a break—and the slight caffeine jolt that seems to wake them up, clear their minds, and get them ready for work or conversation.

Could these people be addicts? Recent (and much disputed) studies have found evidence of addiction to caffeine in the narrowest medical sense of the term. "Overdoses" of caffeine can produce unpleasant side effects ranging from the familiar "coffee nerves" to chronic anxiety, depression, abnormal heartbeat, and stomachaches. Constant use may be reinforcing and can lead to increased tolerance. Suddenly quitting—even over a weekend—can cause such withdrawal symptoms as headaches, fatigue, and sleepiness.

But absent from caffeine users' lifestyles are the more serious aspects of addictive behavior. Caffeine doesn't control people. Probably no one has ever committed a crime for a cup of coffee or spent too much of a paycheck buying Twinings tea at the gourmet shop. Cutting down or quitting is relatively simple, thanks to the explosion in the market for products with little or no caffeine. Most people are now aware that caffeine can be found not only in coffee and tea, but also in some sodas, cold medicines, pain relievers, and even (in small doses) chocolate. All of this makes it fairly simple for overusers to eliminate the problem—provided they recognize it.

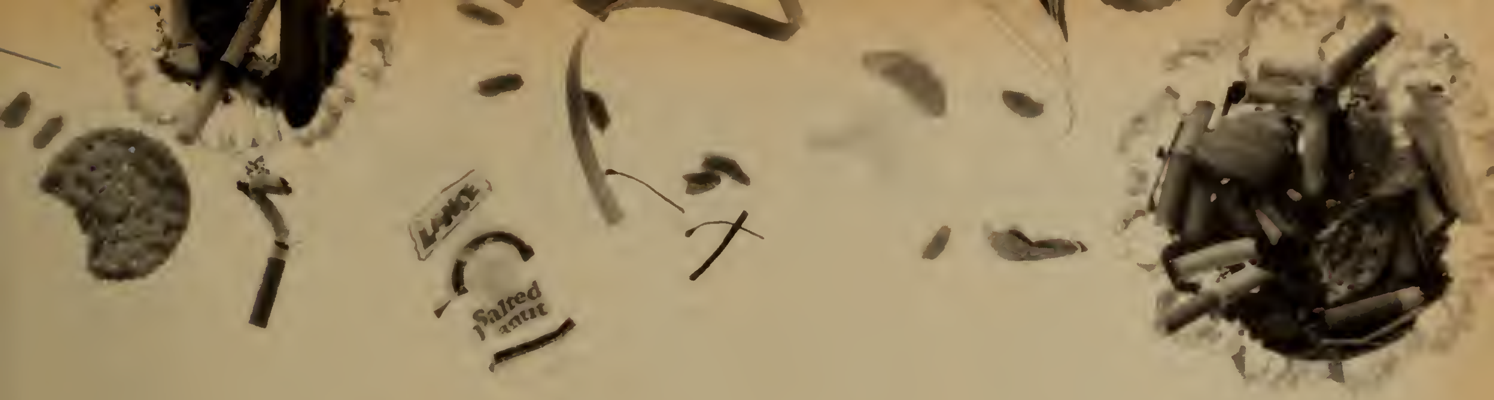
As with any drug, "too much" is the amount that begins to produce unwanted side effects. The average safe dose of caffeine for adults is about 400 milligrams, the amount that can be found in two five-ounce cups of drip coffee or about eight cups of tea. Many people accidentally exceed this dosage by not counting their trips to the coffee pot or by not recognizing other sources of caffeine. They may suffer from "coffee nerves," but never make the connection between the symptoms and the cause. For this reason, it may be a good idea for heavy coffee or tea drinkers to count their cups on an average day and, if they are drinking too much, gradually cut down or substitute decaffeinated products.

So far, there is little evidence of serious health risk to the general population from caffeine. The medical community has challenged widely publicized studies of possible links between the substance and pancreatic cancer, high blood pressure, and increased smoking.

Even so, some people should completely avoid caffeine: those with gastric or duodenal ulcers (caffeine may stimulate production of acid in the stomach), pregnant women (heavy caffeine users have a higher rate of stillbirths, premature births, and low birthweight infants), and nursing mothers (a baby can actually be kept awake by a cup of coffee its mother drank). But for most people, the best current advice is that, so long as you don't overdo it, you can go ahead and enjoy your cup of coffee.

—Julia Ridgely

Researched by Louise Sutton Porter.



CIGARETTES:

Why breaking the habit is hard to do

By Ann Finkbeiner

"Quitting is pretty awful," said Timothy Moran, psychologist at the Johns Hopkins School of Medicine, talking about breaking his cigarette addiction. "I've actually quit smoking twice in the last ten years. The first time I was off for two years but started again after my father died. This time, I've been off for a year. And still, three or four times a day I think a cigarette would be so nice."

Moran is not alone in his struggles. Or in his failure to quit. A 1984 survey by the U.S. Congressional Office of Technology Assessment estimated that over 50 million Americans are addicted to the nicotine in cigarettes. Of those, nearly 45,000 try to end their dependence every day, suffering through symptoms that include anxiety, irritability, severe headaches, and weight gain.

"The most difficult thing about quitting was to sit down and write—no question I couldn't concentrate," continued Moran. "My productivity went through the floor. And the anxiety: it's similar to clinical anxiety attacks—sweaty palms, racing heartbeat, your stomach knots up, you feel an urgent need to get out of whatever you're in."

Nicotine is a powerfully addictive drug—more so than heroin, according to Donald Jasinski, director of the Center for Chemical Dependence at the Francis Scott Key Medical Center in Baltimore. Quitting is a tough battle. Two-thirds of those who quit are smoking again within six months and only 20 percent of those who quit go a year without smoking. True, giving up cigarettes is not life-threatening, as kicking a heroin or cocaine addiction can be, but that's little comfort to the person craving that first-thing-in-the-morning smoke.

Why smoke at all? "You smoke," said Moran, "not because of the negative consequences of not smoking—those take a while to set in. You smoke because you want the cigarette. A cigarette is relaxing, calming, and the smoke tastes good."

Some of nicotine's psychological and physiological effects, in fact, have a biochemical basis. For example, Edythe London, neuropharmacologist at the National Institute of Drug Abuse's Addiction Research Center in Baltimore, has found that nicotine acts in regions of the brain associated with mood, anger, sexual arousal, pleasure, and concentration. Studies have shown that smoking improves a person's concentration for approximately 30 minutes. Others have found that nicotine changes the way the body metabolizes fats, which could account for the fact that, on average, smokers weigh less than non-smokers. Compared to other, more dangerous substances, "nicotine is inexpensive, legal, widely available, widely accepted, and does not disrupt cognitive or motor performance," says Jack Henningfield at the Addiction Research Center.

Nicotine could be left at that, a comforting, socially innocuous drug, except that nicotine, tar, carbon monoxide, the smoke particles inhaled during smoking, and the nitrosamines in smokeless tobacco are all toxic. Studies, replications of studies, and still more studies show, in the words of U.S. Surgeon General C. Everett Koop, that "smoking is the chief, single, avoidable cause of death in our society and the most important health issue of our time."

On the average, a 31-year-old, two packs-a-day smoker will live 8.1 years less than a non-smoker. Smokers are twice as likely to die from heart disease—30 to 40 percent of deaths from coronary heart disease are smoking-related—and 10 times as likely to die of cancer. For example, smoking causes 80 to 85 percent of deaths from lung cancer and 84 percent of larynx cancers. Smokers also have greater risks of dying from cancers of the mouth, esophagus, bladder, and pancreas. They also develop more peptic ulcers than non-smokers.

They don't suffer alone. "Passive smoking," or inhaling the tobacco smoke in a room, has become a hot issue indeed. The spouses of smokers have more allergy attacks, angina, asthma, and lung cancer. Children who live with smokers have more respiratory illnesses. Babies born to smoking women weigh less at birth and have less oxygen in their tissues than babies born to non-smokers. This past December, in releasing the Public Health Service annual report on smoking—the first to focus entirely on risks to non-smokers—Surgeon General Koop stated that there is enough medical evidence on the harm of being exposed to cigarette smoke to justify strong measures that segregate smokers from non-smokers at work and at home.

Nicotine, without smoke, speeds up the heartbeat, whether you are awake or asleep. It narrows by half the width of arteries. Its best use is as an insecticide: fill a greenhouse with nicotine fumes, and next morning all the bugs are dead.

Faced with these unsavory facts, why do people keep smoking? "It's not because they want to—they don't," said Diane Becker, who heads the Johns Hopkins Hospital's smoking cessation programs. "The majority are not saying, 'What the heck.' It's that they're hooked."

Nicotine is an addictive drug, although the tobacco industry disputes this assertion. A drug is considered addictive, says Henningfield, if it meets the following three criteria:

1) People who take the drug must regulate their dosage so the amount of it in their bodies stays constant over time. Smokers will smoke more short cigarettes than long ones. Similarly, they smoke fewer high nicotine cigarettes than ones low in nicotine.

2) The drug must act in the brain to produce euphoria, making the user want to keep taking it. Researchers have long known that nicotine interacts with cells in the brain involved in controlling mood, memory, and general state of awareness. As far as causing euphoria, nicotine's high is very similar to cocaine's, say people who have tried a variety of addictive drugs.

3) People who quit taking the drug experience symptoms of withdrawal. Most people who quit smoking go through what Moran did. "Nicotine withdrawal is less dramatic than opioid or sedative withdrawal," says Henningfield, "but it's still pretty detrimental to the quality of peoples' lives."

Studies at the Addiction Research Center have shown that quitting cigarette smoking causes impatience, irritability, anxiety, stomach upsets, increased appetite, weight gain, temporary insomnia, and concentration lapses. According to Henningfield, a smoker's short-term memory suffers within eight hours of quitting time; various math skills deteriorate, too. Those abilities still show deficits ten days later. "Nicotine may not enhance cognitive performance in non-smokers," said Henningfield, "but it sure messes up smokers who quit." The most unpleasant symptom of withdrawal is a really powerful desire for a cigarette. "Most patients feel normal physically within approximately two weeks," said George Bigelow, a psychologist at the Hopkins medical school who researches the behavior of smokers and quitters, "but craving for cigarettes persists anywhere from three months to 10 years."

As a result, said Henningfield, "most people don't just quit and stay quit. Some do, but I don't understand them, any more than I understand a football player with a broken collarbone finishing a game." About 15 percent of those who enroll in smoking cessation programs cannot stop at all. Two-thirds of those who do quit will start again in three to six months, a first-quit relapse rate similar to that for those addicted to opiates and alcohol. An ex-smoker risks relapse most when under emotional stress, or when in situations where he or she used to smoke—after meals, with a glass of wine, and with spouse or friends.

Not that quitting is impossible. In fact, a report entitled "Smoking and Health: A National Status Report," issued in November by the Department of Health and Human Services, shows that the percentage of ex-smokers in the U.S. population has increased to about 16 percent from only 5 percent in 1955. Smokers typically make several attempts to stop, and the chances for succeeding increase with each try. Bigelow and others stress that smokers should not consider themselves failures for their inability to quit on the first try or subsequent tries. "It is simply part of the process of quitting forever," he says. The chances of relapse drop significantly if the smoker can stay off cigarettes for six months.

The best way to get off cigarettes and stay off, according to Bigelow, is to go cold turkey rather than cut back gradually. The best way to go cold turkey is a combination of nicotine gum—prescription chewing gum laced with nicotine—and an organized program for smoking cessation.

Nicotine gum allows the smoker to work through the conditioned-response aspects of cigarette addiction before dealing with the physical component. "We use the gum mostly as an adjunct," says Thomas Pearson, head of the Preventive Cardiology Center at Hopkins.

"Cold turkey works for people who aren't very addicted and who may need neither the program nor the gum. Otherwise, we work gradually: we decrease blood nicotine levels and increase the feeling of success by switching to cigarettes with lower nicotine content without compensating with more cigarettes.

"We also give them techniques for dealing with craving, like exercise, cold liquids, chewing—they're mostly substitutions and distractions. Finally, we give them a quit date." On the quit date, the people are given the nicotine gum, told how and how long to chew it, and told to keep it where they usually keep their cigarettes. "Smokers using both a program and the gum," said Pearson, "have a 50 percent higher success rate."

If you read the literature on smoking and talk to those who treat smokers, one thing comes through clearly: nicotine is not something most people can trivially pick up and put down again. Pearson tells a story, for example, about a patient he encountered on a recent trip to China: "We saw a fellow in his forties who had been smoking Pall Mall regulars since he was 12. He smoked through colds, left church services to smoke, everything. He developed a squamous cell carcinoma that grew through his mouth and neck and required radical surgery. His surgeon told him his illness was 90 percent likely to have been caused by smoking. Two days after the endotracheal tube was taken out and he was off the respirator, he started smoking again. Later, they found the cancer had metastasized to his lungs. He smoked through the chemotherapy and all its unpleasant side effects. He was obviously unable to say yes or no, obviously not in control.

"Then, unexpectedly, the cancer in the lungs went away, and he decided he wanted to live to see his young son grow up. He quit smoking and now chews one piece of nicotine gum a day and carries the gum in his pocket in case of flashbacks. He's had a very rough time. If this wasn't addiction, I don't know what the hell is."

Ann Finkbeiner is a contributing editor of the Johns Hopkins Magazine. *Joseph Alper contributed to this article.*

Daffodil Dreams

Deep in winter, squirrels reshuffle the crocus bulbs and a gardener conjures up spring

By Elise Hancock
Art by Jan Adkins

It was mid-November before I had to put the garden to bed. Some annuals had died, of course, but the impatiens bloomed generously, lighting up the corners of the garden. Sage glinted blue by the fence, and the parsley, chives, and basil just kept coming. Every time I walked past, I'd pinch a leaf of basil and enjoy the aromatic summer whiff on my fingers. Each chilly day I'd think, is this the last of the garden? Is winter really here?

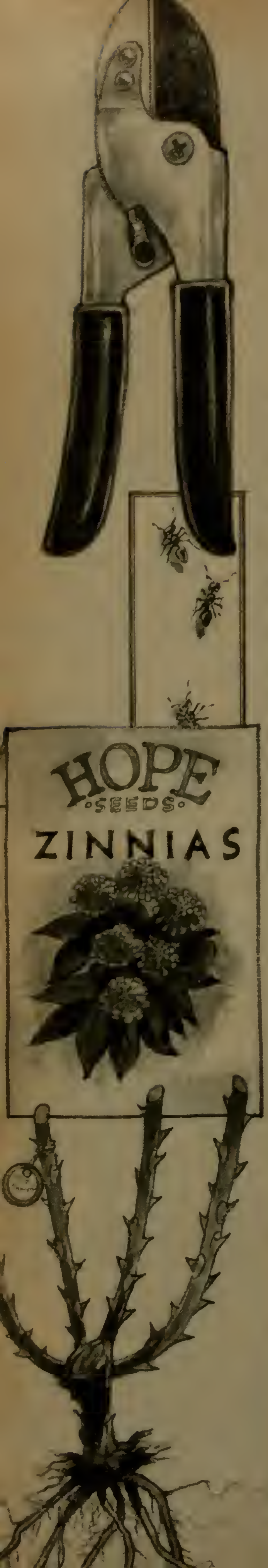
It wasn't, but it was coming. The euonymus put out red berries, which I hadn't expected—this is a new house and garden to me. The berries seemed like a gift. A pair of squirrels gathered walnuts from my neighbor's tree. At first, they scorned the nuts that had already fallen, but would run out on the limb to pick fresh ones. Sometimes, watching, I'd catch my breath, fearing a squirrel would fall. Surely he can't get *that* one! But he did. Then he'd sit upright to nibble off the hull, watching this way and that for intruder squirrels.

The gray tabby knew the squirrels were there. I'd often see her crouched, eyeing them hopefully. Once I saw her stalk one up a tree, until the squirrel turned head-down and scolded, locking eyes with the cat. Often he'd run up into the tip-top branches, where the cat cannot go, and turn around to jeer. The cat never gave up—she watched unblinking, fully alert, as if she thought the squirrel might laugh so hard he'd lose his footing.

These little dramas, too, were a gift of the season, and like the season they passed. When all the nuts were gone—even the leavings on the ground—the squirrels vanished. My chrysanthemums bloomed, then faded, and suddenly one morning it was all over. Basil and impatiens lay flat on the ground, frozen black, and dead leaves scuttered in the wind.

Pulling out the annuals, I found the squirrels had been before me: the flower beds were full of walnuts. A few were already sprouting. And I found snapdragon seedlings, even though I had no snapdragons this summer. Life is tenacious; living things want to grow and survive. Have you ever left a brick on grass? After three weeks the grass looks dead. But once you remove the brick, the grass soon greens again. It's hard to imagine what, in scientific terms, the "life force" might be, but it's there. While gardening, I touch it.

I don't think, exactly, while I'm gardening. I suspect it's a meditative activity. The hands proceed on auto-



matic pilot, pulling weeds or snipping stems, while attention floats. Perhaps I have vague thoughts about the smells of earth and foliage, or the sun, or the squirrels. Perhaps I stop to enjoy the leaf shadows, or to watch an ant colony. (I leave them alone. It's their garden, too.) Hours pass, and I come into the house tired, dirty, and completely refreshed. It's a small garden, but it opens on the cosmos.

Perhaps that is why the passing of the autumn garden seems so poignant. Life may be tenacious, but the seasons turn. Nothing can stop the procession of the equinoxes. Lovely as they are, the annuals die. Even the perennials will not last forever. I, too, have my seasons. So winter is an end.

It's also a beginning. While the garden rests in mulch, the bulbs are rooting underground, waiting for spring. If I were stupid enough to dig one up in January, I could see this. The earthworms are there, quiescent, waiting to resume aeration of the earth. The earth itself waits.

And I, inside in the warmth, plan far more beautiful gardens than my urban space can possibly accommodate. In the summer, I know better than to try roses—my patch lacks six hours of full sun. In the winter, I pore over catalogs, thinking there might be *one*, some one kind of rose that could tolerate less sun. I conjure up roses.

In winter, I dig through catalogs for scented plants—next year, I think, every annual will smell absolutely wonderful, will be chosen for spectacular scent. How about an all-white garden? You can see pale flowers in the dark, so a white garden is good for a working person. But it might be dull—how about a patch of zinnias, good old no-fail zinnias? No—they're nice to pick and bring into the house, but the garden is too small. They'd wreck the scale. Perhaps, then, a blue and white garden . . . blue looks so cool in the Baltimore heat, and white plants are often scented. In the daytime, flowers lure pollinating insects with bright colors. But many white plants are night-bloomers, and they must use odor to attract moths. Moonflowers, for instance, open only at night—huge white plates of glistening, fragrant bloom. If you come out early enough in the morning, they'll still be open, each four-inch bloom pearled with dew. I stop to remember moonflowers of a vanished garden. Really, the world is miraculously put together.

So white, I think, yes, definitely lots of white. But there are few plants that bloom blue. What blue flowers can tolerate shade and part-shade? Are any of them scented? Well, perhaps not all the flowers need to be scented. The blue sage was wonderful this year . . .

And so it goes. The winter garden is a garden of the mind, a fantasy garden. I'm not planning—I daydream gardens.

I do not know what I will truly plant next spring. Impatiens for sure—I have so much shade. Herbs, of course. But in fact most of the garden is already planted. Daffodils sleep in the myrtle. Day lilies and bee balm—both scented—are already thriving, and I hope the lily-of-the-valley is working underground. I stop to remember the fragrance, the delicate white bells I used to pick for my mother. Any proper garden *must* have lily-of-the-valley, or you couldn't be sure when spring came.

As it will. Already the days are growing longer.

Elise Hancock edits the Johns Hopkins Magazine.

Faculty and staff athletes come in all shapes and sizes. But from lunchtime joggers to long-distance racers, they thrive on combining science with the sporting life.

GOOD SPORTS

By Michael Shanley
Photos by Michael Carroll

They run, row, walk, and pedal; they stroke, serve, and swing. Some glide and float, others pound and sweat. Their skills range from championship level to strictly recreational.

But there are ties that bind WPI's faculty and staff athletes together: an appreciation for the camaraderie that even solitary sports provide, and an unflagging sense of purpose. The latter may involve specific goals like diet and health, but almost invariably, the athletes define their rewards in spiritual terms.

Most would agree with Administrative Secretary Katie Curran, who has been swimming laps midday at the pool in Alumni Gym for years: "It becomes very much a part of your life. It's so rewarding—just makes you feel so good—that you can't imagine *not* doing it."

Brian Savilonis, associate professor of mechanical engineering and a former national racewalking champion, puts it another way: "It clears the brain cells."

"I have to work out every day," says Herb Beall, associate professor of chemistry. "If I don't, I just don't feel right. I'm almost uncomfortable."

Those for whom exercise is an important part of life seem to find it difficult to express that feeling to armchair fans. David DiBiasio, an associate professor of chemical engineering who plays tennis and raquetball, says that "those who do it know what I'm talking about."

For WPI's many runners, their chosen form of exercise means a constant effort to balance the need for moderation and the drive to compete. Mechanical Engineering Professor Allen Hoffman '63, a charter member of the Footpounders (see sidebar) and former WPI cross-country coach, hasn't run in a marathon in about five years, but says, "Lately, I've felt the urge to try another one."

Carol Theisen, of the WPI student counseling center, has been moving in the opposite direction—away from long-distance running.

A few years ago, she was running up to 60 miles a week in preparation for the three marathons she completed, but she says she has now cut back to a "reasonable level." "I still run four or five times a week, swim a couple of days, and ride my bike on weekends if the weather's nice," she says, "but I'm not as compulsive as I used to be."

She also competes in triathlons, the training for which she says "got pretty crazy, trying to get in more than one kind

Hoops, being played here in Alumni Gymnasium, may still be the most popular sport for WPI's casual athletes. Right: Hans Thamhain, WPI's only ultra-marathoner.

of workout a day.

"I'm not that big on competition anyway. I mostly do it for fun and for my own emotional health. It's the social thing, too, especially here, because at noon so many faculty and staff members work out."

Running is the most popular but not the only athletic pastime at WPI. Last summer, the college fielded a faculty-staff softball team that gained fame as city champion of the Jaycees League.

On Mondays, Wednesdays, and Fridays, there's an aerobics session in Harrington that is open to all. "It's invigorating," says Co-op Director John Farley. "It's a buoyant atmosphere and a lot of fun because there are so many other people." When he's not at the aerobics class, Farley often spends the noon hour shooting hoops in Alumni Gym. He and a handful of other faculty and staffers join with students in regular games of pickup basketball.

"There's a tremendous range of talents among those who play. It's friendly, but competitive," explains Chemistry Professor Al Scala, credited with founding the noon games. He adds that basketball is a relatively safe form of exercise: "In 15 years, I've only been hospitalized twice: once for torn ligaments and once to have 12 stitches put over my eye, courtesy of [Admissions Director] Bob Voss."

Scala's road to fitness is perhaps typical of many. "After I got married, had kids, and went to grad school, my exercising stopped and I concentrated on my family and my profession."

Since returning to an exercise regimen some 15 years ago, Scala has emphasized the enjoyment aspect: "I view the heart-lung benefits as ancillary. I do it for a good time."

DiBiasio would like to have a good time playing handball, but can't find anyone who shares the same enthusiasm for the game he developed as a college student. He settles for regular tennis matches with chemical engineering colleagues Bill Moser and Tony Dixon, and Computer Center Director Jim Jackson.

History Professor John Zeugner was a tennis pro in the early 1960s, teaching fundamentals to club members in Sarasota, Fla. He still has a decent serve when he finds the time to play.

There are few faculty or staff fencers at WPI, so David Brown, assistant professor of computer science, is lucky to have his fencing club students to occupy his time and energy.

Brown took up the sport as a teenager. "I had always liked swords," he says, "and since I never particularly enjoyed having my face ground in the mud, most other sports were out of the question." While he enjoyed some success with

fencing clubs in his native England, he has concentrated on coaching since coming to the U.S. in 1974. He believes WPI's fencing teams have done well, considering that they must compete against colleges with larger sports budgets and fencing scholarships.

"It's a taxing sport, both mentally and physically," says Brown. "Someone once described it as chess played at lightning speed, and that's pretty close."

There are dozens of known cyclists, runners, swimmers, and who-knows-whaters on campus. On top of that, there are many who exercise in the privacy of their own homes, neighborhoods, health clubs, or golf courses unbeknownst to others. There's no shortage of avid golfers on campus, Steve Herbert '66, secretary of the Institute, and Roy Seaberg '56, director of special admissions programs, being perhaps foremost among them. Mark Ferguson, as you may judge by looking at him, is a dedicated weightlifter.

Their brows sweaty, smiles on their faces, these WPI athletes pound ahead unceasingly into the future.

Hans Thamhain: No such thing as too much for a triathlete

Hans Thamhain's day begins at 4:30 a.m., when he leaves the comfort of his Framingham home to run 13 miles with three friends.

He returns home to shower and gulp down breakfast, but still manages to arrive on campus before many students and faculty members have rubbed the sleep from their eyes.

For Thamhain, a professor of management, it's part of a year-round routine that often finds him running more than 100 miles a week. In a given year, he'll compete in three or four marathons and several triathlons, with several shorter road races thrown in for good measure.

"Sports keep me mentally and spiritually fit," he says. "They give me a sense of balance in life and a different way to express myself. I work very hard, and enjoy it, and I like to play hard."

But in spite of all the training required to prepare for marathons and triathlons, Thamhain says, "Sports don't consume me, but enhance me. I also have my work and my family and my social life, and they're very important to me."

Thamhain only started running 10 years ago at 40, a relatively advanced age for a competitive runner, but he quickly developed a love for long-distance racing.

"I usually run four marathons a year," he says, "two competitively and two just for training or fun." He trains hard to qualify for the Boston Marathon, then runs the race at top speed.

Marathons apparently weren't enough, so Thamhain began to compete in triathlons a few years ago. While any of these races—consisting of swimming, biking, and running—are extremely challenging, the most popular of these races—consisting, for example, of a one-mile swim, a 25-mile bike ride and a 6.2-mile run—seem easy compared with the endurance triathlon. Patterned after the original race, the Hawaiian Ironman, these events include a 2.4-mile swim, followed by a 112-mile bike ride and concluding with a full 26.2-mile marathon.

Such endurance events require not just intense training, but a plan for mentally transcending the inevitable pain that comes from pushing the body far beyond its normal limits.

Thamhain, who finished the Cape Cod Endurance Triathlon and hopes one day to run the Ironman, typically downplays the inner strength needed to compete on that level: "The training takes an awful lot out of you, but if you get through that and stand confident at the starting line, it's not too bad.

"I said to myself, 'One lousy marathon and this thing's all over.' "

"The swim is nothing unusual, and the biking shouldn't be too bad. It's the marathon that gets most people. When I got off the bike, I had been out eight hours, so I just said to myself, 'One lousy marathon and this thing's all over.' It was a struggle, but it's a struggle for everyone toward the end."

Thamhain competes in shorter, more humane triathlons during the summer, and has twice qualified for the U.S. Triathlon Series Race of Champions in Hilton Head, S.C. To qualify, an athlete must have taken one of the top 10 places in a regional qualifying event, which Thamhain did in Boston. "Just to participate in that race is a big thrill," he says, "a true reward." He plans to travel to Nice, France, in October for the European equivalent of the Ironman.

