PLAY BALL!

Teaming up with
Fred Kublimann
and Dal Maxvill
The gift for garb: Costume designer Bonnie Kruger gets a feel for the fabric she will transform into a Victorian ball gown for the Performing Arts Department production of Lady Windermere’s Fan. The drawing room drama, written in 1892 by Oscar Wilde and acclaimed as the playwright’s first great stage success, portrays the relationship between a mother and her daughter, and the fashionable London society of which they are a part. Artist-in-residence Ann Marie Costa directs. Performances are scheduled in Edison Theatre at 8 p.m. Friday and Saturday, March 30-31 and April 6-7, and 2 p.m. Sunday, April 1. Ticket information is available at the box office, (314) 899-6543.
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Imaging Breast Tumors with PET

Physicians may one day rely on pictures, rather than surgery, to tailor treatments for individual patients who have breast cancer.

Scientists at the School of Medicine have created the first images of human breast tumors using positron emission tomography (PET). Breast cancer can be imaged with mammography and other radiologic techniques, but the advantage of PET is that it may enable doctors to determine, without biopsies, which tumors will respond to hormone therapy and to monitor, almost immediately, effectiveness of the treatment. PET produces images of function, whereas most other techniques show form.

The research team—headed by Michael J. Welch, professor of radiation chemistry in radiology at the University's Mallinckrodt Institute of Radiology—created pictures of the cancer that existed in the breasts of 13 women, using PET to scan estrogen receptors concentrated in their tumors. The ability to produce these high-resolution images represents a sweeping advance in the field.

"This is the first time a tumor receptor has been imaged in humans," claims Welch. "The impact could be tremendous. Besides our own estrogen work, there is an awful lot of research worldwide looking at receptors in the brain."

The Washington University findings are expected to be especially important in treating metastatic breast cancer, a form of breast cancer in which the primary tumor spreads and secondary tumors crop up at other sites in the body.

In order to use PET successfully, Welch and his colleagues first had to devise a highly specific radioactive tracer, a derivative of natural estrogen called F-18 fluoroestradiol. The drug, when injected into a woman's body, binds to the estrogen receptors in her system. When tracked on a PET scanner, it reveals the concentration of those estrogen receptors in any tumors, producing actual images of the cancer. The scientists confirmed the work by comparing their PET-based calculations of estrogen receptor levels to measurements obtained during subsequent biopsies; good correlation was obtained.

If estrogens were keys, explains Welch, estrogen receptors would be their keyholes. Without those keyholes, estrogen can't carry out its hormonal functions. Like estrogen, the receptors are found throughout the body, particularly the brain, uterus, ovaries, and breasts, but tend to accumulate in breast tumors. Tissue studies have shown that they occur in about two-thirds of breast tumors in postmenopausal women, and in a third to a half of tumors in premenopausal women. In breast cancer, anti-estrogen drugs—the most popular is tamoxifen—act as plugs, blocking estrogen receptors. Without estrogen, the cancer cells can no longer thrive.

Knowing the nature of the breast tumor would allow doctors to prescribe hormonal therapy with a reasonable assurance of its effectiveness, and with a second scan, to quickly check treatment progress and make adjustments if necessary. Not knowing, doctors must wait for the hormonal therapy to register its effectiveness, meaning they risk wasting months of potentially valuable treatment time.

The researchers are working to improve the drug they use for the imaging and to slow the rate at which the compound is metabolized. This effort would yield higher concentrations of the drug in tumors, resulting in more informative images. They also are considering whether the drug, because of its ability to concentrate in the estrogen receptors of tumors, might be adapted to carry cancer-killing radiation.

Among North American and Western European women, one death in 25 results from breast cancer. The disease is the leading cause of death for women aged 35-54, and second only to cardiovascular disease for women aged 55 and older.
Researcher Discovers World's Oldest Rocks

Since 1979, geologist Samuel Bowring has made annual trips to Canada's Northwest Territories to collect rock samples and map the rolling, treeless tundra of the Arctic. The field expeditions, says the assistant professor of earth and planetary sciences, were conducted in the name of "basic, fundamental science."

Yet Bowring's quest in the name of "basic science" has produced rock samples proven to be 3.96 billion years old, making them the oldest rocks discovered on Earth. Retrieved from the Slave Province in the Northwest Territories, the rocks constitute the oldest known crust of the Earth and will provide scientists with valuable insights into the early history of the planet. The samples narrow the gap to 600 million years between the Earth's debut as a planet 4.6 billion years ago and the first preserved rocks.