Although road races and triathlons are solitary activities, Thamhain says he couldn't do the training alone. "There are three other people I run with in Framingham. We keep each other in check. And it takes that kind of commitment, that spirit, to get you out at five in the morning."

Associate Chemistry Professor Herb Beall's athletic career has progressed from rugby to running to racewalking.

Herb Beall: Running from rugby

"I started running as a way to get in shape for rugby," says Herb Beall. "In 1974, I was on sabbatical in New Zealand, where they're crazy about rugby, and got intrigued with the sport. So when they formed a rugby club here in Worcester, I joined and started to play."

Beall and a student started a WPI rugby club in 1980. "Immediately, we ran into the problem of no referees," he says. "So I bought a book on how to referee rugby and joined that group's union."

Although he still referees club games, the associate professor of chemical engineering has given up coaching the WPI club in order to devote more time to the chemistry textbook he's writing. He no longer plays rugby because the potential for injury threatens his running. Once just a vehicle for keeping in shape for rugby, running has become his passion.

"A few years back, I saw an ad in the paper for a 10-kilometer race in Upton for which the entry fee was zero. I figured I could afford that, and even if it was a disaster, I wouldn't have lost too much. I enjoyed it, although I don't think I did another race until the same one the next year. After that, I decided I had to start doing it more often. I also got involved with the runners here on campus. They talk about races and get you pumped up."

He usually runs at noon with the WPI Footpounders, a group of faculty and administrators who take to the streets of Worcester daily in packs of four or six runners. "If it weren't for the other runners, and the enthusiasm and support they provide, I wouldn't be close to where I am now," he says. "I like group activity. I'm not the kind of runner who would go out and do it all with my own internal drive. Having those others around makes it much more exciting."

His late start—Beall was about 40 when he took up running —has not limited his achievements. Last year, he finished fifth in the master's division of the *Worcester Telegram and Gazette*'s 10-mile Classic, the city's most popular race. The master's division is considered nearly as competitive as the open division; Beall's time was an impressive 62 minutes and 14 seconds.

Beall also enjoys racewalking; he says, "My principal goal is to keep running and racewalking until the day before they bury me. The idea that I would reach the point where I would still be alive but unable to do these things—that just blows me away."

"A road race . . . is athletics stripped to the essentials."

He speaks eloquently of the rewards of running, which many non-runners find difficult to understand.

"It's a lot of hard work, a lot of concentration and a lot of discomfort at times," he says, "and I have to admit the pleasures are very subtle. Yet for some reason, it's a lot of fun and very rewarding. A road race is a fascinating event. It's athletics stripped down to the absolute bare essentials, the simplest rules you can possibly have: 'Here's the start, there's the finish, and the winner is the person who gets there first.'

"Elements of luck are pretty much eradicated. It's simply a matter of being tougher emotionally and physically than the next guy at that particular time. And you know there are going to be days when you have bad races, but you won't understand what was different. You were just as well trained on the bad day, but you simply weren't up to it. And you don't even know until the race starts. Sometimes at the start you feel, 'Holy mackerel, I'm up to it today,' and you just know it's going to work right. Other times you know you're flat, and you realize it's going to be a long day."

Liz Miles: A rower finds safe harbor after weathering many storms

Elizabeth Miles recalls how she felt after being cut from the 1980 U.S. Olympic rowing team: "I remember, very distinctly, looking at the list they had posted. It was in alphabetical order, and I scanned to the place where my name should have been. There was a blank spot. I just stared. It was a feeling of total emptiness. Then I just packed my bags, went to the train station, and stood there, alone, waiting for the train to come puffing into view. It was pretty classic."

If she can look back on it now with a sense of humor, it's partly because she returned the next year and not only made the team, but won the crucial stroke position and led the eight-member boat to a silver medal in the world championships in Munich.

"I made a vow after being cut that I'd make the team the next year. I got a good coach and worked hard on the basics—became good technically, not just a hard puller. My attitude also changed tremendously. I became more professional, cooler. My approach became, 'This is what needs to be done; this is what I'm going to do,' rather than, 'I want this and I want that.'"

The following year, WPI's budget director was again part of the team, and again won a silver medal. But she was not yet through with heartbreak.

In 1983, Miles and another rower were candidates for the final slot on the team, and Miles was cut.

"We were both about the same,

Former Olympian Liz Miles has taken to the calmer waters of Lake Quinsigamond since joining WPI. Right: Brian Savilonis demonstrates the racewalking gait that he says "most runners think looks silly."

although we had different strengths and weaknesses," she recalls. "And the coach decided to go with her."

The effect was devastating. "I knew I had done my best, that I couldn't have done any better, and I lost. I was blown away."

Although she carried "a grain of doubt" throughout the next year of training, she came back again and made the 1984 Olympic team. Her four-woman boat missed the bronze medal by about a foot.

"At first, they told us we had taken third. We were on our way to the medal stand when they said, 'Oh, sorry, but. . .'"

She made the team the next year and again the team finished fourth, this time at the world championships in Antwerp. "That year was really fun," she says. "After you've made the Olympics, a lot of the anxiety is gone, and you can thoroughly *enjoy* yourself."

Miles, who began rowing as a senior at the University of California at Berkeley, decided to call it quits last year. "It's the time, mostly. At that level, rowing has to become your life. My priorities have since changed and I just can't make the commitment required at the international level."

And while she now enjoys rowing on Lake Quinsigamond when she gets the chance, she doesn't miss the "boot camps" athletes have to attend to be selected for the national team, camps that she calls "intense, grueling, and frightening.

"The camps are more nerve-racking and demanding than the races. It's basically a group of very talented women competing for a limited number of slots. Roughly half are going to make it and half aren't."

It takes a good deal of mental stamina just to deal with the lifestyle and politics of a selection camp: "There's a lot you have to put up with and that's okay if you have a goal in mind—then you'll put up with anything. But it gets to the point where the tradeoffs change. Having achieved what I wanted to achieve, I wasn't willing to put up with the difficulties."

But if it's grueling, it's also fascinating: "Rowing is a neat sport, because there's a lot of variety among the rowers. There are different strengths and weaknesses. Everybody's dealt a hand, and it's a question of how you play it. For

example, it's theoretically an advantage to be tall and strong; height is an advantage for generating leverage, and strength is an advantage, since it takes power to move the boat. Rowing is also an endurance sport, so people with a large aerobic capacity have that going for them.

"But what you find are these amazing, smaller people who simply won't be beat. The best are not necessarily the biggest because there's a whole other side to competition."

There is a trace of regret in her voice when she speaks of leaving competition, and she admits to having toyed with the notion of trying out for the 1986 team. "You miss some of the extraordinary things; a rowing team becomes an entity in and of itself, and the crew members become very close. Over the years, you develop very dear friendships, and now that I've retired, I miss the camaraderie."

One of Miles' friends from her rowing years is Jean Strauss, wife of President Jon C. Strauss, himself a rower. "Jean's no stranger to the pressures of top competition," says Miles. "She's a two-time national champion who has raced internationally against the best in the world." The two were teammates at Berkeley. "We have a half-dozen rowing pals out in California that we still get together with. There's a real bond."

Brian Savilonis: For runner, racewalker, teacher, and coach, "not enough hours in the day"

Brian Savilonis '72, a former U.S. 100-kilometer racewalking champion, finds it "very difficult to balance a full-time career with the high level of training required to compete on a national level. There aren't enough hours in the day."

The mechanical engineering professor has partly redirected his efforts toward coaching the WPI women's track and cross-country teams, but he still competes in national events. "I'm really in the second tier now," he admits. "Coaching makes more sense to me at this point. I find that rejuvenating."

Savilonis also coaches colleagues Herb Beall and Electrical Engineering Associate Professor Fred Looft, who now racewalk as a result of his encouragement, as well as a number of others who attend the regional races he organizes.

"The local races draw maybe a dozen entrants," says Savilonis. "And there are probably 50 people who compete between here and Boston."

Unlike running, racewalking hasn't taken off in popularity—at least, not in America; it is viewed by many as unglamorous and strange-looking. "Most runners think it looks silly," admits Beall. "It doesn't have the pizzazz of really cranking up to high speed. Runners who try racewalking often find it frustrating being restricted by rules that keep you from going as fast as you'd like."

Savilonis says it's not unusual to be ridiculed by passing motorists. "It's not a bad as it used to be, though," he says. "People are more accepting now. A lot of them exercise in some way, and they seem to understand."

A popular sport in Mexico, South America, Europe, and China, racewalking has two basic rules: you must keep one foot on the ground at all times, and you must straighten the knee of the support leg as it passes under your body. As Savilonis explains, "If you stand on one leg like a stork for a minute, you'll get an idea of what it's like."

National class racewalkers like Savilonis, however, are not "walking" in any common sense of the word. Savilonis finished his 100K in just 10 hours and 32 minutes; the current world record for men in the racewalk mile is five minutes and 49 seconds. To achieve these times, the racewalker must use a pace much faster than that of most runners.

Savilonis got his start in racewalking when he was a graduate student at SUNY Buffalo in 1976. A runner since high school, he had been temporarily sidelined due to injuries. "I happened to see racewalking at a track meet and thought I'd give it a try," he says.

After moving to the University of Virginia, he found himself close to Washington, D.C., one of the country's hotbeds of racewalking. His interest increased, and so did his success. By the time he returned to WPI to teach in 1981, he was training 75 miles a week and vying for national titles. His dream of making the 1984 Olympic team was dashed when he got sick just before the trials.

Today, Savilonis mixes his racewalking with a heavy dose of running, at which he also excels. Unlike most, he was a runner long before the fitness craze of the mid-1970s.

"I've enjoyed long, slow, distance training since high school. I was running 100 miles a week back in the early 70s." He first competed in the Boston Marathon in 1969, when the number of entrants was measured in hundreds.

"That was back in the days when *Runner's World* was a black-and-white publication," he says with a grin.

Savilonis has high hopes for his future in both sports. "In three years, I move to the master's division, in both walking and running. That'll be another incentive," he says.

Although he hasn't run a marathon in 10 years, he's considering giving it another shot. He terms his approach to roadracing "casual," but with a marathon personal best of two hours and 43 minutes and recent 10K times of just over 35 minutes, he's among the fastest non-varsity competitors at WPI.

Michael Shanley is a freelance writer living in Holden, Mass.

Fifteen years of the Footpounders

Fittingly, there was a "turtle," or slow and steady runner, involved back when WPI's Fabulous Footpounders got their start.

Today, if Physics Professor Bob Long isn't considered the grandfather of WPI's noontime running group, he's at least a favorite uncle. It was he who first began circling the old cinder track at lunchtime more than 15 years ago, just about the time then-graduate student Brian Savilonis and Mechanical Engineering Professor Al Hoffman, both former track stars, started regular noontime runs.

"I did it primarily for health reasons, both physical and mental. It was a way to lose weight, feel better, and reduce tension," says Long. He was soon joined by Mathematical Sciences Professor Gordon Branche.

As the 1970s progressed, and running became more popular, the group expanded. At some point, in the course of locker room talk, they dubbed themselves the Footpounders—a "foot-pound" being the scientific term for a unit of work as well as an apt description of the mechanics of running. Some credit this bit of wordplay to Physics Professor Van Bluemel, another longtime runner.

There are two species of Footpounders: turtles and non-turtles. The former includes a proud, usually greying group that cranks out four or so miles each weekday. Runners in the other category are faster and more ambitious; they complete regular track workouts and run longer distances in preparation for races.

As one member puts it, "There are those who run for fun and those who compete. The turtles are out there every day, rain or shine, but they don't feel the urge or intensity that some others do."

The numbers and faces have changed over the years as faculty and staff have come and gone. Current noontime runners number about 30, although they are rarely assembled all at once. Among them are a core of perhaps a half-dozen serious competitors and as many genuine turtles.

The Footpounders' achievements

The Footpounders have logged thousands of miles in all kinds of weather. Leading the pack is Registrar Joseph J. Mielinski, Jr., '75, who forgot his usual running attire but didn't want to be left out of the picture.

include an unbroken string of entries in the Cape Cod Relay. Hundreds of eight-member teams from throughout the country now clamor for entry in the 83-mile road race that begins at dawn at Plymouth Rock and ends in Provincetown. The race was much more modest in the mid-1970s, when Long, Hoffman, and their fellow Footpounders first ran it.

And, for five consecutive years, until the 1986 race, the group had a virtual lock on WPI's annual intramural cross-country competition. This year, they'll be seeking to avenge the crushing defeat they suffered at the hands of the Alpha Tau Omega fraternity.

Bob Long probably speaks for all Footpounders when he says of the noon run, "It's an important part of my life. When I can't do it, I miss it."

—MS

BACK TO SCHOOL


Michael Carroll

A recent group of M.B.A. students at work on a term project.

By Evelyn Herwitz

WPI's continuing education programs boost careers and build confidence by sending professionals back to the classroom.

To Stanley Belcinski, it was just something he'd wanted to do for a long time. The mechanical engineering degree he'd earned at WPI in 1963 had provided a good base for his career in quality control engineering. But he'd always had it in the back of his mind to get a master's—to "put a little more mortar into the foundation."

For 17 years, job and family pressures forced that goal to stay at the bottom of his priority list. But finally, in 1980, Belcinski returned to campus, this time as a night school student in the Master of Science in Management program.

Belcinski chose the master's degree over WPI's M.B.A. program for the opportunity it provided him to relearn technical subjects relevant to his work, but he admits that he put off taking the technical courses.

"Getting back into the grind was a bit of a shock," he recalls. "When I finally took the technical component, it was like taking three courses for every course on paper, because I had to go back to my old texts and look things up."

During the last four of his six years in the program, he had the unusual opportunity to attend college with his son, Richard.

"We didn't see much of each other on campus, though sometimes I'd pass him on Tuesday nights on my way to the library," says Richard. "But every time I came home, Dad would say, 'I got an A.

What did you get?' We had a friendly running competition."

For father and son, the experience culminated at Commencement last May, when Richard got his B.S. in physics and Stanley got his M.S. in management. "That was a super day," says Belcinski.

Not everyone who enrolls in one of WPI's continuing education programs gets the bonus of graduating with his or her child. But, as many night school students and alumni will attest, the personal rewards are abundant.

Polaroid Corporation education and training specialist Ginger Slater, for example, who chose to earn an M.B.A. through WPI's videotape instruction program, enrolled for the pure joy of learning. "I'm a career student," she laughs.

Thomas Nally saw going back to school as a natural extension of work. A plant manager for Interstate Nuclear Services in Springfield and a senior in the School of Industrial Management (SIM), he sums up his philosophy simply: "Life is a continuous learning process."

Now in its 32nd year of extending learning opportunities, WPI's Evening Program currently enrolls more than 1,000 students in a wide range of degree and certificate programs.

Qualified candidates with undergraduate degrees can pursue master's degrees in biomedical engineering, civil engineering, computer science, electrical engineering, fire protection engineering, management (M.S.M. and M.B.A.), mathematics, mechanical engineering, nuclear engineering, and physics.

Other initiatives include curricula leading to the degrees of Master of Natural Science and Master of Mathematics; certificate programs offered by SIM and the Plant Engineering Program; and the Greater Worcester Executive Program.

And, since 1976, more than 17,000 professionals have participated in the Institute's Professional Development Seminars and Executive Briefing Program (see sidebar).

Francis Doyle

According to Robert Hall, director of continuing education, just over half of WPI's night school students have been admitted to degree programs. Of the balance, he says, 30 to 40 percent "consider themselves degree seekers, although they haven't yet committed themselves to a program."

The option to earn credit even before being admitted to a degree program gives students considerable latitude in exploring the curriculum. Evening students can take up to four courses for credit without being accepted for a degree. Upon acceptance, those credits can be applied toward the degree requirements.

John Sangermano liked that flexible arrangement. A senior engineer with Digital Equipment Corporation (DEC), in Shrewsbury, Mass., Sangermano took his first WPI evening course in 1978 while working at DEC headquarters in Maynard. Though he initially enrolled "to take things that looked interesting," eight years later, Sangermano is about one semester shy of an M.S. in electrical engineering.

After completing several courses, Sangermano says he made a career decision to stick with engineering and to get his M.S.

That goal has not always been easy to fulfill. "There are times when I have a class, homework, and a major meeting all at once, and I start asking myself, 'Why am I doing this?' "

"There are times when I have a class, homework, and a major meeting all at once, and I start asking myself, 'Why am I doing this?' " says John Sangermano.

"But for the most part, it's like anything else. You have to schedule your time to allow for homework. Fortunately," he adds, "I have a forgiving wife. When I have homework or a big project, I'm able to spread everything out on the dining room table and leave it there for several weeks."

While an advanced degree would be an advantage if he were to apply for another job within DEC, Sangermano has no plans at present to transfer from his current group, which designs computer memory systems.

As a result, Sangermano isn't anticipating any major changes at the office when he completes his degree, probably sometime next summer. "I think I'll get an 'attaboy,'" he says. "I tell my friends I'll be able to read more *Scientific American* articles when I graduate.

"What I've really gained is a feeling that I'm better versed in my field and stronger in other areas."

Director of Continuing Education Robert J. Hall says that corporate belt-tightening has caused enrollment everywhere to plateau.

The flexible credit arrangement also attracted Donald Foster to the program. A senior engineer involved in product development for Polaroid, Foster completed his M.B.A. in 1985. "I was able to start taking courses immediately before declaring a major," Foster says.

Once he began taking courses, Foster says he decided to pursue an M.B.A. because of the quality and enthusiasm of the faculty. He says he was also encouraged by another flexible feature of the M.B.A. program: the fact that the courses were available at work on videotape.

Meeting with a group of about a dozen co-workers after work each week, Foster would watch a three-hour, taped lecture of a WPI management professor and graduate students.

Coursework follows the same schedule as on-campus lectures, and WPI provides proctors for exams. Professors are readily available by phone; in some cases, they go out to Polaroid to teach courses in person.

"The videotape format gave us a great deal of freedom," says Foster. "The courses were offered when and where we wished, and the group was self-managed and self-controlled. It was a very democratic process."

First used in 1979 at Varian Associates, the Management Department's videotaped graduate program is currently offered at Polaroid sites in Cambridge, Waltham, and New Bedford, Mass. Program director Arlene Lowenstein says about 50 students are enrolled in the 12-course core curriculum leading to an M.B.A. or M.S. in management. About 80 percent are Polaroid employees, she adds, while the rest commute to Polaroid from a variety of other organizations, ranging from high-tech firms to hospitals.

For Polaroid's Ginger Slater, the video system is working just fine.

"The program is so convenient," she says. "With my schedule as crazy as it is, if I can't make a class at the regular time, I can just make other arrangements to see the tape later."

Doing without a live professor has proved less of a disadvantage than Slater expected. "If I have a question, I just make a note of it and phone the professor later. And if there's something I don't understand, I can always hit 'rewind.'"

For her, the benefits of the program range from a deeper understanding of group dynamics to an ability to communicate better with finance staff. "It's helped me to connect with other parts of the organization in a way I wouldn't have otherwise," she says.

Understanding and making connections between different but related fields and ideas is also a goal of two very different master's programs offered by WPI.

Designed primarily for secondary school teachers, the Master of Natural Science (M.N.S.) and Master of Mathematics (M.M.) curricula provide a broad grounding in allied disciplines. For the M.N.S., the four-year program includes several courses in biology, chemistry, mathematics, and physics. In turn, the four-year M.M. program covers a variety of subjects ranging from geometry to linear and matrix algebra.

For educators whose responsibilities often include teaching more than one subject area, that diversity is a major attraction—and challenge—of both programs.

"It was very difficult taking courses outside my own discipline," admits Richard Terry, Marlboro High School's science department chairman for the past 24 years. "I hadn't taken or taught calculus in 20 years. And when I studied biology in college, they'd just barely discovered DNA."

But Terry says the effort was worth it. Since completing his M.N.S. several years ago, he feels better able to direct teachers in his department. "The background helps when I go in to observe other teachers," he says. "I'm able to transfer some of the ideas I learned and suggest texts."

Now in her third year of the M.M. program, Beaver County Day School math teacher Wendy Newberry has also found the WPI curriculum to be a source of new classroom opportunities.

A teacher at the private Chestnut Hill school for 11 years, Newberry has added statistics and finite mathematics to her repertoire since enrolling in the program. "I wouldn't have taught those subjects before," she says. "Now I feel much better prepared."

While the need for improved training of high school math and science teachers has been the subject of much national attention in recent years, WPI's two master's programs were actually started well before the latest outcry over secondary education.

In 1958, with funding from the National Science Foundation, WPI initiated an in-service training program that eventually became the M.N.S. curriculum. Originated as a summer institute, the program evolved into a four-year course of study that is open for enrollment every two years. Two courses are taught on campus each semester for a total of four hours of weekly instruction.

Based on that model, the M.M. program was started in 1976. "We felt there was a void for math teachers who needed graduate-level instruction," says Peter Christopher, program director and associate professor of mathematical sciences. "But that instruction was either not readily available or not pertinent to what the teacher was trying to do in the classroom."

Like the M.N.S. program, the M.M. curriculum was designed to include a broad range of concepts. Christopher says it has attracted an increasing number of teachers in recent years.

According to continuing education director Hall, both programs have proved extremely attractive to teachers. Current enrollment of some 70 students includes teachers from as far away as Southern Maine.

That geographic drawing power is due in large part to the programs' content ori-

"There are plenty of continuing ed. courses, but I wanted *math* content."

Michael Carroll

SIM offers its students the latest management techniques without the pressure of grades.

In the Instructional Media Center of Higgins Labs, Professor Douglas W. Woods teaches an economics course to evening graduate students.

entation. "We teach teachers, and they certainly have opinions on how to teach," says Ronald D. Chetham, associate professor of biology and biotechnology and M.N.S. director. "But this is not an education degree; it's a science degree."

Math teacher Wendy Newberry says that "the commute is a drain, but it's worth the extra time. There are plenty of continuing ed. programs in education closer to home, but I wanted *math* content."

"I think it's made me more sensitive as a teacher, something I've gained indirectly through content that's worth my time."

Graduate degree programs provide the opportunity for intensive study in a chosen field, but those seeking more advanced education combined with a less demanding schedule may choose a certificate program.

As the oldest branch of WPI's Evening Program, the School of Industrial Management has been granting certificates to area businesspeople since 1953.

Founded in 1949, SIM was a product of the wartime economic boom that put a strain on Worcester's heavy industry. "During World War II, much of Worcester industry expanded dramatically, while at the same time managers were enlisting or being recruited into the armed services," says SIM Director and Professor of Management Nicholas Onorato.

"As a result," he explains, "the demand for managers exceeded the supply, and a lot of engineers were promoted to fill management positions. But often they didn't have the training or experience to be managers. So the companies decided to do something about it."

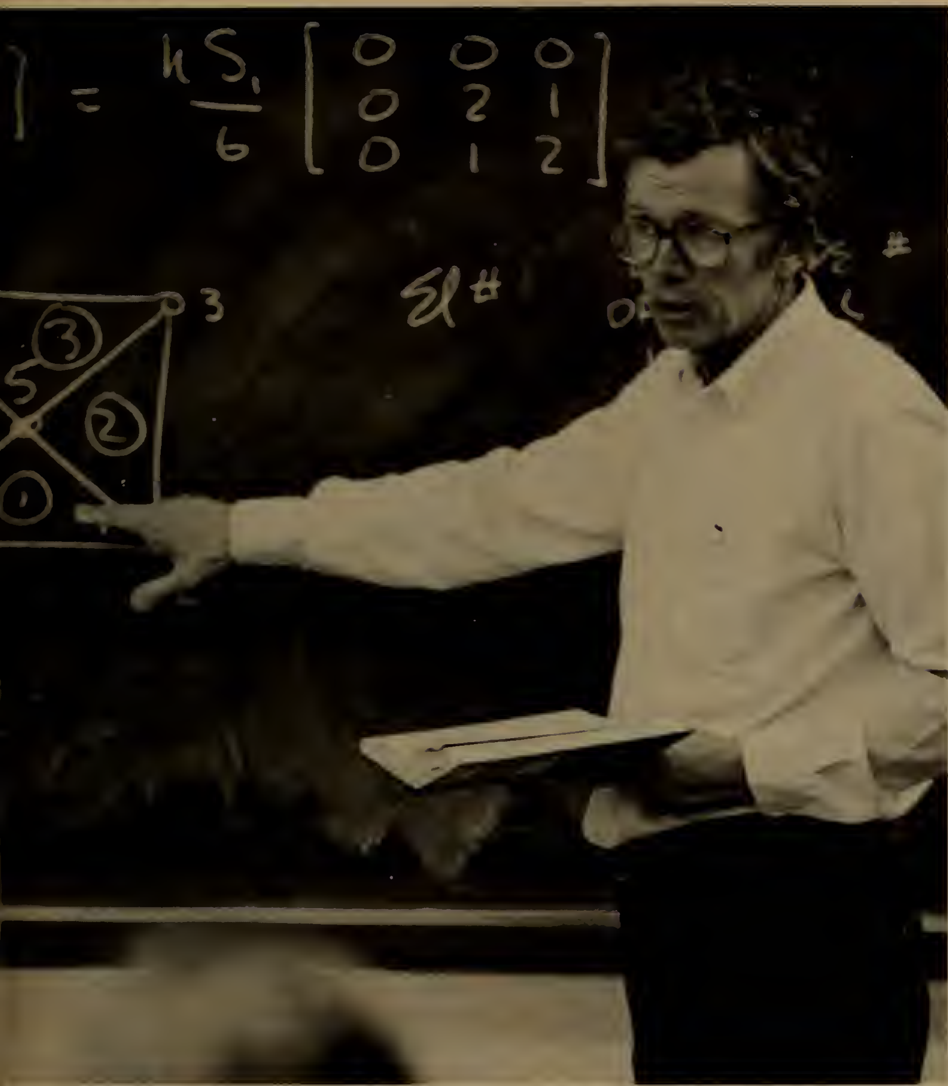
Major employers like Norton Co., Morgan Construction Co., Wyman-Gordon Co., and Worcester Gas and Electric Co. approached the WPI management and economics faculty for help. "Instead of a crash program," notes

Michael Carroll

Executive Seminars: "Pulling It All Together"

For those who want to brush up on technical or managerial skills, but haven't the time to enroll in a certificate or degree program, there is another way to take advantage of WPI's offerings. In just a day or a week, students can learn the basics of subjects ranging from time management to artificial intelligence through the intensive Seminars for Professional Development program.

As this popular program enters its second decade, Continuing Education Director Robert Hall says nearly 18,000 professionals have participated in the seminars. Annual enrollments average 2,500 to 3,000 students. To make participation convenient, most seminars are offered at



ME Professor Hartley T. Grandin, Jr., complements his undergraduate teaching with graduate instruction in the evening.

Onorato, "they decided to develop a curriculum that would cover eight functional management courses in four years."

Though the program's subject matter has been updated where appropriate, that basic curriculum is still SIM's foundation. Courses include personnel relations, marketing, finance, production management, computers, and policy formation.

Today, Onorato says that for SIM graduates, a certificate program is favored over a degree for practical reasons: "Many of these people have already graduated from college and are more interested in training than degrees. Also, they often have families, work pressures, and other community responsibilities. So the program is designed to present the latest management techniques without the pressure of grades."

To be admitted, students must have at least five years' industrial experience and be nominated by their employers, who pay all fees. Classes average about 40

a variety of locations in the greater Boston area and Nashua, N.H., as well as on campus.

Among the most highly subscribed offerings, says Hall, is the Five-Day Management Institute. Taught by Dr. William R. Allen, a faculty member in the School of Management at Suffolk University and a consultant to business and government, the Institute covers topics such as motivating employees, conflict management, and problem solving.

"It's the first course I have taken that tied it all together," says Richard Roy, manager of national technical support operations for Atex, Incorporated. "The course stresses real-life situations that reinforce the theoretical."

Another popular program, and the most frequently offered, is the two-day Project Management seminar. "For technical people, it explains how to operate in a matrix environment—how to plan and schedule a project from inception to completion," explains Hall. "The seminar also provides a great way to introduce people to our other courses."

Geared to help managers learn to shepherd key projects cost-efficiently, the seminar focuses on both organizational skills and interpersonal dynamics. A second seminar in Advanced Project Management offers training in the more technical components of project planning, execution, and control. Says past participant Arthur A. Giannetti, program manager for the Air Force Geophysics Lab/LSP, "I discovered 'project management' through WPI. The uniqueness of this course has enriched my capabilities from 'good' to 'great.' "

While course offerings are rotated over time, Hall says new seminars are often added in response to participants' requests. Among this year's additions is a one-day program on the "Justification and Implementation of Automation." One of seven seminars in the Executive/Management Briefing Series, the program discusses timely topics such as key technology trends and how to evaluate a proposed automation project.

Marketed extensively throughout the region, WPI's broad range of seminars has attracted participants from more than 50 corporations including IBM, Honeywell Information Systems, Digital Equipment Corporation, AT&T, Coca Cola Bottling Company, and Polaroid Corporation.

"We view ourselves as a vital resource for technical professionals in New England," says Robert Hall, and the numbers confirm his view. —EH


Michael Carroll

students, almost double the number in SIM's first class. Since that Class of '53 graduated, Onorato says over 1,100 students have earned an SIM certificate.

To date, some 1,100 students have earned an SIM degree. The alumni roll is impressive, representing nearly every major Worcester employer of the past three decades, as well as a healthy variety of smaller enterprises.

"The list of graduates reads like a corporate *Who's Who,*" says Thomas Nally, now in his last year at SIM. A plant manager at Interstate Nuclear Services in Springfield, Mass., Nally first learned of the program while working at the Norton Company.

And for SIM junior Thomas Wasso, a plant accounting manager at Jamesbury Corporation, the benefits of the curriculum transcend its technical content. "The public speaking course I took in my first semester created a friendship among the students. You learned from the speeches a little bit about each classmate. I think it drew us closer to one another."

For businesspeople looking for a more condensed management refresher course, there is also the Greater Worcester Executive Program (GWEP). Run jointly by WPI and Clark University for the past four years, the program is offered for 10 weeks each spring.

According to WPI's GWEP director, Management Professor Arthur Gerstenfeld, about 20 area executives enroll each year. The certificate program starts with a two-and-a-half-day retreat at the Massachusetts Institute of Technology's Endicott House and continues to meet weekly at WPI every Friday for a full day.

Classes cover the basics, such as macro- and microeconomics, as well as timely topics. This year, says Gerstenfeld, the emphasis will be on international competition: "We'll be looking at technology's response to such initiatives.

We'll be asking questions, such as whether or not use of industrial robotics here at home can meet the challenges of competing with Korea."

With such a wide range of offerings and a strong reputation for quality education, WPI's Evening Program has experienced a steady increase in enrollments in recent years. At present, however, enrollments are leveling off.

In part, Robert Hall says, that is due to corporate belt-tightening and to the shortage of qualified candidates for available faculty positions. Like the undergraduate program, the evening school has experienced considerable demand for courses in management, electrical engineering, and computer science. But instructors for the technical fields are particularly scarce. "We aren't always able to get enough faculty to fill authorized slots," he says.

He believes, though, that WPI's continuing education programs will remain in demand. "There continues to be a very real problem of technological obsolescence among practicing engineers," he says. "But research indicates that those with advanced degrees have a longer trajectory of productive activity.

"The variety of academic activities isn't as important as simply remaining involved. For some, the best solution may be a series of seminars; for others, a degree, or some combination of the two.

"But in the final analysis, continuing education will help forestall technical obsolescence and develop more productive contributors."

LETTERS

The Plan *is* Alive

Editor:

Thank you for your thoughtful and thorough coverage of "the Plan" in the August 1986 issue of the *Journal*. Dean Grogan's words reveal his deep personal commitment to our grand experiment.

Although I did not personally experience Comps, I liken the experience to the presentation and defense of my M.S. thesis. It is over 10 years since that time, and my conviction grows that the entire process assisted my transition from the academic world to industry.

Perhaps the best solution to the perceived problem is, as Prof. Kevin Clements suggests, to reinstate Comps midway through the junior year. At that time they could measure the student's competence in basic science and mathematics, the basic building blocks for the more focused, project-oriented final semesters.

The Plan *is* alive. Like any living organism, it needs to grow and change. When change is instigated by outside stimuli (like ABET), we lose some control of our destiny. I continue to be confident, however, that our faculty and administration are leading WPI through any required compromises to a structure which will embody the original intent of Two Towers IV.

Joseph E. Winston '76
Barrington, RI

PRESIDENT'S MESSAGE
Continued from inside front cover

edge through teaching. This statement, too, has received faculty support.

And, while WPI does not have the uniform quality of institutions such as Carnegie or MIT, in those specific areas where we have scholarly achievement (and there is at least one in each academic discipline and several in some), we can compete with anyone. Moreover, we are recruiting first-rate faculty members, who expect to replicate at WPI the environment for scholarship they experienced in their graduate studies or previous professional positions.

Obviously, the CEPD, the Faculty Goals Committee, and the majority of the faculty do not believe that it is possible to offer a first-rate education in engineering and science unless the faculty are active scholars. This scholarship, *which is necessary to maintain our quality undergraduate program*, can be facilitated by sponsored research and graduate studies.

Hence, Dick Gallagher and I believe we must continue to follow the course reinforced by our own recruitment and recommended by the Faculty Goals Committee and CEPD. We must, however, do so with far greater intensity than yet imagined.

Thus, achieving *broad-based scholarly excellence* is what the Campaign for Excellence is all about. This fund drive will help us ensure that our undergraduate program continues to flourish with new facilities and a first-rate faculty, and it will also enable us to strengthen our graduate programs and imbue our current faculty with new vigor.

Our annual fund-raising, while increasing, is doing so more slowly than institutions with which we like to compare ourselves. While our goal is to raise $52.5 million for specific programs, the Campaign for Excellence will at the same time double our annual fund-raising over the next five years. These additional resources from increased giving and sponsorship will not alone guarantee the scholarly excellence we seek for WPI, but these resources, when spent wisely by our faculty on projects of strategic importance, will make such scholarly excellence possible. The resulting recognition will resound to us all.

Fifteen years ago, WPI developed the Plan for a host of reasons, both internally and externally generated. The Plan has, indeed, served as a solid foundation for WPI, but it alone cannot carry us forward. Today, the goals and dreams of the WPI family are to build alongside the Plan a framework for advanced scholarship that will further enhance our institution. We are not building an MIT or a Cal Tech. Rather, we are building a WPI for the 21st century. Your active participation in the Campaign for Excellence is vital to this exciting future.

Jon C. Strauss

STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION (Required by 39 U.S.C. 3685). 1A. WPI Journal. 1B. Publication No. 01486128. 2. September 22, 1986 3. Quarterly. 3A. Four. 3B. $0/yr. 4. Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA 01609 5. Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA 01609. 6. The name and address of the publisher: Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA 01609; editor and managing editor: Kenneth L. McDonnell, 100 Institute Rd., Worcester, MA 01609. 7. The owner is Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA 01609. 8. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of the total amount of bonds, mortgages, or other securities are: none 9. The purpose, function, and non-profit status of WPI and the exempt status for federal income tax purposes: has not changed during the 12 months. 10A. Total number of copies printed: average number of copies of each issue during preceding 12 months—22,000; single issue nearest to filing date—22,000; 10B. Paid circulation: none; 10C. Total paid and/or requested circulation—none; 10D. Free distribution by mail: avarage number of copies of each issue during preceding 12 months—21,000; single issue nearest to filing date—21,000. 10E. Total distribution: average number of copies of each issue during preceding 12 months—21,000; single issue nearest to filing date—21,000. 10F. Copies not distributed: 1. Office use, average number of copies of each issue during preceding 12 months—1,000; single issue nearest to filing date—1,000. 2. Return from news agents—none. 10G. Total: average number of copies of each issue during preceding 12 months—22,000; single issue nearest to filing date—22,000. I certify that the statements made by me above are correct and complete. KENNETH L. McDONNELL, Editor.

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WPI Journal

WORCESTER POLYTECHNIC INSTITUTE
SPRING 1987

IQP: ON THE RIGHT TRACK

BOYNTON HILL: PRETTY AS A PICTURE

SCIENCE ON FIRE

MESSAGE

The IQP: Toward Closer Interaction with Society

By William R. Grogan '46

Today, more than 6,000 students and alumni have completed Interactive Qualifying Projects, intensive academic efforts involving creative application of their intellectual skills within a larger social context.

Yet for a century before the Institute created the IQP in the early 1970s, educators everywhere were busy trying to determine how cultural depth and societal awareness could be incorporated into the undergraduate science and engineering experience—an experience too often prone to course-mill inflexibility.

No other college of engineering and science has created a pedagogical device as innovative as the IQP, or one so specifically designed to address the need for personalized breadth.

Three goals capture the mission of the IQP:

- To cultivate confidence in questioning social values and in communicating effectively with non-technical people.
- To integrate the skills of evaluation and analysis learned through science and engineering in the solution of problems with social and humanistic issues.
- To provide methods for assessing not only the impact of science and technology on society, but the impact of social attitudes on technological developments, including their study from an historical perspective.

In reaching these goals, projects involving people as individuals often require study in the humanities, while those dealing with collective behavior require the perspective of the social sciences.

It's interesting to consider the IQP today in light of two recent national dialogues on undergraduate education. First, the Carnegie Foundation's *College: The Undergraduate Experience in America* identifies eight "points of tension" that seem "to sap the vitality of the undergraduate experience."

One point is precisely the issue WPI has tried to address through the IQP. Ernest Boyer, president of the Foundation, argues in the report that "the college has an obligation to give students a sense of passage toward a more integrated, more coherent view of life" than can be is provided by the "fragmentation of knowledge in academic disciplines."

The report goes on to describe "an enriched major" that not only "gives the students a chance to explore their fields in depth, but responds to three larger questions: What is the history and tradition of their field? What are the social and economic implications to be understood? What are the ethical and moral issues to be confronted and resolved?"

Second, the forum "National Congress on Engineering Education" (Accreditation Board for Engineering and Technology, Professional Societies and Colleges), recently addressed the issue of educational breadth in engineering curricula. A hotly debated question was the proposed establishment of a standard five-year B.S. program for engineering to provide for a well-rounded undergraduate experience. This proposal was rejected by the Congress.

During the debate, Dr. Edmund T. Cranch, past president of WPI and president of the American Society for Engineering Education, said the fifth year *is* needed to broaden subject areas. Meanwhile, Dr. Nam P. Suh, director of engineering of the National Science Foundation and a recipient of an honorary doctor of engineering degree from WPI in 1986, recommended reducing the number of required engineering courses to "let students explore."

Despite such diverse opinions, the consensus of the Congress was that more of just about everything, from statistics and computer studies to foreign languages and robotics, should be added to the curriculum—without lengthening students' educational careers. While considerable concern was voiced about content, less attention focused on the process of education required to digest it all.

WPI remains very much committed to its process of integrating and reinforcing the knowledge learned in the classroom through its qualifying project system. We will continue to develop this system as a highly effective approach to the education of students for a lifetime of professional leadership.

The IQP, the Humanities Sufficiency, the Major Qualifying Project (MQP), and Distribution Requirements produce at WPI a stimulating and balanced educational system. The IQP and our associated Project Centers belong at WPI not just because they are unique, but because they accomplish their important objectives with a degree of effectiveness and coherence that has for years eluded other institutions of higher learning.

You'll find beginning on page 38 a story about the IQP today—the topics several students are addressing, the projects' impacts on their academic careers, and how their work is affecting the problems and issues they are attacking. We invite your interest and your comments.

William R. Grogan, dean of undergraduate studies at WPI, played an active role in creating the Plan in the early 1970s.

Staff of The WPI JOURNAL: Editor, Kenneth L. McDonnell • Alumni Information Editor, Ruth S. Trask
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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, Hartwick 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.

Staff of the Alumni Magazine Consortium: Editor, Donna Shoemaker • Wrap Designer and Production Coordinator, Amy Doudiken Wells • Assistant Editor, Julia Ridgely • Core Designers, Allen Carroll and Amy Doudiken Wells.

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

 Address correspondence to the Editor, The WPI Journal, Worcester Polytechnic Institute, Worcester, MA 01609. Telephone (617) 793-5609. Postmaster: If undeliverable please send form 3579 to the address above. Do not return publication.

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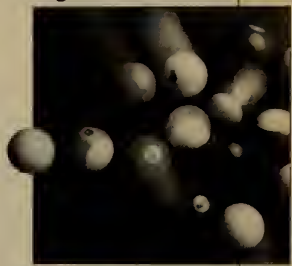
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Cover: Junior physics major Nancy Teasdale, perched on a solar panel atop Stoddard Residence Center, grasps a solar photovoltaic cell, the centerpiece of her Interactive Qualifying Project. Story on page 35. Photo by Robert S. Arnold.

Robert S. Arnold

Fire

"Besides the deaths," says Jonathan Barnett, associate at WPI's Center for Firesafety Studies (CFS), "the sad part about the Dupont Plaza hotel fire in San Juan is that many people seem to think the problem is solved because the arsonist was caught. I haven't heard anyone say, 'Wait a minute, this building failed us.' "

What Barnett is talking about is not as simple as negligence or liability: It appears that the fire was started not with a bomb or with lashings of gasoline, but with a small can of Sterno and a pile of furniture already stored in the hotel. But the deaths of 96 people attest to the fact that something went horribly wrong in San Juan, something that could go wrong in almost any building.

In the last decade, there's been a dramatic increase in knowledge about how fires start, how they travel, how they radiate heat and spread toxic fumes, and how they react to water or other extinguishants. But much of this information has remained scattered in scientific journals and theses, rarely reaching the drawing boards of the people designing buildings.

Using as a base this newfound knowledge, together with traditional engineering theory, teachers and students of WPI's Center for Firesafety Studies are utilizing new methods and techniques to investigate fire's secret ways and to design environments and systems to control them. Then, like all good engineers, they take this knowledge out into the real world.

The Center for Firesafety Studies opened its doors in 1979 as the nation's only master's degree program in fire protection engineering. Its beginnings were modest: a few part-time students, a part-time director, several part-time professors, and no suitable textbooks.

In the last eight years, though, the Center has changed considerably. "I never dreamed we'd have come as far as we have in such a short time,"

fighters

says David Lucht, Center director. The Center boasts more than 60 graduate students, four full-time teachers as well as several adjunct professors and professors shared with other departments, a textbook custom-written for the course, a new lab, a library of fire-safety journals, a thriving internship program, and a branch of the national fire-safety honor society.

And the potential for growth continues. "There are a lot of interesting, well-paying jobs out there," says Lucht, "in manufacturing industries, insurance companies, government, consulting, you name it. I received three letters just today looking for graduates."

To understand the momentum behind the Center's rapid growth, it helps to understand a few simple facts and a little history. First, the U.S. has the worst firesafety record in the industrialized world, a record that reflects the destruction of thousands of lives and straps a burden of $36 to $45 billion to the back of the economy each year. And, with the advent of high-tech businesses, even small rooms can contain millions of dollars worth of equipment that a fire can quickly ruin.

Until the turn of the century, the only tools building designers had to help prevent these disasters were common sense and traditional rules of thumb. After the great Chicago, Boston, and Baltimore fires of the 1870s, many insurance companies were left bankrupt, and the industry realized it would have to take measures to head off further calamities. Building methods soon began to change: heavy brick walls were used to slow fire in its path, easily ignited wooden roofing shingles were abandoned in favor of tile and other fire-resistant materials, and the minimum lawful distance between buildings was increased.

By 1905, the National Board of Fire Underwriters had published the first national model building code law, based on the empirical knowledge of the day. Because the knowledge and mathematical tools needed to systematically model fire simply didn't exist at that time, these codes—prescriptions, really, such as don't construct a wooden building more than three stories high or so many square feet in size—have served industry for more than 80 years.

Professor of Civil Engineering Robert W. Fitzgerald '53, a member of the CFS faculty, has always been interested in the construction of buildings and so, by necessity, has become intimately familiar with the building codes. And because so much of the code had to do with fire, fire, too, has become an abiding interest.

In 1968, he recalls, Congress passed the Fire Research and Safety Act, mandating a program of fire-prevention education for schools and communities and funds for basic research into the causes and behavior of fires. Then, in 1973, the National Bureau of Standards established a Center for Fire Research, putting some of the country's best minds to work on the problem. Soon, the United States Fire Administration was launched as President Gerald Ford appointed Dave Lucht its first deputy administrator.

At the same time, powerful computers were demonstrating their ability to model complex engineering problems. Engineers began to encode the knowledge they had about thermodynamics, heat transfer, and fluid dynamics, and, as the computers crunched through huge numbers of calculations, simulated fires roared to life on video display terminals.

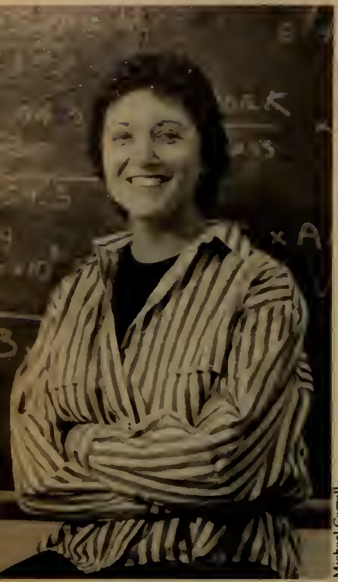
By 1978, WPI had decided that it could make a major contribution to the field. "We were deeply involved in the WPI Plan then," says Fitzgerald. "The barriers between engineering and science were falling, so a great deal of cross-fertilization was going on. WPI decided there would be great value in supporting a program in firesafety studies—as long as the program was first-rate."

At the time, there were two undergraduate fire protection engineering programs in the country, one at the Illinois Institute of Technology (where Lucht earned his B.S. degree) and the other at the University of Maryland (where Craig Beyler,

Fire blazes on computer screens and lifesaving begins in the lab at WPI's Center for Firesafety Studies.

Opposite page: FPE graduate students Scott P. Deal (left) and David Birk study the characteristics of a propane flame under a hood in the CFS laboratory.

By Leslie Brunetta



M.S. student April Berkol came to the Center with a degree in mechanical engineering and two in French.

assistant professor of fire protection engineering and mechanical engineering, earned his). WPI's administration and faculty believed that, in order to complement those programs in a way that would be in the best interests of science and the nation, its program should be for an advanced degree and involve original research.

"We try to maintain a balance between research and practice," says Lucht, "because we perceive that one of our missions in life is to have one foot in the theoretical world and one in the practical. We can be the bridge that gets this information into the engineers' offices and into their heads."

One of the Center's most effective bridging actions to date has been the publication of *Fire Dynamics*, a first-of-its-kind textbook, by Dougal Drysdale. Drysdale was brought to the Center during 1981–82 from the University of Edinburgh, Scotland, by a CIGNA Corporation grant funding a visiting professorship.

While at WPI, Drysdale was able to devote his time solely to teaching and amassing the material now contained in the text. The first edition of 2,000 copies, published by John Wiley & Sons, quickly sold out, an unusual feat for a textbook of this kind.

"It's become the standard, state-of-the-art treatment of how fires burn," says Lucht. The book was one of the Center's first milestones. Early on, Lucht had spoken to Herrick A. Drake, then president of Aetna Insurance Company, about funding the program. "I told him there was enough fire-research literature out there to fill his office, and promised we would boil it all down and make it more useful," Lucht says. Drake was named chairman of the Center's Board of Advisors, a group of more than 20 distinguished professionals and academicians.

In 1984, Drake died suddenly, while still in office, and the Center has since instituted the Herrick A. Drake Commemorative Award to honor people making valuable contributions to the field.

Senior Richard F. Buckley tests a prototype of an experiment to determine how materials ignite in space.

"I feel so good," Lucht says, "that we were able to deliver on our promise to him before he died."

Fire Dynamics, the book, is the centerpiece for Fire Dynamics, the course, itself the centerpiece of the program. "Our whole curriculum," says Beyler, "focuses on understanding the chemical and physical aspects of fire. We offer students things they wouldn't otherwise experience." The course relates the principles of thermodynamics and heat transfer to the basic theories of the ignition, growth, and spread of fire while stressing how this theory can be used in real-life problems.

Once students have this fundamental knowledge, they can move on with a keener eye to the program's more practice-oriented courses. These include Risk Evaluation (learning to evaluate the risks encountered in manufacturing, chemical and energy production, and storage and transportation of flammable materials), Fire Detection and Special Suppression Systems (analyzing and designing detection and non-water-based suppression systems), Fire Protection Design (designing more firesafe buildings), and Failure Analysis (investigating and reconstructing fires).

In 1986, the Center added a course on risk management, taught by professors in the management and mechanical engineering department. "Ultimately, a manager has to decide whether or not to pay for and implement a fire protection engineer's ideas," says Lucht. "The course has addressed risk assessment and techniques for making management decisions under conditions of uncertainty. It adds an important dimension to our program."

The classroom component of the course clearly has one foot in the world of theory and the other in practice. But so do most of the Center's students, who are either enrolled in internship programs or completing their degree work part time while working in the field. This means the theory and skills they learn at the Center are taken fresh into industry, insurance companies, or consulting jobs, enabling the Center to have an immediate impact on the myriad aspects of firesafety. And the knowledge flows both ways, according to Lucht: "We have a lot of experienced people coming in who bring as much to the Center as they gain here."

One such student is Don Crowley, corporate loss prevention manager at Digital Equipment Corporation. Crowley signed up for the program soon after it opened in 1980, hoping it could give him a greater depth of knowledge to draw on, and graduated in 1985. "I'm really sold on the Center," says Crowley. "It's a thinking program rather than just a stockpile of facts, so it's affected my whole approach." Crowley says he now regularly uses risk analysis to assess more accurately safety procedures and decisions, and finds that mathematical modeling of fire problems helps not only his own understanding of a problem but also that of other managers: "Modeling makes it a piece of cake to explain things. Now, nontechnical people can see what I'm talking about before a problem happens."

The Center also offers unusual opportunities for students and business, government, and industrial sponsors through the Graduate Internship Program. The Center's program differs from conventional student cooperative education programs in that its students already have their baccalaureate experience under their belts—they're not only ready for more advanced placements, but they can also offer more knowledge and maturity to their sponsors.

The program has placed students with Rolf Jensen & Associates (one of the nation's major fire protection consulting firms), in the firesafety office of the Vermont Yankee nuclear power plant, as field engineers for Factory Mutual, and in the fire prevention bureau of the Boston Fire Department, among others.

April Berkol, for example, came to the Center's

Robert S. Arnold

M.S. student Lennart Monson (right), a consulting fire protection engineer for MBS Fire Technology Inc., and CFS graduate Donald Crowley '85, corporate loss prevention manager at Digital Equipment Corp., find the information in Center courses on topics like risk management essential to their professional endeavors.

Robert S. Arnold

At day's end, CFS Director David A. Lucht (right) discusses curriculum matters with Associate Professor Robert W. Fitzgerald '53 (left) and Assistant Professor Craig L. Beyler.

combined B.S./M.S. program having already earned a bachelor's degree in mechanical engineering and B.S. and M.S. degrees in French. As an intern working with the director of industrial health and safety at IBM's Charlotte, N.C., plant, Berkol was able to wet her feet in the world outside the Center's classrooms. "I got great hands-on experience," she says, "and got a close look at a major industrial company's concerns about fire. There were so many different problems I had never thought of.

For one, she suggested installation of in-rack sprinklers at an IBM warehouse and strict control over the heights of and distances between stacks of materials in the warehouse. The company seemed pleased to have the problem examined from an engineering point of view."

At one time, the University of Edinburgh also had a master's program in fire protection engineering. But today, WPI's is the only program of its kind in the world. Young as it is, it has an international reputation, drawing students from Australia, Brazil, Chile, China, and Malaysia.

Many of these students are sponsored by their governments or employers. For instance, Joao Silva, an engineering professor specializing in safety engineering in his native Brazil, has been sponsored by his government to study ways of updating Brazil's inadequate prevention techniques. "Brazil is a growing country," says Silva, "so we have to adapt state-of-the-art fire prevention models to fit our own needs. WPI is the only place I can learn this."

Another country that has recognized WPI's strengths is India. Its Loss Prevention Association, which helps set standards for firesafety, has already sent four senior engineers to WPI. "They're going back to leadership positions," says Lucht. "It's satisfying, because they're leaving here and spreading the knowledge worldwide."

During 1986, with a $50,000 grant from Aetna Life and Casualty Company, the Center built its first-generation Fire Sciences Laboratory, signaling a new era for the Center. Now that the benches, exhaust hoods, and other testing equipment are in place, students can work on problems involving small fires and fire protection devices.

For instance, on one of the lab's benches sits a sphere about the size of a basketball and looking like a Jules Verne vintage diving bell—an explosion capsule. A student can inject gases into the capsule, shock them into explosion with a spark, and then measure how much extinguishant it takes to put the fire out. One student is using the capsule to explore the relationship between the amount of energy in the spark starting the explosion and the amount of extinguishant needed; the experiment may eventually lead to more efficient suppression systems in, say, chemical plants.

Each student has to complete a thesis or project to qualify for a degree, and what often starts out as a way to approach a problem in the student's full-time job develops into an original contribution to the science of firesafety. Student research projects going on in and outside the lab range from ways to design better buildings, to ways to better model fires on computers, to how to put out fires more efficiently.

The lab is also used for the Major and Interactive Qualifying Projects (MQPs and IQPs) of undergraduate students who are majoring in other departments but are interested in firesafety. Some undergraduates, for instance, are working on a project that will, with several other student-designed experiments, fly on a space shuttle mission. This program is sponsored cooperatively through MITRE Corporation, NASA, and WPI.

Last year, WPI received a $120,000 grant from NASA to explore the feasibility of establishing a center for firesafe design in the commercial development of space. If the proposal proves successful, WPI could become the world's premier academic center for firesafety in space.

"Nobody knows exactly what fire will do in microgravity," says Associate Professor Richard L.P. Custer, CFS associate director and head of WPI's NASA effort. Flame rises on earth because the gases it creates are lighter than the surrounding gases. And gravity also has a lot to do with how fluids in fire suppression systems are dispersed.

Take most of the gravity out of the equation, and you're playing with a new set of rules. The problem is that the rule book hasn't been written yet. "There's going to be significant manufacturing going on in space during the 1990s," says Custer, "and conditions will exist to permit explosions. We want to find out how to fight them before they happen."

Closer to earth, Bob Fitzgerald and Jonathan Barnett are working on problems involving old and new steel frame construction. Sponsored by the American Iron & Steel Institute and the National Science Foundation, the two faculty members and students are trying to develop a design method for predicting structural steel fire performance, taking into account such things as different kinds of fires, how much load is on the steel, and how much protective insulation has been provided on the structure.

"It's clear that we're spending too much money on steel-frame buildings for the amount of protection we have," says Barnett. "For instance, the codes may call for two inches of insulation because that's how much the beam needed in the test furnace. But there's no real connection between the tests and real life. We can design now on the basis of much better knowledge."

Barnett is also working on a three-year project sponsored by General Dynamics' Electric Boat Division. He's trying to develop a computer model for compartment fires in submarines—an especially dangerous kind of fire because there's no escape. "There's the same threat of fire as in any other building," Barnett says, "but if you can imagine being in a three-story tube, two weeks away from being able to surface, you have a good idea of the problem."

A different nautical problem is the subject of Craig Beyler's U.S. Coast Guard-sponsored study—estimating the time for ship compartments to become fully involved in a fire. Beyler, the Center's number-one theoretician, according to the other professors, applies to the Coast Guard study and his other research (predicting different materials' ignition points and nuclear power plant-related hydrogen combustion experiments) the computer modeling techniques that have been a major factor in firesafety engineering's evolution from an art to a science.

Computers, though, are just tools for executing people's ideas. What distinguishes Beyler's work, and the work of the other professors, is not so much the new techniques they use as the new approaches they take to the devastating problem of fire.

"It's exciting to be in an engineering field where major transitions are being made," says Dave Lucht, "to be getting away from the trial and error phase by being actually able to calculate what a fire will do. Maybe a computer analysis of the Dupont Plaza would have told people, 'Hey, this kind of tragedy could happen. And here's how you can prevent it.' "

Leslie Brunetta is a case writer at Harvard's Kennedy School of Government and a free-lance writer and editor.

Robert S. Arnold

CFS Associate Jonathan R. Barnett '74 (right) and Associate Professor Richard L.P. Custer, CFS associate director, have helped build the Center's foundation for a growing enrollment.

Pretty as a

Picture

By John R. Grimm '89 and
Paul F. Halloran '89

The Picturesque movement in American architecture found stunning application in the WPI campus, and is preserved today in Boynton Hall, Washburn Shops, and Institute Park.

Marvin Richmond

The original campus, ca. 1870, viewed from downtown Worcester, consisted of just two buildings.

The creation of WPI in 1865, when it was known as the Worcester County Free Institute of Industrial Science, was the culmination of the efforts and desires of two prominent business leaders in Central Massachusetts, John Boynton and Ichabod Washburn. These men recognized the need for an education broader than a traditional apprenticeship and more practical than the conventional "liberal education" of the day. Boynton pointed out the need for a well-rounded education, while Washburn stressed the importance of applied training.

These two men, previously unknown to each other, were brought together with the help of Stephen Salisbury, Jr. (1789–1884), a member of one of Worcester's leading families. Neither Boynton nor Washburn would live to see WPI welcome its first freshman class in 1868. It was Salisbury, first chairman of the WPI Board of Trustees, who would oversee final construction of Boynton Hall and Washburn Shops. It was Salisbury, too, who would accept responsibility for planning the appearance of the campus. (See accompanying story.)

Salisbury, in fact, could be labeled an agent of the Picturesque, a style popular throughout the late 18th century in Europe and championed by American architects in the second quarter of the 19th century. Influenced by the Romantic movement in art and literature, the architects of the Picturesque movement rebelled against the symmetry and simplicity of Classicism. They used asymmetrical building plans, intricate detail, and roughhewn stone to create effects that would evoke emotion and curiosity in the viewer.

Andrew Jackson Downing, whose pattern books spread the popularity of the Gothic and Italianate revival styles in America, was one of the country's leading advocates of the Picturesque. Downing seems to be the first to have recognized the importance of integrating a picturesque landscape and a place of learning. The effect he created seems to suggest that the landscape itself is the aesthetic link between Boynton's call for education and Washburn's emphasis on practical laboratory experience.

We find testimony to the importance of the natural scene in college campuses in a remark by Professor Chester S. Lyman, of Yale University, at the opening ceremonies of WPI in 1868. "[New England's] hills and rocks," he said, "[its] schools and colleges, have nurtured a hardy, intelligent, inventive race of men, of indomitable energy, who are specially qualified, by nature and training, to pursue successfully the more difficult industrial arts." The recognition of the part America's landscape played in the shaping of its inhabitants makes a strong case for the pertinence of the picturesque scene in a place designed to educate young people fully.

Boynton and Washburn's inspiration and promise of financial assistance made possible the creation of a committee to preside over and build the school. The first task of the building committee was the selection of an appropriate site for the campus from three adequately sized plots, the first located at the center of the city, the second toward Worcester's southern boundary, and the third a five-acre piece of land owned by Stephen Salisbury at the northwest end of town. Salisbury's offer of the property was an ideal choice because of its wooded hillside setting and close proximity to the center of Worcester.

View from the towers

The committee's next task was to form a plan for the layout and landscaping of the campus. They sought the advice of Calvert Vaux, a landscape gardener famous for his partnership with Frederick Law Olmsted in laying out New York City's Central Park. Vaux's suggestions would include the location of the buildings and the general arrangement of the grounds of the Institute. The plans he submitted formed the principal layout of the southeastern portion of the campus (see figure 1), an arrangement that is little changed today.

Vaux's foremost objective was the positioning of the two main buildings. By visiting the property and examining the topographical plans prepared by Phinehas Ball, Vaux concluded that the only feasible location for the buildings was upon the summit of the hill at the northeast corner of the lot.

Vaux designed the entrance, main approach, and walkways of the campus to give favorable views of Boynton Hall and Washburn

The towers of Boynton Hall and Washburn Shops (far right) offer impressive views.

The Salisburys: A Peerless Legacy of Public Spirit

by Susan M. Meyer

Three Stephen Salisburys are associated with Worcester's history, two of whom held the position of president (today known as chairman of the board) of WPI. Stephen Salisbury (1746–1829) came to Worcester in 1767 to open a branch of his family's Boston store, selling goods imported from England and the West Indies to the farmers of Worcester County.

A successful businessman and gentleman farmer, he purchased approximately 200 acres of land extending north and west of Lincoln Square. Sections of this farm would later be donated—first by his son and then by his grandson—for the development of the Worcester County Free Institute of Industrial Science and the neighboring Institute Park.

Stephen Salisbury II (1798–1884) was the only surviving child of Stephen and Elizabeth Tuckerman Salisbury (1768–1851). The elder Stephen had a strict upbringing that emphasized the importance of duty to his family and his community. Prepared at Leicester Academy, his son entered Harvard College in 1813. The curriculum was based on a thorough knowledge of the classics. Some 300 letters survive between the "affectionate" parents and their "dutiful" son at Harvard:

> My dear son, as your future prospects depend upon your prosecuting your present studies with fidelity—lose not the present time neglect not a lesson—Endeavor not to be behind any of your Class in a thorough knowledge of every lesson required of you, and by your Close Application and good Conduct, may you merit the Esteem and Approbation of all your instructors.

Stephen II remained a scholar of the classics for the rest of his life, always striving to be one of "those who improved society by their intellectual labors." In 1829, at the age of 31, he inherited his father's estate, the largest in Worcester County. At the time of his birth in 1798, Worcester was an agrarian and commercial town of 2,400. When he died in 1884 it had become a thriving industrial city of 60,000. Although he remained a gentleman farmer throughout his lifetime, Stephen II maintained a strong presence in the industrial, financial, and political growth of Worcester. The Court Mill building, constructed at Lincoln Square by Stephen II in 1832, was an important early contribution to the city's industrial development. By renting rooms with water power, he provided the opportunity for many small businesses to get started with little capital.

Stephen II served as the president of the Worcester Bank for nearly 40 years and held the same position at the Worcester County Institution for Savings for 25. He served in the town and later in the city government, and spent two years each in the Massachusetts House of Representatives and the Senate. The lengthy list of institutions he supported, many of which depended upon his generosity for their survival, includes the American Antiquarian Society, Worcester Free Public Library, Massachusetts Historical Society, Peabody Museum, Harvard University, Worcester City Hospital, the Mechanics Association, and the American Bible Society.

> Most of all, the Worcester County Free Institute of Industrial Science has been indebted to him, not indeed for its establishment, but for its high scientific and literary reputation. With the funds that he bestowed upon it,

Marvin Richmond

Marvin Richmond

Robert S. Arnold

Shops. The key to achieving these views was the arrangement and positioning of the two buildings. He felt that, when placing two or more buildings near each other, right angles were desirable to establish a dominance of one structure. Stephen C. Earle's Boynton Hall, being the main building, was faced south onto the plateau on which the main approach was to arrive. (For a more detailed account of Earle's architectural contributions to Worcester, see the WPI *Journal,* May 1986.)

Accordingly, Washburn Shops, designed by Elbridge Boyden, architect of Worcester's Mechanics Hall, was positioned fronting east. This created an area to the rear of the structures for all necessary outbuildings and yard space, appropriately hidden from the picturesque view from below. In addition, a space on the west side of Boynton Hall was reserved by Vaux for a possible extension. (It was never executed, but additions to Washburn Shops soon appeared on both the north and south ends of the original facade).

> very largely exceeding the aggregate of all other gifts, he might have established a seminary that should transmit his own name to posterity . . . On the other hand, he adopted the founder's plan . . . careful always to place in the foreground the honored memory of Boynton and Washburn and claiming for himself only the privelege of serving in the way indicated by their deeds of gift.

Stephen II donated a five-acre section of the Salisbury farm for the new technical institute in 1868, adding additional plots over time. He served as the first president—determining the curriculum and hiring the instructors—a position he held until his death.

His classical education influenced his insistence upon a balance between the practical and theoretical education offered at the new school. To help ensure that the elements of a traditional education remained part of the school's curriculum, he bequeathed to the Institute "ten thousand dollars to be safely and productively invested as a part of the fund for instruction in languages in said Institution."

Stephen II had married three times and buried each of his wives. His only child, Stephen Salisbury III (1835–1905), was born of his union with Rebecca Scott Dean of Charleston, N.H. Rebecca died of consumption when her son was eight years old. He was educated in Worcester schools and attended Harvard College. He later studied at universities in Berlin and Paris and graduated from Harvard Law School in 1861. Traveling through the Yucatan that year, he became interested in Mayan culture and published several scholarly papers on the subject.

Marvin Richmond

Three generations of Stephen Salisburys provided funds and spiritual guidance to a developing Worcester for more than a century.

Soon after his father's death in 1884, he took his father's place on the WPI Board and asked for an accounting of his father's gifts to the Institute; $236,800 was found in the books, though far more was thought to have been given. Continuing the Salisbury commitment to the Institute, Stephen Salisbury III donated $100,000 in his father's memory to build the Salisbury Laboratories.

He filled his life with community service and intellectual pursuits. The only heir to a fortune, he took his father's place on the boards of most of the organizations previously mentioned and provided essential support to a variety of new institutions springing up in the new city. He was involved with Clark University, Worcester Lyceum, Natural History Society (now Worcester Science Center), Society of Antiquity (now Worcester Historical Museum), and the Music Association, as well as many others.

In 1887 he gave the city 18 acres of the remaining family farmland for use as a public park. In his letter to the mayor, he wrote:

> The conditions of this gift are that this area shall be called Institute Park in recognition of the usefulness of the Worcester Polytechnic Institute to the material interests of the city and county.

Stephen Salisbury III, who never married, was the last of the Worcester Salisburys. Upon his death in 1905, the family fortune and landholdings were left to numerous community organizations. He is probably best remembered as the founder of Worcester Art Museum, to which he donated his family's fine and decorative arts. He named the Art Museum as his residuary legatee; he left $200,000 to WPI as a final bequest. After his death, the Worcester historian Ellery Bicknell Crane commented,

> Of the Salisbury family it is to be said that from the emigrant ancestor down, the name has been a synonym for industry, integrity, public-spirit, and civic duties ably and faithfully performed.

Susan M. Meyer is curator of the Salisbury Mansion, run by the Worcester Historical Society.

The buildings themselves evidenced many characteristics of Picturesque architecture. Boynton Hall's rough, broken surface gives it a Gothic appearance, as do its variously sized arched window and door frames. The strong, vertical thrusts of its walls, chimneys, and clock tower blend harmoniously with the surrounding trees and other plantings. The rooftop, which is visible from many angles, is made of rough slate and heavily ornamented, which suggests that it adds to the effect of the entire building, not just serves as a shelter from the weather.

In contrast to Boynton's rough surface and roof, Washburn offers a more broken surface by means of arched windows and vertical and horizontal lines, and no view of the rather flat roof. The horizontal lines emphasize the north to south length of the building, but triangular window awnings, chimneys, and the main tower keep the vertical theme intact. These structures are also asymmetrical, another attribute of the Picturesque that keeps close the relationship of the buildings to the surrounding landscape.

Salisbury took charge of erecting a small, turreted, one-room building on the campus to be used as a magnetics laboratory. Being set away from the other two buildings, just to the left of the main entrance, the site was free from vibrations that would throw off the accuracy of the equipment to be used there. Also, the axis of the Magnetic Laboratory (used later by Dr. Robert H. Goddard '08 for his experiments on rocket power, and known today as the Skull Tomb) was built to coincide with the magnetic meridian, with the north-south axis passing through opposite windows in the tower. For these reasons, this site was ideal for carrying out the delicate experiments needed in measuring the gravitational pull of the earth.

It was a common technique of Picturesque landscape architects to position the dominant object of an area in direct view of the main entrance. In Central Park, for example, Vaux and Olmsted positioned a massive rock just inside the main Fifth Avenue entrance in order to occupy visitors' minds with thoughts of nature, enabling them to forget those of the city.

The Magnetic Laboratory, too, draws one's attention to the towers, the main and, even today, most recognizable structures of the campus. This association was strengthened by the fact that both the Lab and Boynton Hall were made of Millstone Hill granite, giving the Lab look of a scaled-down Boynton Hall.

Surrounding the Lab a number of spiry-topped trees were planted, unifying symmetrically the graceful slopes of the turret. Thus, the Magnetic Laboratory established the important first impression of the campus while remaining part of the natural scene.

Similarly, the towers of Boynton and Washburn serve a multiple purpose for the Institute: they stand upon Boynton Hill as monuments, memorials to the two men whose names they bear. They tell us, too, of the reason for higher education, the idea of obtaining a higher place on the ladder of knowledge and a clearer view of the challenges students will face. They are landmarks that serve to identify the location from a distance, calling out the name of the place on which they stand. Finally, they are observation points, offering commanding views of their surroundings For all these reasons, the towers stand proudly, yet remain picturesque.

The road to the Hill

Olmsted's design for New York's Central Park treats us to a number of distinct spaces, which appear as complete scenes when viewed alone, but which were designed both to highlight the areas around them through contrast and to make the scale more spectacular. The view from the two towers also features many related scenes.

Imagine the views in the late 1800s: to the west is a magnificent panoramic view of Bancroft Hill rising from the foot of the campus. In the evening, light and shadow cascade across the campus from the hill's ridge of trees as the sun falls behind it.

Ninety degrees to the left appears a view of the Elm Park area, with its thickly forested hill sloping toward its then three ponds.

To the south we view a rolling field bounded by a middle ground composed of downtown Worcester and fringed by a distant wall of hills.

The view east plays host to the intertwining paths and roads of the campus, running down the side of the hill, darting in and out of the protective cover of the trees. A bit to the north, the rolling ridge of Green Hill comes into sight. The contrast of forests and open fields upon its summit adds to the splendor of this natural boundary.

The most commanding view comes to the north, where two distinct areas are introduced: Rural Cemetery and Institute Park.

Rural Cemetery, established in 1838 and set at the base of a small hill, has many clearly separated plots bound together by a system of roadways. An artistic scattering of trees in conjunction with the stone monuments adds much to the undulating landscape.

Institute Park lies directly between the campus and the Cemetery; it is composed of a man-made pond and the grounds surrounding it. The mirror-like surface of the water is broken by the presence of a thickly vegetated island, from which an extraordinarily picturesque view of the campus can be observed.

Andrew Jackson Downing, a one-time partner of Vaux, believed that the approach to a structure should be one of

repose until a clear, unobstructed view of such a structure can be unveiled in magnificent fashion. To accomplish this goal, Vaux planned a main approach that commenced near the southeast corner of the campus, offering a complementary view of the buildings.

One might think that the most viable solution to surmounting the hill would be a straight-line approach to the main buildings. However, the problem with such an approach was twofold: First, the steepness of the hill would make such an approach impractical. Second, it would diminish the effect of the landscape and de-emphasize the dominance of the main buildings. Thus, Vaux proposed that the approach sweep northwesterly toward the center of the campus.

This lengthening of the approach coincides with the ideas of Downing, that an approach " . . . should be chosen as to afford a sufficient drive through the grounds before arriving at the [building], to give the stranger some idea of the extent of the whole property . . ." From this point, the main road assumes a southwesterly direction by a gradual curve along the slope of the hill, which culminates with a sweep across the southern slope to land on the plateau in front of the principal building, Boynton Hall.

Marvin Richmond

Marvin Richmond

Vaux realized the importance of keeping as much of the natural scene as possible intact, so the chief amount of grading was done along the line of the road. The effect was to give it the appearance of a natural ridge, which of itself would suggest the reason for the location of the road.

Vaux treated the trees and shrubbery throughout the campus similarly, leaving what was already there when he could and beautifying where needed. His main planting and use of existing round-headed trees, such as oak and ash, considered to be the most picturesque varieties, helped harmonize the landscape and the buildings. Scattered throughout the ridge are evergreens and other spiry-topped trees, which provide contrast to those previously mentioned.

Complementing the main approach road was a system of walkways which seem to have been laid out either for convenience or pleasure. One walkway, which is still maintained, begins at the southeast corner of the lot and travels a fairly direct course to Boynton Hall. This route seems to have been constructed more for convenience than pleasure because of its brevity and steepness, but it remains a pleasing walk because of its wooded nature.

Another path runs from the center of the lot to Washburn Shops and was built for convenience. A third path appears to have been constructed solely for pleasure, winding through the undeveloped northeast section of the campus, where Gordon Library and Kaven Hall stand today, toward the main approach. The only true lawn area on the campus at the time was a level tract just north of the Boynton Street gate.

Looking southeast from Boynton Hill, ca. 1875 (opposite); Skull Tomb (top); the view up the hill from the main gate at the corner of Institute Road and Boynton Street, ca. 1885, shows the new north and south wings of Washburn Shops (left).

"The presence of water"

Salisbury's influence over the picturesque development of the campus continued late into the 19th century. Before his death in 1884, he had persuaded the city to change the name of old Jo Bill Road to Institute Road, and also to curve it around the bottom of Boynton Hill. This eliminated one of the straight-line boundaries of the original campus and replaced it with a natural curve, in accordance with the importance Downing placed on the use of curves wherever possible.

These small but meaningful changes helped in the improvement of the campus' appearance. But one major deficiency stood in the way of WPI's becoming a picture-book representation of the Picturesque aesthetic as put forth by Downing and his peers: the lack of water. Not surprisingly, perhaps, it would be Salisbury's only son, Stephen Salisbury III, who would find a solution to this deficiency that would serve the entire Worcester community.

Vaux had expressed similar concerns in his plans for the campus. He said that the only objection he had to the location of the school was the absence of water to complete the picturesque scene he was trying to create.

Stephen Salisbury III seemed to agree with Vaux's feelings, because around the same time finishing touches were being added to the WPI campus, Salisbury was planning the adjacent Institute Park. At this time, the school lacked ample land to be used by the students for leisure purposes. Salisbury acknowledged this fact by developing a piece of his family's estate into a city park, a tract that would come to serve almost as a second campus for the Institute.

Salisbury's intentions for founding the park did not, however, center on WPI. In a letter to the mayor of Worcester, the Hon. Samuel Winslow, Salisbury relates to the public his understanding of a problem that was plaguing Worcester as well as other cities. As the city grew in population, he noted, the grounds and gardens formerly surrounding homes were being divided, and in their place new structures were being built.

Urban growth of this type threatened space for public relaxation and enjoyment. Salisbury called for the establishment of a park system in order to secure land for public use before it was taken over for residential or commercial use. Olmsted had similar feelings to those of Salisbury. He tried to establish a system of parks in New York City but was met by great opposition and was confined almost entirely to the creation of Central Park.

The Institute Park pond, Salisbury Pond, was created in 1832 as a mill pond to supply power to a wire factory erected by the second Stephen Salisbury. But the relationship between the campus and Institute Park appears to be closer than merely an approximate fit: the two have become so close and dependent upon each other that to view them as individual parts of a whole can only serve to detract from their beauty.

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The view north, ca. 1880, shows Institute Park and the Norse Tower of Salisbury Pond.

Charles Nutt, in his *History of Worcester and its People*, noted that the Park itself serves as a campus for the Institute, and keeps open in front of its main buildings a picturesque foreground such as it could have in no other way.

For his part, Downing noted that "the simplest or the most monotonous view may be enlivened by the presence of water in any considerable quantity; and the most picturesque and striking landscape will, by its addition, receive a new charm, inexpressively enhancing all its former interest."

This unification of the Park and campus was the final step in the Salisburys' creation of a magnificent picturesque scene. Olmsted believed that, as a community matured, a class of people emerged as leaders—leaders who took public interest into their own hands, and acted for the benefit of all. The Salisburys' contributions prove that they were leaders of the character Olmsted described.

End of an era

With the turn of the century came the construction of a new building, Salisbury Labs. This building, which was funded almost completely by money left by Stephen Salisbury III, signaled WPI's first departure from the Picturesque ideals previously followed so closely. The plans for construction were drawn up by professors at WPI so that its interior would be "as useful as possible." The resulting exterior was somewhat boxy, unimaginative, and anything but picturesque. It is truly ironic after all the work the Salisburys put into developing the campus and Institute Park that the first breach of the picturesque principles on the campus would bear their name.

Each new building construction that followed would remain similarly detached from the Picturesque tradition. Gordon Library, built in 1967, was one notable exception. Many consider the 1986 renovation of Alumni Field, with its synthetic grass surface, as the ultimate departure from the picturesque.

Institute Park also underwent some major changes. While the pond remained basically unaltered, the bridge to the island was burned in the early 1900s by vandals, as were many of the Park's gazebos. The Norse tower was repeatedly repaired and finally razed in the 1950s because it was a safety hazard.

However, recent additions and proposed changes to WPI suggest a possible return to the recognition of Picturesque ideals. The roof of Founders Hall was gilded to reflect that of Boynton Hall, although the buildings are fundamentally different. This attention indicates an attempt to unify old and new elements of the campus.

In addition, the recent proposed closing of West Street reflects the need for additional campus recreational area and the importance of unifying the two halves of the campus, now separated by the street. [Following local opposition to the plan, WPI removed its proposal from City Council consideration.]

A rebirth of recognition of the role landscaping plays in construction suggests an awareness that is vital to the aesthetic integrity of college campuses, parks, and cities everywhere. This recognition speaks highly, as well, of the vision of planners such as Downing, Vaux, and Salisbury.

This article is excerpted from a Humanities Sufficiency report written by John Grimm and Paul Halloran in conjunction with the 1986 American Antiquarian Society Seminar, "The American Picturesque," Dr. John Conron, professor of English and American studies, seminar leader. Dr. Kent Ljungquist, associate professor of English, was adviser to the project.

Lost and found in thought

In writing a diary, even the most private person has a reader in mind.

By Joe Levine

Kevin Weber

About 10 minutes out of Raleigh, N.C., on a spring evening in 1979, an elderly woman aboard the southbound Amtrak Silver Star asked me to get her suitcases down from the luggage rack. I obliged, but ungraciously. I was in the midst of scribbling in the cheap gray notebook that served as my journal—something rhapsodic about the girl in the blue peacoat across the aisle—and I wanted to finish what seemed a particularly inspired thought before the fuss of arriving drove it out of my mind. But the elderly woman, like the knock on Coleridge's door, proved a fatal interruption: Not only was I unable to finish the entry, but I also left my journal on the train. No number of phone calls to Amtrak over the next few days could retrieve it from oblivion, and by now, eight years and nine journals later, I have to assume it is gone forever.

Why would I leave my journal on a train? And what became of it? I am both Freudian enough to believe that the act was intentional and literary enough, in a clichéd sort of way, to believe—even now—that it must have a Meaning.

Thomas Mallon, an English professor at Vassar College, has written a book on the motivations of journal-keepers, great and small (*A Book of One's Own: People and Their Diaries*). He offers me some insight into my own:

"Millions of journals have perished in late adolescent *Kinderdämmerungs*" (bursts of youthful self-hatred), he observes. " 'Oh, my God, how could I have written this?' the 17-year-old cries, and off into the wastebasket goes her book."

Or, in the case of my gray journal, off it went down Amtrak's Southeast Corridor. Yes, that makes sense. By leaving the thing on the train, I was closing the book on a self whom, at that time, I didn't much like, a wounded outsider who spent a lot of time worrying and feeling sorry for himself. Someone so overwhelmed by the social difficulties of college that he rarely made it to class, hiding out instead in a coffee house. The fateful train ride to Raleigh occurred during spring break of my sophomore year; by that summer I had notified my college adviser that I would be taking the following year off, and a year later, much restored by working a 12-hour-a-day job, I washed up on the shores of a new school.

But wait a minute: Unlike Mallon's horrified 17-year-old, I didn't throw out my journal. I left it on a train, roughly the equivalent of setting it afloat in a corked bottle, a message intended for other eyes. But whose? Hack scenarios leap to mind. The girl in the blue peacoat picks up the journal, and one day, years later, we accidentally end up in group therapy together. Or she finds it, reads a few pages, and gets so bored that she, too, leaves it on the train—as does a succession of other passengers. In fact, just about the only possibility I haven't given much consideration to is the most likely one of all: Someone picked it up and threw it in the trash without a second glance.

Mallon confirms that other diarists, even ones who haven't lost their notebooks, nourish similar delusions of grandeur. "No one ever kept a diary for just himself," he declares, adding that all journals are written for a "you" of some sort. A glance at something less than a cross section of the craft's more celebrated practitioners seems to back him up. For example:

- Samuel Pepys, the 17th-century English naval bureaucrat now generally regarded as the father of the modern journal, appears to boast on every page to some eternally appreciative drinking buddy, "I find my sexual exploits thoroughly entertaining, and you will, too."
- Anne Frank, in the (mostly female) tradition of adolescent confessional diaries, addresses hers by name—"Kitty"—and tells it at the outset, "We're going to be great pals!" In fact, Kitty becomes her only pal during the long months spent in hiding. When her father considers burning her journal to keep the Nazis from finding it, she threatens suicide.
- Arthur Bremer, the man who in 1972 shot George Wallace, was so concerned with how posterity would view him that he fretted in his journal (left in his truck) about the possibility of a natural disaster somewhere eclipsing his coverage on network news.

But Bremer is only an extreme exam-

An 1877 edition of Samuel Pepys' diaries includes a naval motif with his initials (left) and a London map showing the area destroyed by fire.

George Sand (above) preferred male attire. An 1851 print (right) is a rare salute to the courage of women in the West.

Secret writings make some delightful summer reading

Faculty members suggest some journals for enjoyment, insights, and an intimate view of scholarship.

"Man, woman, and child should not go to the grave without reading at least a couple of pages of the journals of Samuel Pepys, maybe the most delightful diarist there is. He had a cabinet post in the court of Charles II, and simply happened to live at a time when pretty spectacular things were happening in England."
—William Siebenschuh, vice dean of Western Reserve College, Case Western Reserve University (CWRU), and associate professor of English

"There are some excellent anthologies of 19th-century women's writings. *Revelations*, edited by Mary Jane Moffat and Charlotte Painter, is organized by subjects—love, work, power—and includes excerpts from Louisa May Alcott and George Sand. *Let Women Speak for Themselves*, edited by Christine Fischer, is about women in the American West—not big-name people, just ordinary people whose diaries she was able to find."
—Winifred Wandersee, assistant professor of history, Hartwick College

"The American composer Ned Rorem has published 10 books of his journals. They're pretty gossipy, but on a high, intellectual plane. Since I am a composer myself, I enjoy reading about what went on in his mind when he wrote the pieces I like."
—John Carbon, assistant professor of music, Franklin and Marshall College

"There are a couple of Crusades histories written by the participants—not warriors, but priests and monks. One, by a fellow named Odo of Deuil, is about the French portion of the Second Crusade [in the 12th century]. We don't know when they were written, just that after it was over, they wrote about it in a very personal way."
—Bernard F. Reilly, professor of history, Villanova University

"Joyce Warner's *That Time of Year* is a chronicle of life in a nursing home. She was a writer and taught English at Mount Holyoke, then developed crippling arthritis. She writes about trying to hold onto her sanity in that kind of environment. Novelist Barbara Pym kept journals all her life, recording observations about her feelings and works and how she kept writing, even though no publisher would accept her books. After her death, they were collected in a book called *A Very Private Eye*."
—Sarah H. Matthews, associate professor of sociology, Western Reserve College, CWRU

"The journal of Héroad, court physician for Louis XIII, is available only in French, but excerpts appear in *Parents and Children in History* by David Hunt. It tells about the medical practices of the time, which are frightening in some instances—it's definitely not a visit with Dr. Spock."
—Peter Wallace, assistant professor of history, Hartwick College

ple of Mallon's "apologist," the diarist who, by choice or chance, plays a part in the making of history and wants to shape the image of himself or herself that will live forever. Political administrations abound with these, as attested to by the spate of "papers" that are published once everyone is safely out of office. (Watergate brought a score of apologists to light and the Iran/*contra* scandal is a good bet to do the same.)

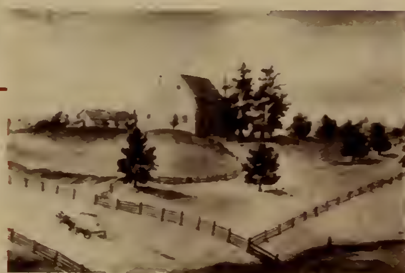
• The self-expressionist diarists, whom Mallon calls "pilgrims"—the group one would expect to have the most private impulses—are perhaps most concerned with their readers. Henry David Thoreau may have written the bulk of his 39-volume journal in splendid isolation, but he clearly did so for the edification of future disciples. From these journals, he culled material for *A Week on the Concord and Merrimac Rivers*, with its Zen-like meditation on the beauty of the reflection-world mirrored up from the water's surface; from the journals, too, came *Walden*, with its more overt urgings to be civilly disobedient.

• A pilgrim of this century, European author and diarist Anaïs Nin, for years refused to show her journals to friends or lovers, calling the books a "refuge" for the shy, frightened sides of herself. Yet she published them in a six-volume set before the end of her life, suggesting that those sides of herself had always yearned for an audience and were merely preparing for the day when they would be strong enough to face one.

The "you" each of us addresses may be less explicit than these, Mallon says. But "someday, like the one you love, he'll come along. In fact, you're counting on it. Someone will be reading and you'll be talking. And if you're talking, it means you're alive."

The journals of Louis XIII's court physician reveal the privileges of wealthy children, among them the time and the toys for play (above).

The Quaker "saint" John Woolman (left) traveled around the colonies preaching against slavery. He lived in this house in Mount Holly, N.J. (below).



Kevin Weber (all)

Novelist and critic Henry James (above) in 1912, the year in which he wrote the first of his three-volume set of memoirs.

"Joyce Maynard's *Looking Back, a Chronicle of Growing up Old in the 1960s*, was written when she was between 18 and 20. It's really pretty perceptive, and it's useful to us because it was about her own generation."
—John Andrew, associate professor of history and American studies, Franklin and Marshall College

"We have [at the archives] the complete diaries of Theo Brown, a designer with John Deere who graduated from WPI in 1901. These are really exquisite; they cover the period from 1893 to his death in 1972. He was also an artist and photographer, so they're full of drawings and photographs. We also have some of the early journals of Robert Goddard. Most are at Clark University, where he taught; a five-volume set of all of his papers has been published."
—Lora Brueck, archivist, Worcester Polytechnic Institute

"Astronomers haven't left many diaries, but they have left observing notebooks. When I was working at the Naval Observatory, I would sneak away to the rare books section (it had the best air-conditioning) and read Asaph Hall's observation book at the time he discovered the moons of Mars. When Halley's comet came, I looked at the records of the old observatory here [at F&M] about how the astronomer and his wife came home from church, put the horse away, and then charged over to the observatory to look at the comet."
—Michael A. Seeds, associate professor of astronomy, Franklin and Marshall College

"I would recommend the journal of John Woolman, the Quaker 'saint.' He greatly influenced me in my studies of 18th-century religious life in the Philadelphia area. His attention to the problems of the human species is very moving, and his attitude toward the treatment of Indians and blacks is quite compassionate."
—Donald B. Kelley, associate professor of history, Villanova University

"Woolman did a lot of traveling around the colonies, speaking out about slavery. He was a tailor, born in 1720. In the introduction to a later edition, John Greenleaf Whittier wrote that Woolman was only 4½ feet tall, a hunchback, and had arms longer than his legs. But his journal is one of the few that have come down from that time. On his own, using his own money and his own time, he was able to have considerable influence on his contemporaries."
—William Achor, professor of physics, Western Maryland College

"I've been following the ongoing series of diaries of Edmund Wilson, one of the best of the 20th century. I'm also looking forward to the journals of Henry James, which will be published soon. I think it will be interesting shop talk for writers and will show a more human side of him."
—Keith Richwine, professor of English and department chair, Western Maryland College

Compiled by Julia Ridgely

I'll buy that. I met my own "you" a long time ago, in 8th grade: Miss Staats, the English teacher who assigned and collected my very first journal and wrote encouraging comments in the margins.

"What are we supposed to write about?" most of the other kids complained the day she handed out the little spiral pads. But for me, the first time I sat down to write in the journal was a discovery of something I already knew how to do. I alternated between flights of self-discovery—"Saw a movie about Winston Churchill tonight. Have decided I'm going to be great"—and ecstasies of self-flagellation. The latter centered on my infatuation with Kathy, who was beautiful but for the most part ignored me, and my own indifference to Hilary, who was fat but had a crush on me and had asked me to the movies for my birthday. To add to my guilt, Kathy was going out with my friend Eddie. Of course, the times she would stop speaking to him just to keep him on his toes were the times when she would suddenly find it convenient to pay attention to me.

"Everything about my liking Kathy is bad," I wrote gloomily. "I'm betraying Hilary, and I'm going against my own principles. When it comes to affection, I'm a heel."

At the tender age of 13, then, I was already indelibly marked in Mallon's lexicon, as both a "confessor" and a "pilgrim." "By unburdening one's soul on paper, one could have one's sins and remember them, too," observes Mallon of the 19th-century confessional journal. Yes, that's me he's talking about. And here again, in the chapter on pilgrims: "Thoreau sees his diary as, literally, a container for the effervescings of a soul moving ever further toward enlightenment." That's me, too.

But whether heavy with guilt or laden with pretensions, all my 8th-grade journal entries were read with the most straight-faced care by Miss Staats. I know this because, when she handed the notebook back to me, I found exuberant red check marks on nearly every page. Next to the one in which I declared myself a heel were no less than two checks and the words, "Take this further."

And so I choose to believe that, when I left my gray journal aboard the Silver Star, it was with the subconscious hope that it would one day meet up with a reader as accepting as Miss Staats, someone more tolerant of me than I was of myself. In my journals since then, I have always addressed such an ideal reader. She understands me precisely as I wish to be understood; looks over my shoulder and nods approvingly when I do something clever or noble; moves back to a respectful distance when I berate myself for moments of cowardice, only to return fully refreshed as soon as the tirade is over. I have, I suppose, internalized Miss Staats.

"We are well advised to keep on nodding terms with the people we used to be, whether we find them attractive company or not," Joan Didion writes in her essay "On Keeping a Notebook." "Otherwise they turn up unannounced and surprise us, come hammering on the mind's door at 4 a.m. of a bad night and demand to know who deserted them, who betrayed them, who is going to make amends."

At one point, a few years back, I had reversed Didion's image. It was I who, quite literally, was hammering on the past's door, finding constant excuses to go back and visit the college I had fled. But now my curiosity about the past has dimmed to a simple fantasy about the lost gray journal: that someday I will get it back. If nothing else, this harmless preoccupation has given me an awareness of other people who are hunting their own ghosts.

Last summer, while teaching a prose class at a college prep program in New England, I encountered one of these kindred spirits. I was now cast in the role of Miss Staats, trying to persuade skeptical teenagers that they, too, might find it rewarding to write down their thoughts and observations in a notebook. Their complaint was an echo from 8th grade: "What are we supposed to write about?"

But one girl, a short, talky kid whom I'll call Libby, kept handing me entries pages thick. They were a wonderful confirmation of Didion's belief that "keepers of private notebooks are a different breed altogether ... children afflicted apparently at birth with some presentiment of loss." Most of her writings were about her father, who had become ill when she was very small and died soon afterward. She could remember little about him directly, but she had a clear image of him because relatives, family friends, and store keepers on the block where she lived had all told her many times what a fine, compassionate man he was.

"I know I would have liked him," she wrote. He had been forced to walk with a cane near the end of his life, and of that she said, "I wish I had been old enough to help him. I know I would not have minded walking slowly with him."

And there was more: stories about him, including one about a dying father and baby daughter, neither of whom can sleep at night. It was all lovely stuff. But finally my curiosity got the better of me, and I asked Libby if she had any idea why she was thinking so much about her father just then.

She answered the question with another journal entry, about a conversation she had had with her mother just before coming to summer school. It was time Libby knew something of her own history, her mother said. She had been conceived by artificial insemination from an anonymous donor, because the illness of her father had left him sterile. Libby's mother was sorry to drop this on her all of a sudden, but there was never going to be a "right" time, and Libby was old enough now to know.

"I felt as if the wind had been permanently knocked out of me," Libby wrote in her journal. "In one sense, nothing had changed, but in another sense, it was as if my father was no longer my father."

And yet there was still this image that had become part of her, and the frightening, alluring knowledge that somewhere out there, her natural father might well still be alive. In a way, the bomb her mother had dropped, far from severing her from a father she had already lost, gave her new license to seek him again in her mind. "Sometimes now I imagine turning the corner onto a familiar street, and there he is," Libby wrote. "Our eyes meet and we recognize each other."

The way I see it, I am no more likely to be reunited with my lost journal than Libby is with her fantasy father. In either case, a reunion would probably result in disappointment. But both of us are free to fill our journals with imaginings of such a meeting, and from imaginings often come stories.

Joe Levine remains a frequent train traveler, claiming trains are still the best place to get any writing done. He asks only that you call him in New York if you ever find his lost journal.

THE COMING OF CHAOS

One day three years ago, sitting in his office idly skimming through a borrowed textbook, Jack Clark found himself looking into a bewildering new world.

The book was *Theoretical Ecology,* edited by a Princeton biologist, Robert May. The subject was, of all things, insect and animal populations. And there, on page 11 or so, May was saying that some laughably simple little equation exhibited behavior he called "bizarre." Clark, associate professor of mathematics at Western Maryland College, had his doubts.

Many equations have unusual properties, he knew. But this one, for heaven's sake, was not one of them. If anything, it was among the most familiar in all of mathematics. "It's a parabola," Clark thought to himself, referring to the equation's geometrical representation, a staple of high school math courses. "How complicated can it be?" What could be so bizarre and bewildering about it?

"I looked at it," he recalls. "And it was."

The equation was a model for estimating the future size of an insect population on the basis of its present size, taking into account its natural growth rate and making allowances for losses due to food shortages, predators, crowding, and other environmental checks. It was not a particularly sophisticated model. "It's the simplest possible example," says Clark. "You can't look at anything simpler." Yet the behavior it predicted was "absolutely mind-boggling."

To use the equation, you simply plug in the current year's population and compute the next year's, then use that to figure the following year's, and so forth. "Iteration," mathematicians call it. The results hinge on the natural growth rate, a sort of compound interest factor related to the species' reproductive capacity. Below a certain value, not surprisingly, the population dies off. For growth rates a little higher, the population climbs, then levels off. All of this is to be expected.

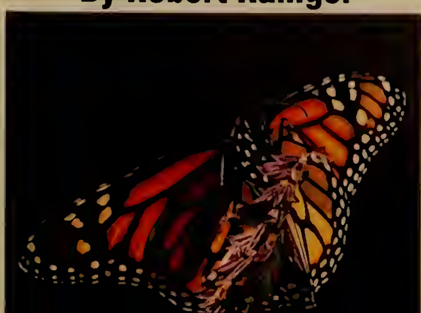
Then things get sticky. For a still higher growth rate, you get a surprising twist. One year, starting with a small insect population, you might have plenty of food and other resources, therefore unchecked breeding. The result? A higher population the following year. The year after that, thanks to fevered competition for mates, food, and breathing room, many of the insects die off. Then, the next year, population is back up. It's like the story of Joseph in the Bible, said Leo Kadanoff, a University of Chicago physics professor explaining the same equation recently to a group of physics students and faculty at The Johns Hopkins University. Joseph prophesied seven years of feast followed by seven of famine. Well, under the right circumstances, this funny little equation predicts just such a feast-or-famine cycle.

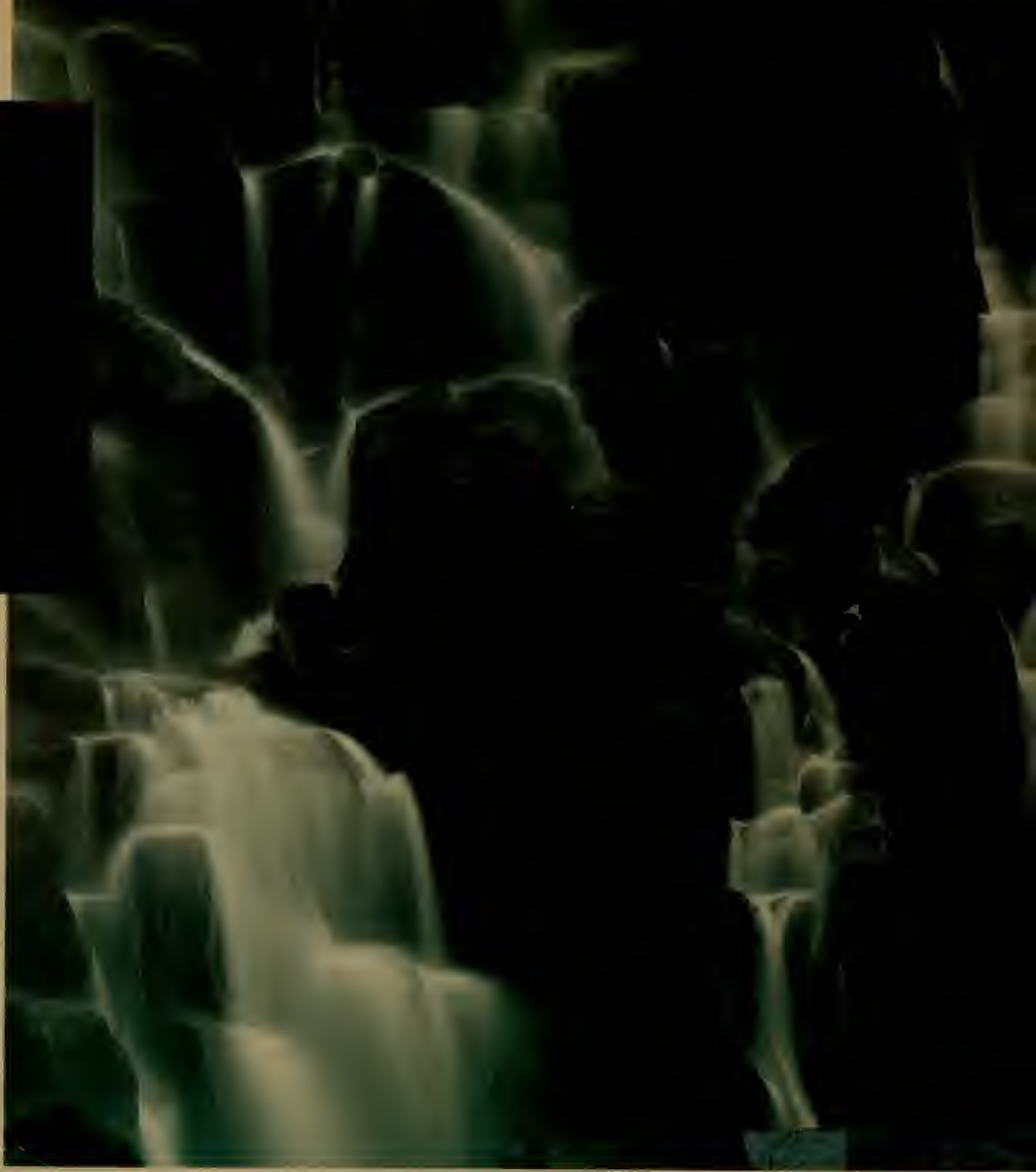
All this, though, still lies within the bounds of intuition and common sense. But now, at yet higher values of the growth rate, the equation predicts even more outlandish results. Now the population doesn't simply oscillate between feast or famine year by year, but among four discrete population levels in a regular cycle. And with higher values still, you get an eight-year cycle, until ultimately, the population shifts among an infinite number of levels over an infinitely long cycle.

At this point, the population neither dies out, nor climbs toward a plateau, nor takes regular swings from year to year. In fact, it seems to conform to no

This emerging area of study helps to predict the unpredictable. But it also uncovers anarchy in unexpected places. Chaos theory is the flutter heard round the world.

By Robert Kanigel





Kevin Weber

From the roll of dice to a roiling waterfall, chaos researchers seek the patterns in seemingly random events. Edward N. Lorenz at MIT generated the butterfly (preceding page, top) in solving equations on his computer.

pattern at all. Say you start off with 300,000 insects. The next year the equation might predict 840,000. The third, 537,000. The fourth, 994,000. The fifth, 23,000. The sixth, 89,000. It never goes above or below certain values. But within that range there seems to be no rule, no law, no pattern that applies. Why, to someone not privy to what's going on, the population might seem quite unpredictable, the outcome not of an equation methodically churning out preordained results but some random process subject only to cosmic whim.

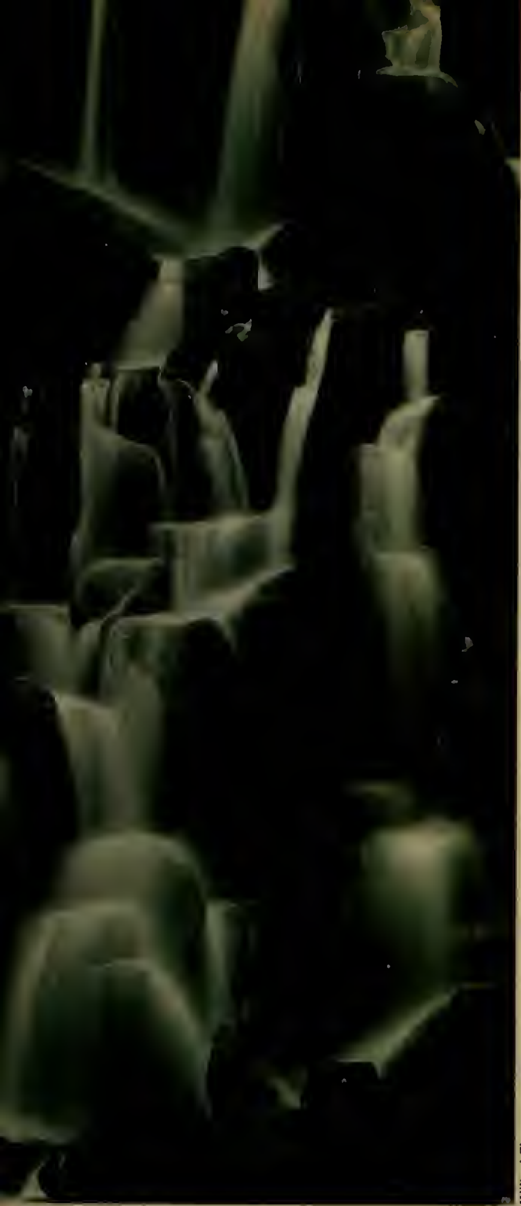
More wonders lay ahead. "When you play around with that simple equation," says Clark, who's been mesmerized by it ever since, "you come back shaking your head." In it he would find "Lorenz masks" and "strange attractors" and "Feigenbaum numbers" and stunning computer graphics and all manner of strange and wonderful mathematical behavior. "The deeper you look, the more mystifying it becomes. If you take the bifurcation diagram and really explore it, you're led from one mystery to another. The problem itself seems to be fractal-like," Clark adds, referring to mathematical shapes that, like the map of a seacoast, retain their complexity no matter the scale at which they're observed. For Clark, "it was the most amazing stuff I've ever seen."

There, sitting quietly in his office in Lewis Hall in Westminster, Md., and skimming through a borrowed book, Jack Clark had stumbled into the emerging field of chaos.

Chaos theory is about pattern and form, randomness and order. The simple equation so seductive to Clark is but the tip of an iceberg, the simplest manifestation of a new area of study that has hypnotized scientists and scholars around the country. "Everybody's into chaos," says Thomas Bridges, a Worcester Polytechnic Institute mathematician. Researchers are using chaos theory to seek hidden patterns in heartbeats and electroencephalograms. To analyze fluid flow. To model arms buildups that could lead to nuclear war. To study the tumbling of Saturn's moons.

Chaos theory has scant respect for traditional disciplines. The math and physics journals are full of it, of course. But it's also the topic of conferences attracting people who might otherwise never sit in the same room together, like stock market analysts, neurobiologists, and philosophers. And a lot of them, when they first encounter the subject, find themselves shaking their heads in awe the way Jack Clark did.

Chaos theory says that out of pristine



Willard Clay

mathematics can emerge a seeming anarchy. Yet viewed another way, it holds out the promise that complex phenomena once written off as the natural consequence of a random universe—the ups and downs of the stock market, the roiling turbulence of a waterfall, the sudden swings of the weather, the mysterious rises and falls of animal populations, perhaps even the idiosyncrasies of human personality—might profitably come under the scientist's magnifying glass for a second look. This new discipline seems to say that amid the seeming confusion of everyday events lurks a hidden harmony.

"A new paradigm in scientific modeling," chaos theory has been called.

That, as it happens, is among the more modest appraisals of it. Joseph Ford, professor of physics at Georgia Institute of Technology, says chaos theory portends "a third revolution in physics," the next step after relativity and quantum mechanics.

And Ralph Abraham, a University of California at Santa Cruz (UCSC) mathematician, goes Ford one better. Chaos theory, he declares, "is as important historically as the discovery of the wheel."

How long before a falling apple reaches the ground? To what speed must a rocket be propelled to reach earth orbit? These are great, old problems, beloved by every high school physics teacher for their straightforward equations and unambiguous answers. They are models for the kind of analysis in which classical physics glories. But relatively few real-life problems yield to such neat solution.

Chaos theory helps with some of the untidy problems.

In 1776, the French mathematician and astronomer Pierre-Simon de Laplace declared that one had only to know the position and velocity of every particle in the universe in order to predict its whole future course. "Determinism" is the doctrine associated with that boast: the idea that inviolable physical laws completely account for all subsequent events. And down through the years scientists and mathematicians have sought to discover these laws.

But this has not proved easy, the universe only occasionally arranging itself with falling-apple neatness. As F. Tito Arrechi, an Italian laser physicist, observed at a recent chaos conference in California: "Ideal problems are just in the textbooks, for the joy or desperation of students." So to wind up with *something*—some model of real-world behavior, however flawed—scientists make simplifying assumptions.

Linearity is one assumption that helps most to make the equations manageable: double the input, double the output. Triple the input, triple the output. The more you do something, the proportionally greater effect it has. The word linearity comes from what you get when you graph the results—a straight line.

Most phenomena, of course, are not linear. The rise and fall of animal populations is one example. Another is the turbulent flow around an airplane wing. Human behavior is about as non-linear as you can get. Yet non-linear equations become hopelessly complex. In fluid mechanics, for example, "you start with these horrible differential equations and usually you can't solve them in even the simplest boundary conditions" (the special cases that sidestep some of the mathematical obstacles), notes Robert Brown, professor of physics at Case Western Reserve University (CWRU). The equations do describe the behavior, yet using them for any but the simplest cases is next to impossible. So, as Brown's colleague, mathematician Michael Hurley, says, "you tend to ignore the non-linear problems altogether because no techniques are available to solve them." The world in all its rich complexity, then, remains elusively outside the theoretician's reach.

But now, with the coming of chaos theory, all this may change. Chaos theory helps scientists to understand nature's messy and maddening unpredictability.

Indeed, it *predicts* unpredictability.

With simple, linear systems, if you're a little bit off in counting up how many you have of something or in noting where you are, then somewhere down the line, your answer is a bit off. Not so in chaotic systems. There, if you're just a little off, your prediction is blown to pieces. The laws of physics still apply; except for quantum mechanical effects, which predict uncertainty at the subatomic level, the outcome is preordained. It's just that *predicting* the outcome is impossible. The back alley crapshooter "determines" the roll of the dice. He shakes them up, perhaps mutters an incantation over them, then rolls them onto a stretch of familiar sidewalk. Yet, loaded dice excluded, he can't predict how they'll fall. And the best physicist in the world, using the best computers in the world, can't do any better.

Mathematicians call it "sensitive dependence on initial conditions." To illustrate its power, James P. Crutchfield and three other chaos researchers describe an idealized billiards game in which the balls roll and bump their way around the table with no loss of energy. In such a game, they note, even an all-knowing player in perfect control of the cue stick would be powerless to make the balls go where he or she wished. Were the player to ignore an effect even "as minuscule as the gravitational attraction of an electron at the edge of the galaxy," the balls would be out of position after one minute of bouncing around the table, the researchers theorized in *Scientific American* (December 1986).

Kadanoff at Chicago gives a more consequential example. Imagine, he says, that a weather forecaster could instantly consult the past century's weather maps, with their temperatures, barometric pressures, cold fronts, developing storms, and the rest—all precisely recorded. Well, you might think, to develop an accurate long-range forecast (predictions for one or two days are easy) maybe you need only go back through the stack of weather maps until you find one just like today's. Say that day was May 15, 1892. To predict the weather for two weeks from today, just pull out the map for May 29, 1892, and, presto! you've got it!

It doesn't work, of course, not even approximately. And that's one reason most meteorologists think that detailed long-range weather forecasting is impossible. In this grossly non-linear system, all it takes is the tiniest, seemingly most insignificant difference between today's map and the 1892 map to throw your predictions completely askew.

The unpredictability of chaotic systems is the dark side of the new field. The bright side is that behind much of what passes in nature for formlessness, anarchy, or mere chance resides order—an order hard to discern. Chaos theory gives scientists a way to find the pattern.

"It's miraculous. You're not going to believe it. A lot of people haven't grokked it yet," says UCSC's Abraham, warming up to tell you about the liberating experimental approach that chaos theory permits. Want to find the hidden order in something even so agitated and irregular as a waterfall? OK, you select a point of reference in the middle of the fall. You rig up mirrors or lasers or whatever you need to pick up the reflected, shimmering whiteness of one point in the flow, then aim it back at a photo cell. At regular intervals you sample the intensity recorded by the photocell, digitize it, and feed it into a computer. Then you massage the data, performing simple manipulations on it, and assemble it into matrices—big banks of numbers. Plug it into a computer graphics software package, plot it out on the screen, and see what you get.

Then, not necessarily, and maybe not by following just this scenario, and maybe only after much diddling with the data, what you get on the screen just might be lovely, feathery, swirling patterns. Quite often, they are the same patterns others have recorded in other systems, sometimes so recurrently that by now the patterns have names—like Lorenz masks and Birkhoff bagels and Rössler funnels, each one honoring the scientist who discovered it. "It's amazing, just amazing, that this trick has worked for so much data," says Abraham. Problems in chemistry, fluid flow, epidemiology, and astronomy have all benefited from this and kindred approaches.

What Rob Shaw did back in the 1970s exemplifies the freedom the new approach grants. One day, according to the story, Shaw, then a graduate student at UCSC, was bothered by a drip in his laboratory faucet. It didn't go drip . . . drip . . . drip . . . like some faucets. But rather, when the valve was set just right, it went drip . . . . . . drip . . . drip . drip . . . . drip . . . . drip . . . drip in no perceptible pattern. It followed a script that, before the coming of chaos theory, might have been written off as random. Intrigued, Shaw rigged up a microphone so that each drop recorded the time of its arrival, then fed this into a computer and graphed the results. The data created a sinuous three-dimensional curve that wound up in a book, *The Dripping Faucet: A Model Chaotic System*.

Note that the strategy Abraham describes and Shaw's work demonstrates does not require analysis of the forces acting on some hypothetical tiny particle of water, as a more traditional approach might. There are no differential equations to solve, no traditional mathematics at all. All you've got are numbers. All you do is play with them. And midst the waterfall's thunder or the faucet's drip, all you seek is pattern.

Lorenz masks, Birkhoff bagels, Rössler funnels, and the other recurring patterns are geometric representations of what mathematicians call "strange attractors."

An attractor is simply the value, or group of values, to which a system is remorselessly drawn, and it need not be "strange." A roast placed in a freezer will ultimately cool to the temperature of the freezer. A lump of clay dropped on the floor will land there; it won't get up and run around. Mathematically, the freezer temperature and that spot on the floor are examples of point attractors. But neither one is a strange attractor.

Drop a hard rubber ball on the floor and you've got something a little different. Without air resistance and friction (and with a lively enough ball even with them), the ball will occupy a series of positions—up and down, up and down—in a regular and predictable way. This is called a periodic attractor; but it's still not "strange."

A strange attractor still draws the system to a range of values. But now there seems to be no readily apparent pattern. But there *is* a pattern, it turns out, one so awesomely convoluted that it's never obvious at first glance. Only when plotted out by the computer in what mathematicians call "phase space" does it take the shape of Lorenz masks or Rössler funnels or the rest. Were purely random processes at work, the resulting computer plot would be nothing but a featureless smear of points.

While outcomes represented on a Lorenz mask are free to roam anywhere on that elaborately twisted and folded contour, making prediction impossible, they are at least *confined* to that sea of swirls. They can, unpredictably, assume many values—but not *any* values. Therein lies the peculiar, almost paradoxical, nature of strange attractors. The path of the ball played in a pinball game

can't be predicted; yet you know that, in the next second, it won't wind up clanking around in a communications satellite over the North Pole. Edward N. Lorenz at MIT discovered Lorenz masks while proving that accurate long-range weather forecasts are impossible; still, one can state confidently that Miami won't face snow in August.

Lorenz masks and the other shapes reveal the aesthetically satisfying form sometimes lurking in apparent chaos. A similarly satisfying mathematical pattern describes nature's descent *into* chaos.

About a decade ago, Mitchell Feigenbaum, a particle physicist then visiting Los Alamos National Laboratory in New Mexico, began studying an equation similar to the insect population one with which Jack Clark later became so absorbed in Westminster, Md. With that equation, if you push up the growth factor far enough, the population begins oscillating between feast and famine. Push it up more and the two-year cycle bifurcates into a four-year cycle, then eight, and so on. "Period doubling" is the mathematical term. Well, playing around with a hand-held calculator, Feigenbaum discovered that the values of the growth factors at which these bifurcations took place were all related by a common number, 4.669, now known as Feigenbaum's number.

This was intriguing enough. Even more intriguing, when Feigenbaum looked at completely different equations that bore no outward resemblance to the insect population equation—systems similar in that they degenerated into chaos through period doubling—he got exactly the same number. And got it down to 15 decimal places. This was downright bizarre. Embedded in the mathematics governing the onset of chaos lay a kind of strange universality.

There is something heady, even intoxicating, about a science that draws a route map to chaos with a hand-held calculator. That reveals enchanting computer swirls lurking behind a jumble of confused data. That encourages an experiment, like Rob Shaw's with the dripping faucet, requiring nothing more than what someone once described as "a contraption that looks like a precocious child's project for the science fair."

Is it any wonder that chaos theory fires the imagination of scientists? Or that, as Abraham says, "people are in love with chaos"? The old mathematics, with its simplifications and idealizations, had

Peter Howard

A look at insect populations led Jack Clark at Western Maryland College to the world of chaos.

Kelly & Massa

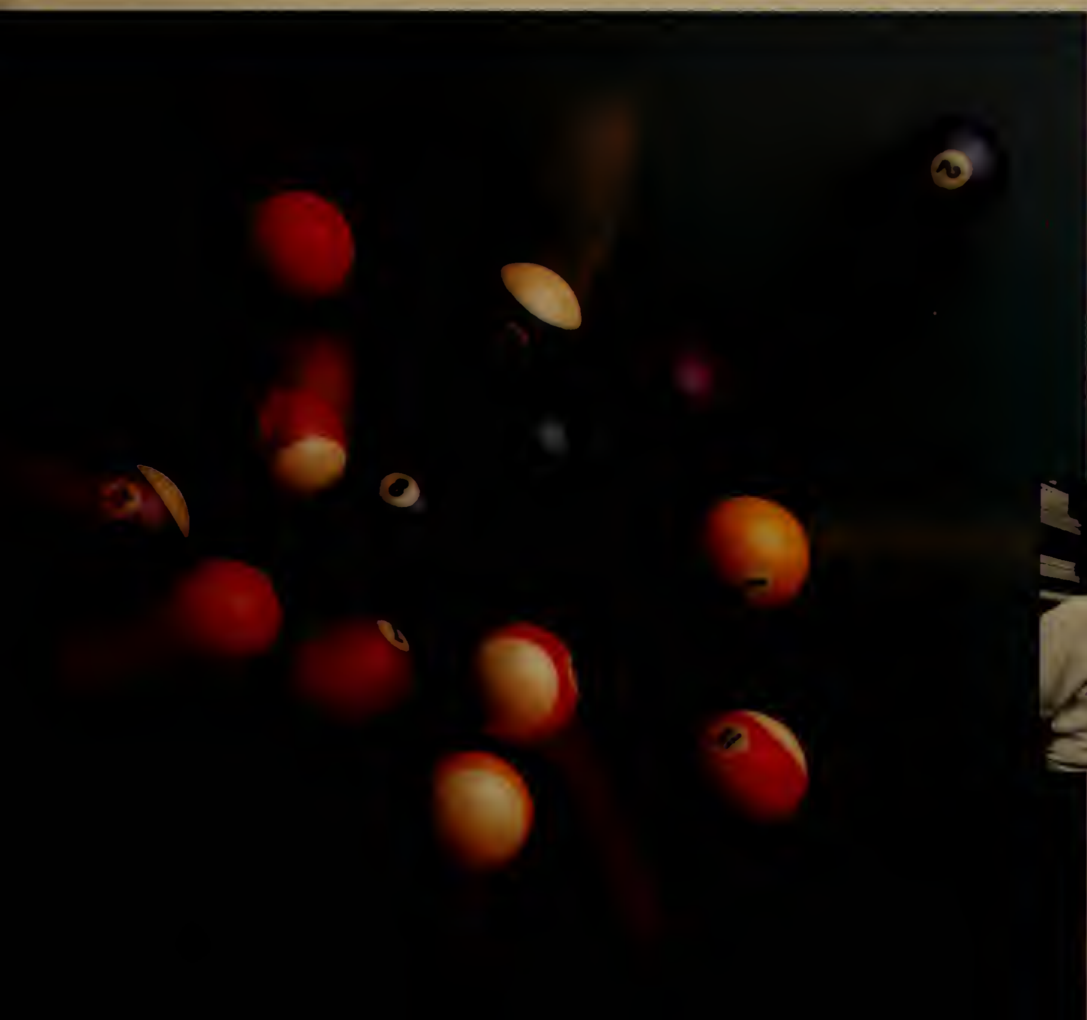
Villanova physicist Kenneth Hartzell found unpredictable fluctuations in a free electron laser.

CWRU's Michael Hurley (below left) and Robert Brown see some potential in chaos theory.

Doug Garmon (both)

But even in fluid turbulence, this new focus can't provide all the answers, adds WPI's Mayer Humi.

Robert S. Arnold



Kevin Weber

Imagine a billiards game where no energy is lost. One electron could alter the result.

failed the laboratory scientist, said Shervert H. Frazier, director of the National Institute of Mental Health. He gave the introductory remarks at a National Institutes of Health conference last year devoted to such biomedical applications of chaos theory as the study of irregular heartbeats, muscle tremors, and manic-depressive mood swings. "The 'messy' new mathematics sounds more promising. I like the new words of the field," Frazier adds. "'Chaos' and 'strange attractor' sound like syndromes with which I can identify as a psychiatrist."

This funny-looking new mathematical kid on the block seems better suited to the complexity and unpredictability of nature, Frazier is saying, than does the chaste mathematics first handed down to us by Newton.

When James B. Ramsey was a student at the University of British Columbia in Canada, he helped to work his way through school as a trader on the Vancouver Stock Exchange. He specialized in certain mining stock often subject to wild fluctuations. An assay would be announced and the stock would shoot up. News that cast doubt on the assay would send the stock plummeting. A contract with the Japanese or plans for a tunnel through the mountains to reduce the cost of getting the ore to market could send a stock from $5 to $20 in five minutes.

Once, economic theorists would have been happy to predict the price of the stock at the end of those five minutes, explains Ramsey, who today is an economist at New York University. Yet it was only *within* those five minutes and before the stock had stabilized, he remembers, that he'd had a chance to make money. "In 10 minutes, or half an hour, it was all over. You'd had it." Chaos theory, he believes, offers a way to better understand the gyrations of a stock during such tumultuous intervals. And that's one of the things he's working on today.

Of course, as he has found, it's not so easy. He has tried to apply chaos theory not only to stock prices but also to industrial production, money supply, work stoppages, and other economic data. But so far, none of those ghostly computer patterns have emerged from the data. And Ramsey is convinced today that "it's very, very unlikely that any form of simple [chaotic] attractor will be discovered for economic data." Such data is too influenced by a complex interplay of forces to yield to anything so relatively straightforward.

Is chaos, perhaps, being oversold?

"Although it gives scientists a chance to get a hold on non-linear problems," says Hurley of CWRU, "there are still lots of non-linear problems chaos theory can't handle." For example, José Scheinkman, an economics professor at the University of Chicago, has found evidence for non-linear processes behind apparently random economic data—only to find himself unable to describe just *which* non-linear processes. To Scheinkman, chaos theory is endlessly promising. "But," he cautions, "we're just starting."

Some traditional scientists are known to view the still infant science as flaky and lacking in rigor, and its proponents—virtually all of them interdisciplinarians of one stripe or another—as dilettantes. Adds Brown, Hurley's colleague at CWRU: "Some think there's nothing going on here as long as they can't use it to design a better torpedo or airplane."

In fact, according to reports from a recent conference in California, engineers designing the tail section of the Boeing 767 reduced its air resistance using mathematical methods sharpened on problems in chaos theory. Chaos research is also aiding recovery of secondary oil reserves, learned the participants at that conference, which brought together chaos researchers from 14 countries. The Navy is said to be actively funding chaos study because it could help reduce the drag on ocean-going warships. And a McGill University physiologist, Leon Glass, has successfully enlisted chaos theory to model the behavior of cells in the heart.

Then, too, as knowledge begins to percolate down from the work of the pioneers, the prospects for practical application increase—because now scientists know enough to look for it. Kenneth Hartzell, an assistant professor of physics at Villanova University, for example, recently found a suspiciously chaotic clump of data in experimental work with a free electron laser. In such a laser, the paths of electrons passing into an evacuated region between two mirrors are twisted and turned under the influence of magnets arrayed along the outside, generating light. Hartzell found that when the magnets were arranged in a certain way, the train of electrons fired into the laser, normally spaced in a regular and

Kevin Weber

As intriguing patterns appear, drip by drip, cloud by cloud, the field of chaos whets the appetites of some scientists. Others call it flaky.

predictable pattern, began to spread and contract unpredictably. "The bunching parameter displays very high frequency fluctuations with a chaotic-looking structure," he noted in a paper submitted to *Physics Letters*.

Hartzell couldn't say for sure just what was happening. Was it chaos or wasn't it? Still, he was attuned to the *possibility* of it. Ten years ago, the unusual data would have been written off as experimental error.

Around the country, the same thing is happening: The concept of chaos is entering the vocabulary of intellectual work.

Can such seemingly intractable social problems as crime, poverty, and war be interpreted as the natural consequence of chaotic systems? Are children molded by small, seemingly trivial events—as in the "Rosebud" story from the film *Citizen Kane*—as much as by traumatic ones? Could it be that while parents certainly do influence their children, it can never be predicted just *how*?

Might musical, artistic, or literary creation be seen as powerfully set in motion by choice of the first measure, the first

Willard Clay

brush stroke, the first sentence, with the final piece inexorably flowing from, or at least exquisitely sensitive to, these "initial conditions"?

Could an understanding of dreams benefit from insights granted by chaos theory? Might their bizarre nature be the by-product of a chaotic system whose "initial conditions" are the brain waves corresponding to some final waking thought?

Still in its infancy as a discipline, chaos hints at immense explanatory powers with applications as yet uncharted. Strange attractors "act as a kind of pump bringing microscopic fluctuations up to a macroscopic expression," Crutchfield and his co-authors write in *Scientific American*. Quantum mechanics, they observe, "implies that initial measurements are always uncertain, and chaos ensures that the uncertainties will quickly overwhelm the ability to make predictions . . ." It's impossible to estimate the implications of that insight for helping to explain the maddeningly confusing and unpredictable phenomena of everyday life.

But answers are hard to come by. Cautions Mayer Humi, a Worcester Polytechnic Institute mathematician, they're hard to come by even in the study of fluid turbulence, the intellectual progenitor of chaos theory and the area to which it has been most directly applied. The problems Ramsey and Scheinkman have had in applying chaos theory to economics testify to how far the new science has to go. Application to yet murkier areas, obviously, lies still further in the future.

Still, as yet unfettered by established Truth, chaos theory virtually incites speculation: Crutchfield and his co-authors, for example, have suggested that an animal fleeing from a predator, to make its flight path more random, might rely on the "amplification of small fluctuations" so characteristic of chaos. And in humans, "innate creativity may have an underlying chaotic process that selectively amplifies small fluctuations" in the brain and molds them into the mental states that are experienced as thoughts.

Such a "sensitive dependence on initial conditions" in the embryo may be a factor in the development of human personality, notes Alan Garfinkel, a kinesiologist at the Crump Institute for Medical Engineering at the University of California at Los Angeles. And schizophrenia may also result from chaotic process, he told Judith Hooper and Dick Teresi, authors of *The 3-Pound Universe*. Schizophrenics "wander quasi-randomly from one thought to another. That's extreme sensitivity to initial conditions. Then, on the other hand, you have very rigid behavior, fixed delusions and obsessions. Everything reminds you of x. Every little thing takes you back to the 'attractor.'"

Again and again, chaos has been portrayed as helping to reconcile the philosophical concepts of free will and determinism: The future is determined by the present, yes. But tomorrow hangs on the knife edge of today, needing but the barest breath of free will or circumstance to direct it one way or the other—toward a Mother Theresa, or a Qaddafi.

Fate? Karma? Chaos?

Bring up chaos, it seems, and pretty soon you're talking about butterflies. One writer retells a Ray Bradbury story in which a time traveler, cautioned not to interfere in the world he visits, inadvertently tramples a butterfly. When the voyager returns to his own time, the world is changed forever.

Every treatment of chaos—this one will be no exception—records how the flutter of a butterfly's wings in Tahiti, say, could conceivably cause drought in the Great Plains. (The image, as it happens, goes back to Lorenz, whose classic "mask" has also been compared to a butterfly in flight.)

Both examples illustrate a sensitivity to change in natural systems that the butterfly's lightness and delicacy fittingly symbolize. Indeed, Western Maryland's Jack Clark thinks that chaos theory may have its most lasting and profound impact on ecological studies. "Natural systems are delicate and easily sent askew," is how he expresses the crucial, mathematically validated lesson of the new discipline. As numerous environmental calamities attest, "you can have a nice equilibrium disturbed very slightly and made to go haywire."

We need to learn that lesson again, he says. "Chaos theory may have come just in time to save us all."

Robert Kanigel, a Baltimore-based writer, is the author of Apprentice to Genius: The Making of a Scientific Dynasty *(Macmillan, 1986). This book about mentoring relationships among elite scientists grew out of an article published by the Alumni Magazine Consortium.*

Toward a More Perfect Union

By Julia Ridgely

Amy Doudiken Wells

A state university's student newspaper plans to publish an article on dormitory conditions. The reporter writes a piece sharply criticizing the university for failing to test fire alarms or to provide enough emergency exits. The student editor submits the story for review to a faculty adviser, who strikes out the section on fire safety because it's bad public relations. If that article is published, the adviser warns, he will block distribution of the paper. He then searches the reporter's desk at the newspaper office and finds a copy of a confidential memo from the director of housing—a memo, he suspects, that the student obtained by devious means. So the university expels the reporter without a hearing. When an instructor writes to the local paper expressing support for the student, she is fired.

Reading this scenario—culled from real cases—few people would doubt that the university had violated many constitutional rights, from free press to due process. But before 1961, no court would have agreed. That year, the Supreme Court heard the case of nine black students at the University of Alabama who were expelled without a hearing after a protest. In this case, Dixon v. Alabama State Board of Education, the Court ruled that the students' constitutional right to due process had been violated. In 1969, in the Tinker v. Des Moines Independent School District case, the court broadened the principle, affirming that, "it can hardly be argued that either students or teachers shed their constitutional rights to freedom of speech or expression at the schoolhouse gate."

Just as new to the courts is the concept of academic freedom, the tradition that generally protects college teachers and researchers from censorship. "Most people think that academic freedom is a constitutional right," says Matthew W. Finkin, chair of the American Association of University Professors' (AAUP) Committee on Academic Freedom (Committee A). "As a legal concept, it's only been in existence about 35 years. The idea itself goes back to the Middle Ages. You have an older doctrine that was not legally enforced in any way but has begun to be enforced as an aspect of constitutional law. The fit is not yet a good fit."

Since the Middle Ages, too, town and gown have traditionally remained separate. In the United States, after the Constitution became law in 1787, new, private colleges were founded in the hope that they could avoid state control. In 1819, they received the Supreme Court seal of approval: The landmark Dartmouth College case guaranteed that the private college, like the private business, should be free of federal restraint.

In the 142 years between the Dartmouth and Dixon cases, the courts established few other legal precedents to distinguish between the privileges of public and private universities. It wasn't until 1961 and Dixon that the Constitution came to the campus gates. Since Dixon, public universities have struggled to make the traditions of the university conform to the necessities of the law.

The Constitution was ratified 200 years ago. But colleges are still trying to reconcile the call for rights with the need for restraints.

Tracing the separate paths of public and private institutions is not easy, because distinctions can be unclear between the two types of universities, between state and federal law, and between protected rights and unprotected actions.

Private institutions can make and enforce their own rules because the Constitution prohibits only *state* actions that restrict rights. Just as private employers can require staff to quit smoking, wear suits, or submit to drug tests, private schools can require students to obey curfews, carry I.D. cards, or not serve beer at on-campus parties. Yet most private colleges also recognize the value of giving students many of the rights and responsibilities they will have in the "real world" while the students are still within the protecting campus walls.

The decisions of private institutions can be more difficult and painful than those of a court, since the schools must weigh real situations not only against the law but against the moral ideal of a college or university. Administrators often have to make spur-of-the-moment choices: When must a demonstration be stopped because it interferes with classes? Should a newspaper be published even if it offends some people? How can the rights of an individual be weighed against the needs of the school? In effect, the college must act as its own court.

Ever since the precedent set by Dixon, public higher educational institutions have been considered an arm of the state. Their actions are therefore the "state actions" that the Constitution prohibits from abridging freedoms. A student editor claims that cutting funds for a paper publishing racist articles undermines freedom of the press. A teacher sues on the grounds that the tenure system violates the right to due process. Suddenly private, sensitive issues become a matter for the courts. Fortunately for universities, the courts have slowly been developing a legal idea of academic freedom that in many ways parallels the traditional one. In a landmark 1957 decision, Justice Felix Frankfurter outlined the "four essential freedoms of a university—to determine for itself on academic grounds who may teach, what may be taught, how it shall be taught, and who may be admitted to study."

Private colleges are still deciding what they will permit, just as the courts are still wrestling with what public institutions can legally restrict. Such efforts will not end soon. Free expression and tenure review will continue to be critical campus issues, judging from the new flurry of student protest and the high stakes involved for faculty.

This year, as the nation commemorates the bicentennial of the Constitution, the relationship between colleges and the Constitution is still in its youth. The union is far from being a perfect one.

Free Speech: '60s Legacy, '80s Issues

Last year, Yale sophomore Wayne Dick offended a large part of the campus community by handing out fliers parodying the annual Gay and Lesbian Awareness Days (GLAD) as Bestiality Awareness Days (BAD) and targeting a student activist and a pro-gay-rights professor. Yale's board found Dick guilty of harassment and sentenced him to two years of probation. The organizers of GLAD called the satire slanderous and intimidating; the law school dean said that Dick "ought to be ashamed of himself."

Nat Hentoff of *The Village Voice*

helped to draw national attention to the case as an issue of free speech. Had Wayne Dick really stepped outside the bounds of protected speech, or was he just being punished because his views were unpopular? Dick asked Yale President Benno C. Schmidt, Jr., to take another look at the decision. Schmidt, a constitutional scholar, had been appointed as president right after the first ruling in Dick's case. In his inaugural address, Schmidt had declared, "There is no speech so horrendous in content that it does not in principle serve our purposes." At the second hearing, Schmidt pardoned Dick. The incident ended in a torrent of praise for the value of free expression in higher education.

In many ways, the Dick case is typical of the way private colleges and universities handle these cases. Dick's less-than-scholarly means of expressing his opinion, and the fact that it personally insulted a few people and offended many, led to the first decision to punish him. But over time, the broad issue of protecting freedom of speech came to outweigh the narrow one of his crude parody. President Schmidt declared that the case showed "the paramount value an academic community should give to freedom of expression, even to expression that is distasteful or silly."

"In addition to plain and simple First Amendment censorship, there's a very strong education interest in not censoring what students have to say," notes a press specialist.

Because the Constitution has the status of an honored guest rather than a federal marshal at private colleges, these institutions may take the idea of free speech as an educational tool a step further. Some use a standard similar to a journalist's idea of "balance" and try to create a cafeteria of ideas for students. Thus they can defend inviting Jeane Kirkpatrick or Jesse Jackson to speak, on the grounds that the college is not endorsing their views but offering students an educational opportunity.

State universities don't always have the luxury of forming policy from principle. In 1969, in the Tinker case, the Supreme Court ruled that a group of high school students was entitled to wear black armbands in protest of the Vietnam War. Even more important, the court felt the students were entitled to the full range of First Amendment rights.

This decision came at the peak of an era in which students' desire for more involvement in politics and in critical social issues had led to a national "free speech" movement on campus. The movement, a symbol of student activism, began in 1964 when the University of California at Berkeley took action against a group of young Republicans. They had brought buses on campus to transport students to the Republican National Convention, thus breaking a Berkeley rule against political activity on school property. By the time the Berkeley free speech movement died down, there was little that students weren't allowed to say, print, distribute, or show on campus.

This doesn't mean that students at state schools have no rules to obey. They must still adhere to the law on everything from the state's legal drinking age to local fire codes. They also face campus discipline should they break those laws. Just two years ago, Berkeley arrested students protesting against investments in companies doing business in South Africa. The students had occupied Sproul Hall, site of many of the free speech movement protests. The university made clear that First Amendment rights didn't extend to blocking campus buildings.

The Supreme Court agrees, recognizing that some restraints on free expression may be necessary to keep the peace on campus. Last year, in Bethel School District No. 403 v. Fraser, the high court said that school officials had the right to stop a student government candidate at a required school assembly from giving a campaign speech packed with sexual puns. Some civil-rights activists criticized the decision as backing down from Tinker. Justice William Brennan set the limits in his concurring opinion: "School officials . . . do [not] have limitless discretion to apply their own notions of indecency. Courts have a responsibility to insure that robust rhetoric . . . is not suppressed by prudish failures to distinguish the vigorous from the vulgar."

Just as the actions of the '60s opened the door to free speech on campus, the issues of the '80s may force schools to decide how far open the door may swing before there ceases to be a difference between the atmosphere of the university and the rest of the world. Today's protests—on such issues as South African investments and CIA recruiting—take aim not only at social problems but at the heart of the university itself. Protesters demand that the college account for its investments, defend its recruiting policies, justify whom it chooses to honor, and explain why it treats the surrounding community as it does. In this new age of protest, higher education may be pondering how great a blessing liberty can be on campus.

Free Press: The Value of Many Voices

"The vast majority of calls we get are problems with censorship," says Mark Goodman, executive director of the Student Press Law Center in Washington, D.C. "The most frequent topic for censorship is stories that are critical of officials or school policy. We have calls from college newspapers where administrations have confiscated copies or have fired student editors or suspended them from school."

Often, college funds are used to support publication of campus papers; at public institutions, public funds are often involved as well. Yet because the Constitution bars the states from curtailing press freedom, student papers at state schools are free to ridicule the board of trustees, to refuse to advertise gay dances, or to reject ads for the Army. In local cases, the same right has been extended to campus humor magazines, underground papers, and political tracts. With so many types of publications, some of which go out of their way to shock and offend, chances are good that competing activist groups or administrators will try to draw the line.

College editors were involved in about half of the 556 cases reported to the Student Press Law Center last year. In some instances, school administrators failed to understand that the law limits their actions. But often the cases centered on hazy legal points: Can a student paper run an editorial endorsing political candidates? Can it refuse to accept "roommate wanted" ads that specify lesbian roommates only? Because the Supreme Court has ruled on only one student press case (involving an underground newspaper), most state courts regard the issue as one of first hearing, meaning they must thoroughly research all precedents before hearing the case. Student editors who'd rather not go this long route, even with the aid of civil rights attorneys, often choose to settle out of court.

Student journalists at private schools don't usually have the option of taking legal action in censorship cases. Instead, they rely on the school's belief in free speech, and its fear of bad publicity, to protect their independence. A current theory that a clear-cut, hands-off policy may protect private schools from libel suits involving student publications gives an added incentive to administrators to keep their distance.

"In addition to plain and simple First Amendment censorship," Goodman says, "there's a very strong educational interest in not censoring what students have to say." He adds that, in his experience, private schools "for the most part recognize the serious educational utility of not censoring."

At many institutions, the laissez-faire policy has grown out of years of control and confrontation. As the newspaper of record for a Catholic institution, Villanova University's award-winning weekly paper is expected to reflect the church's teachings on such sensitive issues as homosexuality and abortion. June Lytel, professor of English and adviser to *The Villanovan* for almost 13 years, says that "the policy, generally speaking, has evolved over the years into 'Leave well enough alone.'" Where before, administrators would have demanded to review or delete articles, they are now more likely to trust the students to demonstrate a sense of "social responsibility."

In addition, college officials may now be more conscious that free speech as an issue can cause more trouble than free speech as a fact. Students who become campus editors, Lytel says, "are bright and interested, but they tend to want to be remembered as having championed a cause." Yet she adds, among administrators and teachers, "I think there's been a recognition that if you yak about something as if it's a thunderstorm when it's just a breeze, you get a thunderstorm in reaction."

Professors and Privileges

In the anticommunist fervor of the '50s, faculty members at many universities, public and private, were asked to sign loyalty oaths or risk losing their jobs. But with this stunning exception, government regulation of faculty has been directed mainly at teachers in public primary schools, and then usually at the curriculum, beginning with the celebrated Scopes "monkey trial." In 1926, John Scopes, a Tennessee biology teacher, was found guilty of breaking a state law banning the teaching of evolution. It wasn't until 1968 that the Supreme Court reversed the Scopes decision, saying that the state had no right to place unconstitutional restrictions on its employees.

Efforts to silence individual teachers in or out of the classroom have been more common. On campus, the appearance in recent years of a special interest group called Accuracy in Academia (AIA) raised fears of a resurgence of '50s-style political censorship. Using student informants, AIA seeks to discover and to report classroom cases of "error"—usually a presumed liberal bias. The group's small size and low budget, however, make it less of a real threat than an ideological one.

Courts have ruled against restricting teachers' free expression on the grounds of public interest. The country needs good teachers and cannot afford to ban people from the profession because of their personal beliefs or what they say or do outside the classroom. In 1952, in Wieman v. Updegraff, Justice Frankfurter offered his famous opinion that "to regard teachers—in our entire educational system, from the primary grades to the university—as the priests of our democracy is . . . not to indulge in hyperbole."

In the close quarters of a university, where personal beliefs and principles are eagerly discussed, it's not always easy to separate protected "extramural utterance" from the personality and ideas of teachers. An outspoken critic of the administration who is denied tenure may be suffering from the spillover effects of his or her beliefs.

Faculty who already have tenure are generally safe from attack. But "it does come out earlier within the career" of younger faculty, as well as while a candidate is applying at another institution, notes William Van Alstyne, professor of law at Duke University and a member of AAUP's Committee A. Senior faculty may have opinions quite different from those of junior faculty being considered for tenure. "They may reason their way to a negative vote by thinking that, if the candidate has a certain belief, it's a sign that he or she is unfit," says Van Alstyne.

Tenure cases center more often on due process than on free speech. Due process, a provision of the 14th Amendment, guarantees that fair procedures will be used by the government in determining punishment or promotion. In tenure cases, due process is invoked less frequently than the Civil Rights Act, since many such cases center on charges of discrimination. But due process does come into play in cases like Davies v. Kahn.

Last year, Stanford University invited Norman Davies, a distinguished scholar of Eastern European history, to be a visiting professor. Reviewers had praised his book on the history of Poland, but noted with concern that the work paid almost no attention to the role of anti-Semitism in Polish history. Davies wanted to join the full-time faculty at Stanford. He was twice considered and rejected for a tenured position, the second time after a close vote.

"Athletes may be subject to special kinds of discipline and regulation, but that doesn't give the university *carte blanche* to violate their rights," a lawyer contends.

Davies sued, convinced that historian Harold Kahn and other faculty members had defamed his academic reputation and blocked his appointment. A lower court ordered Kahn to explain in a deposition what he had said, written, and done in the faculty meeting. The appeals court later overturned that ruling.

Matthew Finkin of the AAUP praises

the appeals court for "facing the music" of a difficult question. "There's no such thing as a defamatory idea," he says. "The court came to grips with the fact that there's a conflict of values between the need to protect against defamation and to allow scholarly debate."

Freedom of speech for faculty has been well established, not only because it is in the tradition of academic freedom but because it is in the interest of education. But when faculty members sign research contracts, either for the government or for private industry, they may lose many of their privileges.

Most schools have strict guidelines on what limits companies can place on researchers—whether, for example, someone developing a new widget for a corporate sponsor can be required to agree not to publish articles on widget design theory in technical journals. Government control, however, can extend well beyond the bounds of a contract. On grounds of security, the government requires some employees to submit everything they intend to publish for review; this rule has been applied to professors engaged in government research.

Some faculty may be so eager for grants that they sign contracts without fully understanding the consequences, Van Alstyne says. But, he adds, "the AAUP cannot have these things judged wholly according to volition or nonvolition of the participants. Most of us [at the AAUP] have taken the view that, what the government can't do by statute, it can't do by contract." Some restraints, for example on publishing very sensitive military work, may be appropriate. But at some point, he says, the restrictions would greatly change "a university in the sense that we now understand it. We all draw lines of some kind, but the hazard is there: the doctrine of the opening wedge."

Search and Seizure's Latest Challenge

No recent civil rights issue has caused greater concern than that of drug testing, which pits the desperate national need to control drug abuse against one of the gravest invasions of privacy imaginable. The question is creeping into colleges by way of the sports field. The National Collegiate Athletic Association (NCAA) policy of drug tests for national athletic events has led many universities to start their own testing programs. They don't want to be embarrassed should their teams make it to national competitions and fail the drug tests.

A typical program at the University of Colorado involves random testing not only of players but of student trainers and cheerleaders. An uncomfortable aspect of the program is that it requires a coach or faculty member to be present during urine collection to prevent fraud.

The Fourth Amendment protects citizens against unreasonable search and seizure, requiring "probable cause," or reason for suspicion, before a court will issue a search warrant. David Miller, an attorney with the Colorado Civil Liberties Union, which has filed suit against the university, believes that probable cause is at the heart of the issue. "The NCAA's own studies show there's less drug use among athletes than among the general population," he says. "Athletes may be subject to special kinds of discipline and regulation, but that doesn't give the university *carte blanche* to violate their fundamental constitutional rights in a most egregious fashion."

But just as in cases of drug testing on the job, the right to privacy must be weighed against the value of inhibiting drug use. Athletes are already subject to restricted diets, mandatory workouts, and regulated schedules. Why shouldn't they submit to drug tests in return for the privilege of being on a team?

Although some of the legal questions may be the same, the difference between a bed check and a urine sample is the degree of intrusion and seriousness of the consequences. At the University of Colorado, students who test positive for drugs are taken off the team but are not reported to the police. Presumably, a university has an interest in helping students get off drugs, not sending them to jail. Yet, says Judd Goldin, a private attorney working on the case, "all it would take would be a tough prosecutor" to obtain the records and prosecute the students. "There's some irony there," he adds. "They say they're playing police, but they're really not."

In March, a Stanford senior became the first student athlete to win a case against the NCAA's drug-testing policy. Simone LeVant considered the policy to be "patronizing and paternalistic" and an invasion of her privacy. In ruling in her favor, a California Supreme Court judge called the testing policy "overbroad," intrusive, and unconstitutional. He blocked the NCAA from barring her from a diving competition after she had refused to sign a form consenting to urinalysis. The decision, although based on the right-to-privacy clause in the California Constitution, may be so broad that it could sack the whole drug testing program, LeVant's lawyers contend.

The scarcity of lawsuits may be due to the fact that, so far, drug testing applies only to what might be called a special-interest group of students. Says Art Spitzer, an attorney with the ACLU's Washington, D.C., affiliate, "I think if the university tried to extend the policy to non-athletic teams like the intercollegiate debate team, we might get a plaintiff. Student athletes aren't interested in litigation, they're interested in playing."

Rights and Religion

In 1940, when the AAUP issued its *Statement of Principles on Academic Freedom and Tenure*, it allowed universities to make clearly stated exceptions "because of religious or other aims of the institution." But changes both in religious denominations and in the universities have made such distinctions largely unnecessary. The AAUP's 1970 Interpretive Comments on the *Statement* indicated that "most church-related institutions no longer need or desire the departure from the principle of academic freedom implied in the 1940 *Statement*, and we do not now endorse such a departure."

Like employees anywhere, instructors at colleges or universities with a religious affiliation are aware that they may have to give up certain rights for the privilege of teaching there.

Spitzer of the ACLU wrote a brief on behalf of Georgetown University last year after some students sued to be able to establish a gay interest group on campus. "Many private universities take the position that part of what they're here to teach is respect for the same principles that underlie the First Amendment," Spitzer says. "There are others whose whole purpose is to serve some less universal goal. There's no copyright on the word university, no reason a gay group can't set up a gay university. A private university is within its moral rights to say, 'We believe in freedom of speech, but there are certain other things that we believe in, too.'"

Julia Ridgely is assistant editor of the Alumni Magazine Consortium.

THE ENTREPRENEURIAL SPIRIT

SIXTH IN A SERIES

A Peddler's Tale

Whether you're selling milk, wire, or ball bearings, it's all a matter of finding yourself a niche, says O. Vincent Gustafson.

Photos by Robert S. Arnold

By Michael Shanley

Scene 1: Institute Park, early 1900s. A boy brings lunch to his dad, who's on break from the American Steel and Wire Company in Worcester's Northworks building. From their spot on a knoll in the Park, they look up at Worcester Tech, the college on the hill. "Someday," says the father, "I'd like to see you go there." The boy smiles and nods.

Scene 2: Various locations, spanning many decades. As the boy grows into a man, his successes are many. In Worcester, New York, and cities throughout the country, he quietly makes a name for himself in manufacturing circles. He does attend the college on the hill, but only for a year.

Scene 3: Harrington Auditorium, Worcester Polytechnic Institute, May 1985. Sixty years after leaving WPI, the boy-turned-man is on stage before thousands of graduating seniors, parents, and honored guests. He steps forward to receive an honorary doctor of engineering degree. Unlike the graduates, he looks not to the future but to the past. He thinks of lunches in the Park. He thinks of his father. He thinks, "I finally got it."

These episodes chronicle a part of the life of O. Vincent Gustafson '29, a man too restless to be contained by the four walls of a classroom.

"I never felt I was ready for WPI," he admits, meaning never quite ready to slow down long enough to earn a degree. "I saw too many things that could be done outside."

It's not surprising, really, when you consider that Gustafson had a series of successful business enterprises already under his belt by the time he hit college. Not surprising once you understand that in his early teens he had eight or 10 kids working for him in his newspaper distribution business. Not surprising after you've grasped this astonishing fact: before he was 18 years old he had saved $5,000, a small fortune by 1920s standards.

"I peddled papers every day of the week—mornings, nights, and Sundays," explains the founder and chairman of Worcester's Lundquist Tool & Manufacturing Company. "On top of that, I worked on farms throughout the area, or in a nearby factory, standing on a box, turning wooden ice pick and screwdriver handles on a lathe. There were no labor laws—and no deductions from your pay, either."

But as he learned to climb, he also learned to fall. In the Great Crash of '29, he lost nearly all of that $5,000 and whatever else he had saved. "I'd been playing the stock market even when I was selling papers," Gustafson explains. "In '29, when I was at American Steel & Wire, I saw RCA stock fall from 105 to 6 or 7 in a matter of weeks."

It wasn't the last time he would take a beating. Throughout his career he would take risks, reaping the rewards and accepting the losses. Even in recent years, as a venture capitalist, he has suffered setbacks among the triumphs. A consummate entrepreneur, though, he discusses losses and gains in the same evenhanded manner.

Gustafson learned early how to roll with the punches in the capricious world of big business.

"After my first year at Tech, my brother, Russell, and I bought a 6,000-quart milk business on Union Street," the Worcester native explains. "The milk came by train from New Hampshire to the Lincoln Square freight depot. After about six months, we were served with papers notifying us that there were chattel mortgages on two of our four pasteurizers. We were just kids and our lawyer had neglected to tell us about the mortgages. So we lost the business"—and went on to the next.

He planned to begin his sophomore year at WPI in February of 1926, but at the time the college didn't permit students to begin their studies midway through the year.

"My father had worked for many years at American Steel & Wire at Northworks. That was back when it was one of the greatest wire mills in the world. He got me a job, but the only hours available were from 7 o'clock in the evening to 6 o'clock in the morning."

For the next four years, he learned the wire business, moving from the production line to a supervisory position. When he had time, he took classes at Northeastern University's extension at the Worcester YMCA. To complete the required lab work, he'd take the Saturday train to Northeastern's Boston campus.

At the same time, Gustafson was involved in another venture with his brother. "After the milk business went under, we bought a hay and grain store at Lincoln Square. We sold paint and glass, oil, and chemicals—everything people needed around their houses or farms.

Eventually, Gustafson became chief wire inspector at American Steel. To get an idea of the magnitude of the operation at Northworks, consider this: there were 12,000 to 14,000 people working in that one division. (Worcester as a wire mill center had about 25,000 workers in the industry.)

But it was the mid-1930s; Europe was on the verge of war, and production in factories like American Steel would soon be regulated by the government.

At about that time, in 1935, Gustafson was approached by a New York City-based company that represented three Swedish steel mills. (American Steel got its raw material from Sweden, home to the world's purest supply of ore.)

The company, Ekstrand & Tholand, Inc., was looking for a sharp young man with a knowledge of the steel and wire industry. And it wouldn't hurt if he could speak and read a bit of Swedish.

"I was frightened to death," says Gustafson of the prospect of moving to New York. "After all, I was just little Vinny from Worcester."

But little Vinny was too smart to turn it down.

He went to New York and for the next six years traveled the eastern part of the nation, logging by car up to 70,000 miles a year. He sold, among other products, the wire that eliminated sticky valves in automobiles, a breakthrough that is still used today.

As with most who are successful, Gustafson wasn't afraid to get his hands dirty. He was a product engineer, but he did whatever had to be done.

"In those days," he recalls, "the Swedish ships came in on 57th Street—Pier 97. But no rail freight went *out* of Manhattan. It all had to be shipped by barge across the Hudson River to the New Jersey side, where rail traffic distributed it throughout the country. So if your ship was running five days late because of the weather, and you had to

O. Vincent Gustafson '29 and Don Bouthillier, quality assurance manager at Lundquist, make adjustments to a state-of-the-art computerized coordinate measuring machine able to perform statistical analysis and statistical process control on machined or fabricated parts.

get your steel across the river that night and get it on its way to Detroit, well, you'd be down there on the pier, with pails of beer or whatever it took to get the shipment moving, to get that barge up against the side of the ship by the hatch doors so the steel could be dumped out from the belly. Many a day I stayed at the docks until I saw the barge sail across the river."

Gustafson at Lundquist's optical comparator, which magnifies fabricated parts to enable testing of sphericity and linear dimensions.

Just as Gustafson juggled several business interests as a teenager, he dabbled in other projects while working for Ekstrand & Tholand. He became treasurer of General Steel Warehouse Company of Chicago, an arm of E & K with huge warehouses in Cleveland, Detroit, Chicago, Los Angeles, and Toronto.

He was also director and manager of the eastern plant of Koebel Diamond Tool Company, a position he would hold until 1974. He would later transfer to Lundquist the Koebel procedure for processing diamonds with iron powder.

And of course he was dabbling in the stock market and generally keeping his eyes open for new opportunities.

"All this time, though," he notes, "the war in Europe continued to boil. And even though neither Sweden nor the United States were in the war, we began to lose shipments at sea, and it was becoming impossible to supply the assembly lines properly. The company was losing its purpose."

The government was urging people like Gustafson to apply their skills to the war effort.

Expecting to be drafted, the 35-year-old Gustafson returned to Worcester and took a position with Johnson Steel & Wire Company.

"At that time," he explains, "all the great Russian and European cities had what were called anti-barrage balloons in the air. They were up 30,000 or 40,000 feet, and the German planes would hit them and they'd fall. Since the balloons were blown around violently in the wind, it took fabulous wire to make the cables that held them.

"Johnson Wire was a mill of fence, barbed, and 'common product' wire. I became their general manager and helped them get started in high-quality, high-tensile cable work."

By this time, Gustafson knew the business as few others did. As with most who become experts, the knowledge grew from an abiding love of the subject matter. Ask him what makes good wire, for example, and he'll answer, "What makes good wire is the same thing that makes good people. If your genes are good, and you're brought up right, chances are you'll be a good person. In the same way, if you've got good, clean ore, and your production process is meticulous, you'll get good wire."

It's no accident that Swedes have been at the forefront of the steel and wire industry, both in Worcester and throughout the world.

"The Scandinavian countries have been in the business from day one," Gustafson explains. "And it's because they've got the ore there. So when someone in America wanted to start a quality steel or wire business, they went to Sweden to get the people to run it."

Instead of being drafted into active military service after returning to Worcester, Gustafson was deferred to work as a civilian helping the U.S. produce high-quality steel. A rod mill was taken over in Johnstown, Pa., and cleaned up to make top-grade rods. The rods were then shipped to Worcester, where Johnson Wire produced wire and other products for the war effort.

When the war was finally over, Gustafson bought at auction a company called Lundquist Tool.

"It had no business and was closed down," Gustafson says. "I just bought the facilities."

He had an idea—several, actually.

"While I was in New York, one of the Swedish companies that was a member of the consortium I worked for had products called iron powder and sponge iron. The ore in Sweden is so rich that it runs about 96 or 97 percent iron right from the top of the ground. The only impurities are sticks and stones and sand. [Here in the U.S., on the other hand, the ore has high percentages of impurities such as phosphorous and sulphur.]

"Once you've screened off the sticks and stones, you've got sand [silicon] and iron. As you heat that up in furnaces, it becomes just about the purest iron you can get. It drops onto a conveyor belt like a cow flop. If you break a "cake," as we call it, it's like molasses candy—the silicon turned to glass, and it was pure iron."

In the big mills that were making high-quality steel for machining parts, he says, they would throw tons of these sponge iron cakes into the furnaces—or heats—to balance the chemistry because it was a known element.

From Lundquist Tool, Gustafson sold shiploads of cakes.

"We also ground them up and screened them out just like flour. One of the first products that material was used for was to make bearings for refrigerators, vacuum cleaners, and any other kind of equipment that had bearings you couldn't lubricate."

When Gustafson had witnessed this process years before in New York, it led him to get involved in another of his many business ventures. "Back in 1935, the Koebel Diamond Tool Company in Detroit developed a process for setting diamonds in iron powder."

Gustafson became manager of that company's eastern plant. During the war years, it was one of the leading suppliers of diamond tools to general and aircraft manufacturers.

After buying Lundquist, Gustafson brought the diamond powder toolmaking process to Worcester.

"At one time," says Gustafson from his corner office on what is now the administrative wing at Lundquist, "we had about 50 people on this floor making diamond tools. And at another location, we had about 30 people making six-foot-diameter diamond circular saws for cutting stone in quarries."

Eventually, the saw business was sold to a company in Oregon and the diamond tool business to Norton Company.

"I was more or less independent wherever I went," Gustafson explains. "I hired myself that way so I could always have two or three other things going."

During the war, Gustafson had received advice from some of the friends he had established at General Electric plants throughout the region.

" 'Vinny,' they said, 'get a stamping plant or a screw machine plant and go after business from GE's new clock division.' During the war, electric clocks weren't made, and they were predicting a booming business after the war was over.

"So I was keeping my eyes out for a place where I could make tools and stampings."

After acquiring Lundquist Tool, Gustafson was ready to fill GE's need for a plant to produce parts for clocks and timers. This move would continue one of Gustafson's lifelong business practices—"niche-filling."

"There are areas of production that I call the 'niche-fillers of the world.' They don't have to be especially large or visible, but they fulfill a definite need. If you have a specialty product, you can probably stay alive, even in times as competitive as today's."

The 80-year-old Gustafson is still very much on the move at Lundquist and several other business ventures that compete successfully with both foreign companies and American industrial giants.

It was this same theory that led Gustafson in the late 1950s to start making bearings, which to this day are Lundquist's bread and butter.

Today, when times are hard for companies like Lundquist, the "niche-filling" theory is a lifesaving device.

"In the last couple of decades, technology has been transferred all over the world," Gustafson notes. "Where once only certain American companies could produce certain products, now they can be produced almost anywhere. American companies have been forced to streamline. They can no longer live in a 10-room house when they need only seven. They have to fight for their market share now."

Lundquist, with about 120 employees, (and another 30 or so at Lutco Bearings, where much of the assembly work is done) has stayed alive by finding a niche.

"The Japanese will come over here and cut their prices to the bone for a five-million-piece metal parts order," Gustafson contends. "But they're not so interested in the 5,000-piece orders. We'll take those 5,000-piece orders, and fight for our share of the bigger orders—we still get some of those, too.

"In the bearing business, for example, we specialize in things like materials handling equipment—farm machinery, front-end loaders, fire engines—and hinge bearings for use in doors that just can't fail—in places like submarines. We also make special metal parts for companies like GE and Xerox."

Gustafson knows what it's like to lose the battle to new industrial giants like Japan. New England High Carbon Wire Corporation, of Millbury, a company he and seven other area businessmen acquired in 1958, closed in 1980, a casualty of the new global economy.

"At one time, we had 500 workers in that plant," he recalls. "And we were one of the world's biggest producers of specialty high carbon and alloy wires. But in the late '70s, we fell victim to the 'Japanese invasion.' "

These days, the 80-year-old Gustafson says he's passing off most of the business responsibilities to the younger generation (his son-in-law, John Stone, is president of Lundquist), but you wouldn't know it by looking at a list of his activities.

As a venture capitalist, he's got a stake in seven or eight different companies, all in the manufacturing arena. "To keep things straight, I have a briefcase for each company," he says with a chuckle. Of his relative success over the years, he offers, "I'm batting better than .500. I've lost my share, but I've done all right.

Beyond that, he holds a slew of directorships and civic positions. He's worked tirelessly as a volunteer for a host of regional agencies.

"I'll probably never retire," he muses. "I love it too much, and I'm too restless."

Still, he hopes to do a lot more traveling, and looks forward to spending more time gardening and working outdoors with his large family. But always there'll be irons in the fire.

"I've always been a peddler, and that's all I've ever wanted to be," he says, "I'm willing to work, I'm willing to spend the time on a job, and I'm not afraid to learn. Practically anybody can succeed in a given situation, if they dedicate themselves."

Then, as an afterthought, he adds, "But you've also got to be willing to gamble."

Will, dedication, and a dash of courage: a prescription for entrepreneurial success, a characterization of the life of O. Vincent Gustafson.

Michael Shanley is a freelance writer living in Holden, Mass.

The Interactive Qualifying Project continues to be one of the Plan's most distinctive features. In fact, many graduates see their professional lives as an endless stream of IQPs.

The IQP: A Broader View from the Hill

By Paul Susca
Photos by Robert S. Arnold

Imagine a country where a third or more of the population live in refugee camps. You could be thinking about Somalia, where years of civil unrest and famine in western Africa have swept one to two million people into the camps. But today, solar technology offers a shred of independence to the refugees, who depend on government aid for their daily existence.

Photovoltaics—solar cells that turn the sun's energy into electricity—could generate the power needed to pump water for the refugees at a fraction of what the Somalian government now spends on imported diesel fuel. Solar energy's reliability, independence, and low cost

Randall Briggs '86 (previous page) was a winner of last year's President's IQP Award for his research on waste problems that would result from industrial activity on the moon.

make it ideal for Somalia's refugee camps, says physics major Nancy Teasdale '88. But even those advantages are not enough, she points out; there are social factors that keep photovoltaics (PV) out of the camps.

Teasdale is in the midst of her IQP—Interactive Qualifying Project—on solar-powered water pumping systems in Somalia's teeming refugee camps. But her work has taken her far beyond understanding the operating characteristics of modular solar cells and the maintenance requirements of submersible pumps. Understanding how the solar cells and pumps would function in a larger socio-political system—and whether they represent "appropriate technology" for the refugees' needs—has required Teasdale to delve into cultural practices of the refugees, attitudes of the native government, the role of international relief agencies, and the political situation in the region.

If those subjects sound foreign to the milieu of engineers or scientists, then Teasdale has chosen her topic well, for that is the intent of the IQP. A degree requirement for WPI undergraduates since 1973, the IQP calls on students to "define, investigate, and report on a topic of their choice relating science and/or technology to some social need or issue," according to Dr. Lance Schachterle, chairman of the Division of Interdisciplinary Affairs (DIA), which oversees IQP work done by every WPI undergraduate.

Both "science and technology" and "social need or issue" are defined rather broadly by the program. Indeed, IQPs completed during recent years included writing an expanded canoe guide to the Nashua River, evaluating the 55-m.p.h. speed limit, and investigating sex discrimination in the sciences and engineering. And one of this year's recipients of the President's IQP Award focused on programs to educate high school students about careers in engineering.

Junior Nancy Teasdale holds a latest-generation solar photovoltaic cell, a module that can be used singly or in arrays up to the tens of thousands, enabling generation of electricity in even the poorest, most remote regions of the world.

The rationale behind such a wide-ranging program lies in its goals. In order to encourage engineering, science, and management students to become more aware of the effects of their professions on society, Schachterle explains, the program avoids restricting the academic disciplines applicable to studying technology-society interactions. Since students are required to venture outside their own fields, giving them more leeway in defining their projects enables them to set up camp where they feel most comfortable—in fields such as history, literature, sociology, political science, economics, ethics, or management. A practical consideration in keeping the disciplinary barriers down, Schachterle adds, is the desire to include the interests of as many faculty members as possible.

Besides enabling students to become aware of the interactions of technology and society and encouraging them to make policy recommendations, the goals of the IQP include cultivating the habit of questioning prevailing social values and structures.

One of the assumptions that IQPs often force students to assess is "the more technology, the better." Teasdale is completing her project under the guidance of Prof. Edward Clarke, who advises more than a dozen solar energy-related projects every year. Originally, she reports, she assumed that photovoltaics could be easily used by anyone. After all, "a PV panel just sits there in the sun and does its thing year after year," she notes.

"But that's not necessarily a good assumption," she now relates. After studying current PV technology in developing nations, Teasdale contacted a number of people close to the refugee problem, with the help of Dick Ford, a professor at Clark University, who is involved in the study of international development. By conducting interviews with Somalian government officials as well as with relief agencies such as Save the Children and Oxfam America, Teasdale learned that there are institutional as well as cultural obstacles to use of PV power in refugee camps.

For one thing, she found that some international relief agencies and governments, which provide aid based on the number of refugees in camps, seem to create a perverse incentive to keep peo-

ple in refugee status. Moreover, while PV systems are virtually maintenance-free, the water pumps they power do require upkeep. That creates a conflict with the socially defined roles of women, since they, says Teasdale, make up the vast majority of refugees and would have to be trained to keep the pumps working.

Eventually, the social aspects of Teasdale's project took on dimensions broader than the technical alone. Her report contains just two appendices dealing with PV technology; the rest of the report deals with the attending social issues.

Her report concludes with a call for further IQP study into the issue of appropriate technology as well as the specific problems of Somalia. "The opportunity is here," she says, "for someone to do something that's really alive in this area." In fact, it's not uncommon for individual IQPs to continue from year to year, tapping the creative energies of new teams of students whose interests coincide with previous teams' goals. WPI's project planning system enables this type of

Mathematical sciences major Michael Visintainer '87 (left) and Thomas Petersen '87 EE, who completed their IQP at WPI's new London Project Center, studied the effects of changes like the growth of private health care on the government-funded British national health system.

cooperation. For example, for several years now, a new team of four to five students has taken over joint editorship of the *GASCAN Journal,* a technical periodical that documents the efforts of a half dozen other student teams completing projects—also multi-year, multi-team efforts—on experimental packages that will fly aboard future space shuttle missions.

While alerting students to their responsibilities as professionals is a major goal of the IQP, each project approaches this objective differently. "You can't make people better citizens," says John O'Connor, professor of Social Science and Policy Studies and of Management. "What you can do is expose them not only to the issues but to the thought processes that would enable them—should they have the value structure—to become better citizens by attacking those issues analytically." O'Connor encourages his IQP students to investigate the background of their project topics in depth, so that at least half of the final report is a review of the issue's social context.

O'Connor is one of the coordinators for IQPs in the Health Care and Technology division. Under his guidance senior Alan Clune EE has been studying the medical malpractice issue since last fall. After studying the social dimensions of the issue, Clune has concluded that technology is at least partly responsible for the controversy. "When you read about technology in the medical field, you get the impression there's nothing doctors can't do," Clune says, "so you undergo an operation with very high expectations, something small goes wrong, and you're ready to sue."

Technology also prompts doctors to attempt more heroic procedures, he contends, which may be more error-prone and hence result in higher malpractice claims. The deteriorating physician-patient relationship, which, he says, shares responsibility for the malpractice problem, is also linked to technology. "With more and more technology you create narrower and narrower medical specialties, so instead of being treated by one doctor whom you get to know, you're treated by a number of doctors. As the relationship becomes depersonalized, patients don't mind suing the anonymous doctors."

Clune has been looking into the malpractice insurance problem along with partners Brian Jacobs '88 EE, Amy Petren '88 MGE, and Susan Swanson '88 EE. Increasing malpractice premiums present a problem, Clune says, because they threaten the availability of

medical care and high-risk specialists in particular. Clune's part of the work focuses on legislative approaches under consideration in Massachusetts, but his impression is that most of the laws proposed so far will make little difference. What is really needed, Clune asserts, is better internal policing of the medical profession, which he says can be addressed by legislation, and by improving the doctor-patient relationship, a problem that can't be solved by passing laws.

IQP teammates (left to right) Valerie Tanigawa, Caroline Mahoney, and Maureen Theis studied the potential effect of new technologies on the trimester model for abortion. Not pictured is their partner, Tusha Hoskere.

While Clune's team has addressed health care close to home, mathematical sciences major Michael Visintainer '87 has gone abroad to study financial management problems in the British National Health Service. Visintainer's stay in London was part of a prototype program for WPI's new London Project Center. While most students complete their IQPs over the course of a year, students working at the London and Washington, D.C., project centers plunge full-time into their IQP for one seven-week term.

Visintainer and his partner, Thomas Petersen '87 EE, focused on the implementation of a set of management reforms that went into effect in the Health Service in 1983. Some of those changes had to do with the growth of private health care, which is being used increasingly by wealthier patients who aren't willing to wait for government-funded care.

Visintainer formed the impression that health care was generally available and the system functions quite smoothly, but he points out that his project was limited to a fairly wealthy London suburb. "Poor people still get the same care from the National Health Service. It's just that the wealthy people don't wait as long for a routine operation," he says.

The seven-week schedule of off-campus project centers requires students to hit the ground running. When Laurie Bouchard '87 ME arrived at the Washington Project Center in the fall of 1985, it took a week and a half of work with project sponsors at the National Association of Manufacturers (NAM) before the topic was fully defined. Bouchard and her partners, David Astrauckas '87 CM and Christopher Boova '87 CM, used that time to get up to speed on the state of hazardous waste sites under Superfund, the congressional cleanup program. Each spent the rest of the term working on separate cases.

Bouchard says she was amazed at how complex the Superfund decision-making process was. She was especially struck by the way in which problematic sites tended to get tied up in the courts. "Litigation would go on for a few years," she notes, "and the hazardous waste site would just sit there and get worse and worse. Contamination would be leaking into the groundwater and spreading toward communities and residences," before money would become available for cleanup, Bouchard says.

The project sought to develop recommendations for NAM members when they get involved in Superfund sites. For example, "potentially responsible parties" should cooperate more fully with Environmental Protection Agency (EPA) investigations, since litigation tends to delay cleanup. "We also felt that if the states would get more involved in their hazardous waste sites," Bouchard says, "then that would take some of the burden off the federal EPA" Bouchard, Astrauckas, and Boova were among the 1986 recipients of the President's IQP Awards.

Another recipient of last year's prize, Randall Briggs '86 CM, showed that waste disposal problems may, in the future, not be limited to this planet. His project focused on waste problems that could accompany industrial activity on the surface of the moon. Briggs found that, just as on earth, environmental pollution on the moon could limit the continuation or further expansion of lunar bases. Over the course of 20 years of lunar base activity, Briggs says, space vehicles with conventional chemical propulsion could cause the formation of an atmosphere around the moon, interfering with the use of the far side of the moon as an ideal site for a radio astronomy observatory. Contributing to the formation of a lunar atmosphere would be illegal, Briggs adds, because the 1967 U.N. Outer Space Treaty prohibits placing anything on the moon that would contaminate it or limit scientific pursuits of other nations.

But why build industrial plants on the moon anyway? Briggs has a good answer to that question, since his MQP work and his present graduate work at WPI—all of which grew out of his IQP—have to do with the production of oxygen from ilmenite, an ore that is found in abundance on the moon. Today, he says, it takes 20 times as much energy to transport something from the earth's surface to low earth orbit as from the moon's surface to low earth orbit. Thus, the moon is a good place to look for rocket fuel. "It's estimated that 40 to 50 percent of the shuttle cargo in the coming decade will be used for propulsion. That's why most people agree that oxygen will be the first product produced economically on the moon," he adds. Lunar soil could also be mined for use in shielding military satellites.

Sitting in Goddard Hall's lounge under a fantastic mural of outer space, Briggs says he wants to help society avoid polluting the lunar environment the way we have polluted so much of earth's environment. "A lot of people think it's lunacy to worry about polluting the moon," he says, pausing for his pun to sink in. But seriously, Briggs says, engineers are sometimes too optimistic about the ability of technology to solve all of society's problems, although experience has proved the need for caution. "My goal is to have a cleaner moon," Briggs says, "not just to have a more productive process on the moon."

Professor of English Lance E. Schachterle is director of the Division of Interdisciplinary Affairs, which each year oversees some 1,000 Interactive Qualifying Projects, carried out as degree requirements by all WPI undergraduates.

Society demands that engineers and scientists provide both the benefits of technology and assurances that the costs will be acceptable. Brigg's project shows how society may affect the deployment of technology. But often the interactions between technology and social issues are hard to anticipate. Society enthusiastically endorses further advances in medical technology, for example, and then finds that difficult questions of ethics arise as a result. That makes biomedicine a fertile field for IQP work.

A team of four undergraduates is currently finishing their IQPs on the unexpected effect that technology is having on the abortion issue. Juniors Tusha Hoskere MEB and Caroline Mahoney EEB have teamed up with sophomores Valerie Tanigawa EE and Maureen Theis MEB to look at the legal issues involved.

The Supreme Court's *Roe vs. Wade* decision in 1973 established the trimester model of abortions. The medical technology of that time, the Court ruled, could not sustain fetuses outside the womb before the third trimester. Moreover, abortions later than the first trimester posed increased risks to women.

"When *Roe* was decided, having a second trimester abortion was more risky than going full term, and therefore the state had the right to regulate it," explains Mahoney. "Now we're finding that having an abortion is much safer than childbirth. So we're saying that the line between the first and second trimester should be eliminated."

Of even greater concern to the IQP team is the so-called viability line for fetuses, the point at which they can survive outside the womb. So Mahoney and her partners ventured forth to interview physicians and nurses in neonatal intensive care units.

In 1973 the viability line was considered to be 28 weeks. Technology has since pushed the line closer to 24 weeks. Moving the line even earlier would put additional pressure on the trimester

Professor Edward N. Clarke, director of the Center for Solar Electrification, works with dozens of students each year on projects involving solar photovoltaics, which he says will revolutionize electrical generation in the years to come.

model, but Hoskere says that it isn't likely to get any earlier in the next 10 to 15 years. "We had doctors tell us that the fetus cannot survive before 24 weeks because it's not mature enough, and the doctors want to improve the chances of survival of 25-week and older fetuses rather than try to push back the line even earlier," Tanigawa explains.

Still, as technology advances, the viability line can be expected to eventually fall earlier, enabling safe abortions even later in the pregnancy and thus heightening the conflict between the rights of the fetus and those of the mother. So the focus of the project is whether the trimester model is in jeopardy, and, if so, what the alternatives are. "Most of the lawyers we talked to said the *Roe* trimester model was the easiest and simplest way to decide the abortion," Hoskere reports. "Most of them had problems with the model, but they could not suggest a better one."

In February the four students were still mulling over their recommendations. Mahoney and Tangawa favored a system that would allow abortions up to 24 weeks; beyond that the fetus would be considered viable and therefore entitled to its right to life. Hoskere and Theis favored a more technocratic system relying on scientific data on individual cases.

Taking on such a controversial issue for an IQP may be tough, but Theis says there's more to be learned that way. You have to see both sides of the issue, she asserts, and present the information in an unbiased way. But those who work in the field are forced to take a stand.

"With this issue I'm swayed more by the mother's rights, but still the fetus is potentially a human being," Tanigawa says. "That's a conflict that people are dealing with every day out there."

This project is also showing that engineers do not have to be involved with a controversial technology in order to have an impact on social issues. Mahoney points out that working on the development of a neonatal care machine, for example, could have an unanticipated effect on the abortion issue, forcing an engineer to consider the social impact. She describes the engineer's dilemma: "You're trying to save infants' lives; you're not trying to oppress mothers' rights!"

As a result of her work on the project, Tusha Hoskere thinks that, as a practitioner following graduation, she will be more likely to examine the personal motivations behind technical arguments, since personal and professional ideas cannot always be separated. "When we talked to doctors, they said, 'Well, do you want my personal opinion or my professional opinion?' " Hoskere says, "And that's when it hit me that those two ways of thinking have to come together."

The experiences of other students and faculty members also show how IQPs can be effective in getting students to think about the role of engineers in society. "When you place something that seems to be highly technical and scientific into a social and political context, it takes on a whole new shape," says Kenneth Ruscio, assistant professor of social science and policy studies, who is advising Hoskere and the others on their IQPs. Many of the IQPs Ruscio advises have to do with the interaction of technology with the political process. (For Ruscio's views on the interactions of technology and government, see the *WPI Journal*, Winter 1987.)

One of those projects is being done by junior Isaac Davidi, an electrical engineering major who has been looking into reforms in the Defense Department's procurement process, including the technology used in testing new weapons systems. One impression he formed was that the people who design complex weapons systems don't seem to realize that the people who use them don't have the same technical background. Davidi says he'll remember that when it's his turn to design machines.

But the biggest lesson Davidi learned is how big and complex the government is. In interviews with Pentagon officials and congressional staff members, he says he found resistance to reforms and obstructions to a rational decision-making process. "My opinion is that although they think they have enough checks and balances, as long as you have people who are determined to push pet projects through, we can't have enough checks and balances," he says.

One of this year's winners of the President's IQP Award also shows that decisions about the management of technology—especially when affected by public opinion—can run contrary to what seems rational on the basis of scientific data. Robert McGuirk MGE and John Phelps ME won a 1987 award for their product liability case study of the morning sickness drug Bendectin. The two seniors reviewed dozens of epidemiological and toxicological studies but found that there were insufficient data to implicate Bendectin for increased risks of birth defects. The drug was removed from the market, they say, because of the concern produced by the well-publicized allegations of a few lawyers, and the manufacturer's concern that liability judgments would be made on the basis of "courtroom hysteria."

Recognizing bias in the presentation of technical information seems to be a lesson learned in many IQPs. Tim Richer '88 EE has been working with partners Bryan Widmer '88 EE and Jeff Enos '88 ME to predict when various photovoltaic technologies will become economically competitive with fossil fuels. "I can see where politics comes into a lot of decisions such as energy issues, where people make up their own figures just to prove their points," Richer observes. Now he is excited by the photovoltaics industry's prospects. A secure, reliable, and environmentally benign energy source, PV is already used in remote locations, and Richer expects it to find more widespread use in the next four to

ten years.

Photovoltaics is one area of societal and technological interaction that has attracted a number of IQPs, primarily due to the efforts of Dr. Edward N. Clarke, director of WPI's Center for Solar Electrification, one of WPI's two on-campus IQP project centers. Through the Center, Clarke says he tries to "get all students to realize that through the IQP effort, they are part of the unfolding energy revolution." And through the Center for Municipal Studies, Electrical Engineering Professor James S. Demetry '58 tries to share with students his own passion for involvement in local governments. (For more on both centers, see *The Wire*, Spring 1987.)

"The IQP demands unconventional participation by the faculty adviser," says Demetry, former DIA chairman. "It's unlike a course, in which the teacher tends to dispense wisdom, and much more an activity in which the teacher has to be a co-participant in learning." For that reason, some faculty members seem to shy away from advising IQPs, Demetry says. They may feel uncomfortable advising projects on topics on which they are not already experts.

To promote widespread faculty involvement in the IQP, Schachterle says that he and the associate DIA chairs Douglas Woods and PS SS and Floyd Tuler ME, recently restructured the administration of IQPs into 11 divisions. A major concern of the new division structure, with study areas ranging from health care, economic growth, and the environment to risk analysis, social services, and education theory, is to identify and support interdisciplinary activities in which faculty members have made long-term commitments.

"We want to encourage all faculty members to apply their disciplinary research to IQP activity, and to explore imaginative ways of linking IQP advising to their agendas for professional development," Schachterle added. "We're eager to see new faculty members become involved in the IQP, which is increasingly recognized as WPI's most distinctive academic requirement."

How have alumni responded to the IQP? In order to answer this question, William R. Grogan '46, dean of undergraduate studies and one of the architects of the WPI Plan, recently commissioned a professional evaluation of the IQP. Grogan says he had hoped the IQP would help remedy many of the weaknesses of engineering education widely discussed in the 1960s. WPI was especially eager to promote a greater awareness of the social consequences of engineering and science and considered the IQP a primary vehicle to make WPI graduates more alert to both their professional and their civic responsibilities. At the same time, such heightened sensitivity was extremely difficult to measure quantitatively, and the full impact of the IQP might not be realized until the entire career of a former student was completed.

Thus, what the evaluation showed was welcome news. By a ratio of eight to one, alumni from the classes of 1976 through 1984 indicated that the IQP was effective and worthwhile. Alumni argued that project education was far more successful than the more passive milieu of the classroom.

Somewhat to the surprise of the Plan designers, alumni regarded the IQP as having enormous pragmatic value to them *early* in their careers. They observed, in contrast to peers from other colleges, that in starting their careers they felt better able to deal with complex, multidisciplinary issues, more competent in working on teams and in writing reports, and less anxious about communicating their work to nonprofessionals.

They had special praise for off-campus IQP opportunities, Grogan reports, and for the experience they had as undergraduates working on real-life projects. As one graduate observed, "Life in industry is an endless stream of IQPs!"

Begun in 1973, the IQP program was, in fact, 13 years ahead of its time. Only last fall did the Carnegie Foundation for the Advancement of Teaching release its much-ballyhooed report identifying common shortcomings of higher education. *College: The Undergraduate Experience in America* cited a "disturbing gap between [colleges] and the larger world" and recommended that each student prepare a "written thesis that relates some aspect of the major to historical, social, or ethical concerns."

With its emphasis on broadening students' horizons in order to understand the society-technology interaction, to contemplate the role of engineers in this complex society, and to question decisionmaking processes that affect technology, the IQP seems to be on the right track.

Paul Susca is a freelance writer living in Rindge, N.H.

Spring Fever: A gallery of cartoons by Charles Strauss

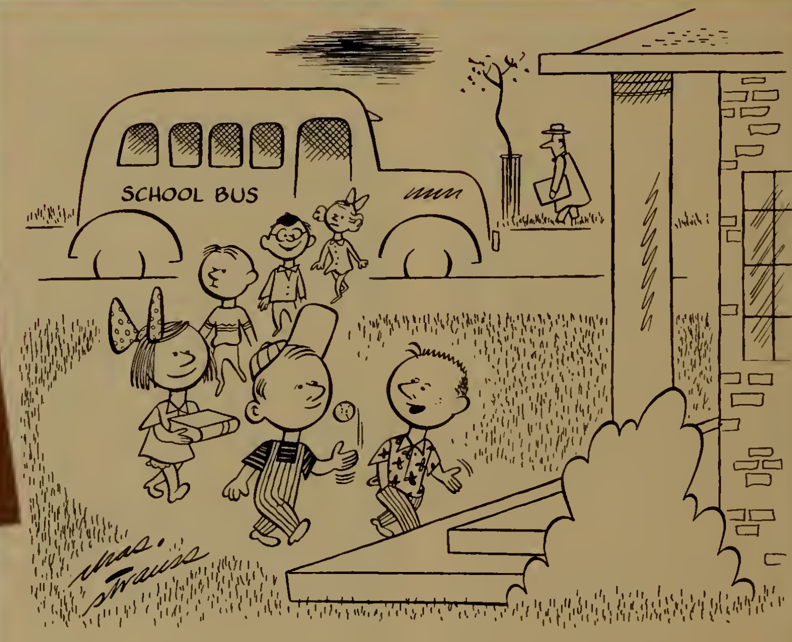
KNOWN FOR HIS SUBTLE HUMOR, President Jon C. Strauss seems to look at the world with the eye of a good-natured spectator. Small wonder, when you consider the fact that his father, Charles E. Strauss, has for years chronicled life as only a nationally syndicated cartoonist can.

As springtime rushes in to finally overtake a winter that was no less harsh than the *Farmer's Almanac* predicted, we complement the season in the pages that follow with a selection of Charles Strauss' warm humor, published beginning in the 1950s in places like the *Saturday Evening Post, Medical Economics, Collier's,* and *The New York Times Book Review.*

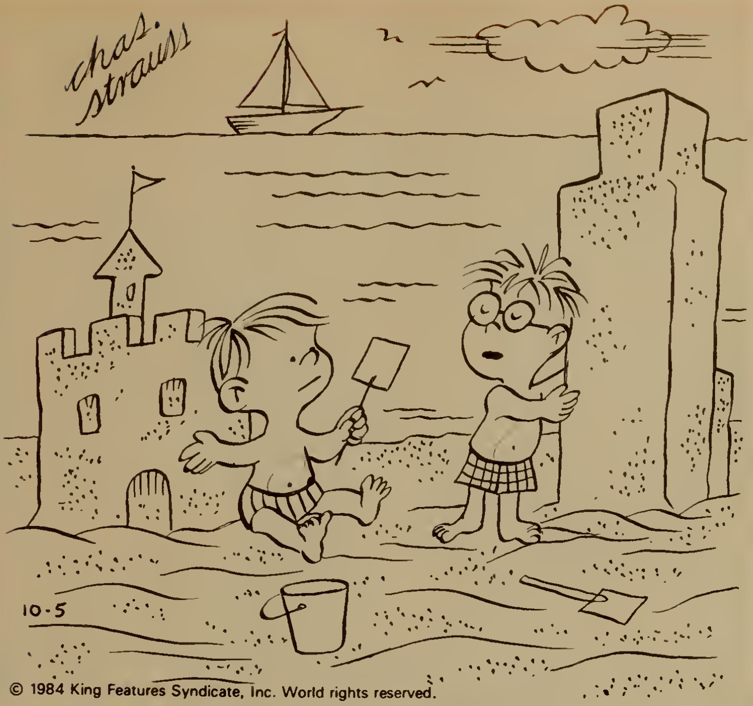
After completing an A.B. degree at Oberlin College, Strauss earned a certificate from the Chicago Academy of Fine Arts and did additional studies at Columbia and Rutgers universities.

Besides cartoons, he has designed book covers, advertising, and printed promotional pieces; completed visual scripts for popular cartoon characters like Casper the Friendly Ghost; and illustrated posters and greeting cards. He is a syndicated newspaper artist of King Features.

In addition, Strauss has served as an instructor in cartooning at the New York School of Visual Arts and an art instructor at Delaware Valley Regional High School, near Milford, Pa. He makes his home in Frenchtown, N.J.



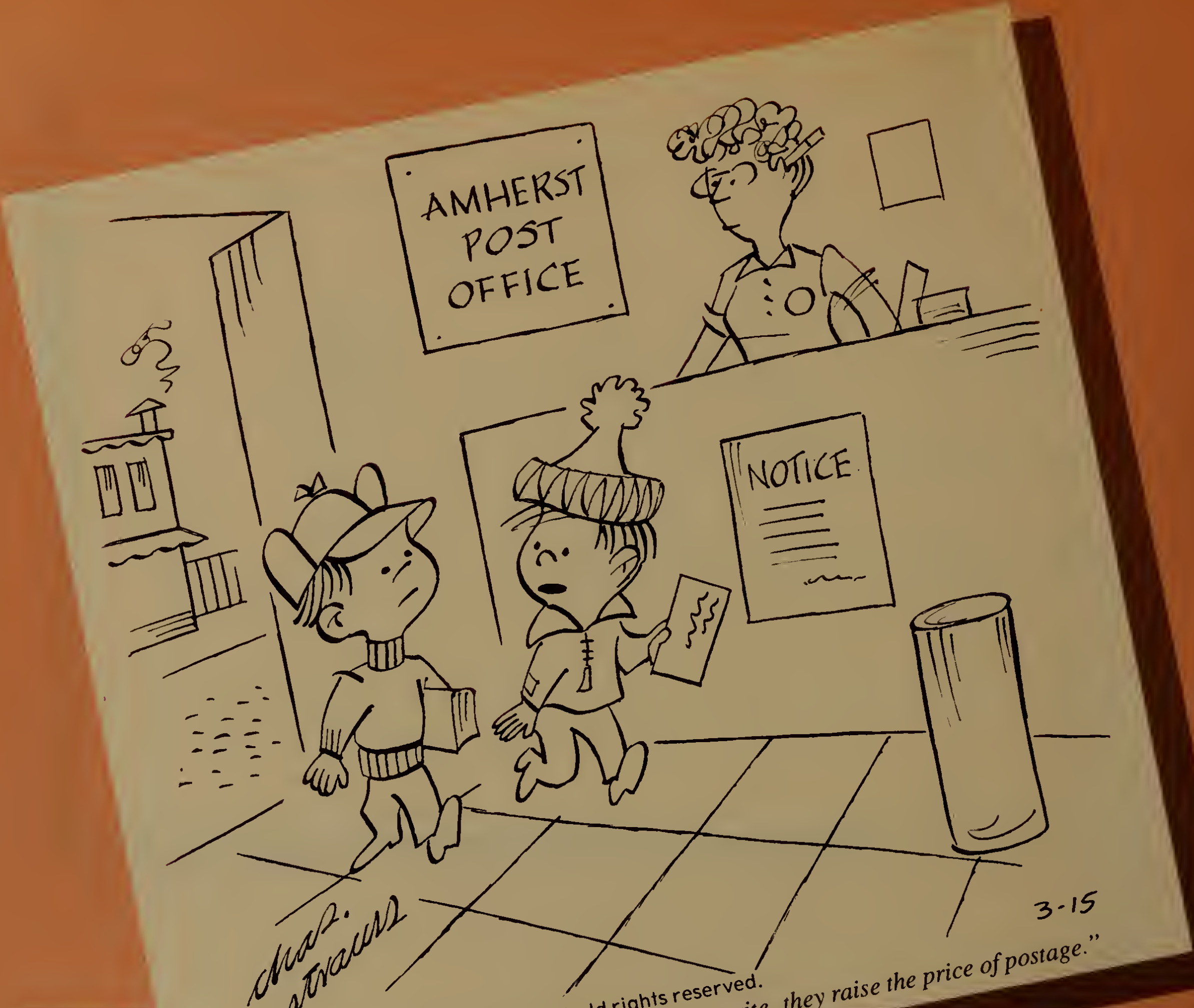
"Play real dumb the first few weeks—then they'll think you're making real progress afterwards."



"Castles are corny—high-rise condos are the thing."

"'I' before 'E' except after 'C'. . . "

"I don't wanna eat my vegetables and grow up to be a big, strong football player. I wanna stay small and light and grow up to be a racehorse jockey."



"Can you beat it? Just when I've learned to write, they raise the price of postage."

"But it takes years to be a doctor, and you can be a barber with a little practice."

Alumni Field, renovated and rededicated in 1986.

CONGRATULATIONS
CLASS OF 1987!

Higgins House, new home of the Alumni office, surrounded by spring flowers.