In his laboratory Bowring dated the granitic rocks, known as the Acasta gneisses, by extracting the mineral zircon and using a mass spectrometer, which allows the individual isotopes of uranium and lead to be measured. He determined that the rocks were at least 3.84 billion years old. Desiring another instrument to assess their exact age, Bowring traveled to the Research School of Earth Sciences at Australian National University in Canberra. There, he collaborated with two of the Australian university's scientists to analyze the rocks. Using an ion microprobe, the most powerful instrument of its kind, the researchers determined the original age of the Acasta gneisses to be 3.962 billion years old, with a relatively small margin of uncertainty of a few million years.

In simplest terms, two types of rock develop from the Earth's interior to form crust—basalt, which comprises the oceanic crust, and granite, less dense rocks that make up the continents. Oceanic crust is about three miles thick and is repeatedly destroyed by sinking back into the Earth's mantle along subduction zones. The oldest oceanic crust on Earth is only about 165 million years old.

Continental crust averages about 24 miles in thickness and is comprised of less dense granitic material, making it more buoyant and resistant to sinking back into the mantle. Once formed, these rocks tend to be preserved, providing clues to the earliest processes of crust formation on Earth.

The rocks Bowring collected are about 600 million years younger than the Earth itself, which along with the moon, Venus, and other planets of the inner solar system was formed about 4.6 billion years ago. In contrast, the first dinosaurs roamed the Earth about 225 million years ago, and humans first appeared between three and four million years ago.

Washington People in the News

Lee F. Fetter, formerly assistant vice chancellor for medical affairs at the School of Medicine, was named associate vice chancellor and associate dean for administration and finance in January. He assumes additional responsibilities in operations, including personnel and facilities management.

Fetter joined the School of Medicine in 1983. Previously, he served four years as Missouri's first executive director of health and educational facilities and two years as director of planning for St. Louis University Medical Center.

Viktor Hamburger, professor of biology emeritus, was awarded the National Medal of Science, the nation's highest scientific honor, at a White House ceremony in October. He was cited for his lifetime contributions to the fields of developmental neurobiology and embryology. A member of the National Academy of Sciences and the American Academy of Arts and Sciences, Hamburger was honored along with 18 other scientists and engineers from around the country.

John K. Wallace Jr., chair and chief executive officer of Imperial Products Corp., has been elected to the Washington Board of Trustees for a term of four years.

A graduate of the M.B.A. program at the John M. Olin School of Business, Wallace is a member of the business school's Capital Gifts Committee and a past president of its Century Club. He serves on the executive committee of the University's William Greenleaf Eliot Society and chairs its membership committee.
Photoreceptor Transplants May Restore Lost Sight

Most neural blindness is caused by damage to and degeneration of the eye's rods and cones, the photoreceptor cells that begin the conversion of light into nerve impulses. A revolutionary pioneering technique to replace these damaged cells has been developed by Washington researchers Martin S. Silverman and Stephan E. Hughes, whose work holds the promise of restored vision for millions of blind people.

Silverman, assistant professor of physiology, and Hughes, assistant professor of neurobiology, both from the Department of Speech and Hearing at the University's Central Institute for the Deaf (CID), have developed the technique to replace missing photoreceptors with transplanted photoreceptors that may take over the task of responding to light.

How did the scientists specializing in speech and hearing become involved with eye research? "We were taking bits of the inner ear and placing them in the eye," says Hughes, who noted that use of the eye chamber as a host for transplanted tissue has become a popular practice over the past 50 years.

"We were addressing questions regarding the inner ear when we discovered a whole new line of research that we could apply to the eye," Hughes continues. "Yet there is a common element here. Some eye diseases have hearing problems tied in. Usher's syndrome, a genetic-based disorder that affects sensory cells of the ear as well as those of the eye, is one."

Although the work holds no immediate prospect for clinical application, the researchers point out that it does leap several hurdles impeding photoreceptor transplants. The major challenge they faced lay in isolating the microscopic photoreceptor cells from the donor retina. Because the cells' organization is as important to sight as are the photoreceptors themselves, traditional cell-harvesting techniques that dissociate and purify tissue were inappropriate. To maintain the cells' original composition, Silverman and Hughes engineered a technique to flatten the intact donor retina from an 8-day-old rat and affix it to a block of gelatin.

By sectioning down through the five layers of the retina and examining each layer under a microscope, they reached the photoreceptor layer. There, they removed a section of approximately 200 microns—about as thick as an index card—of perfectly organized photoreceptors. This section of tissue, attached to a gelatin substrate, became the transplant.

The scientists then inserted the transplant tissue, about the size of a match head, into the eye of the host rat through a small incision in the cornea. They detached the retina and inserted the transplant into the subretinal space from which the photoreceptors had been eliminated. No sutures were required, and the retina reattached itself as the gel dissolved and the cornea healed.

The team's most recent studies reveal that the transplants are successful not only in light-damaged eyes, but also in genetically blind strains of mice and rats. The research is funded by grants from the National Eye Institute of the National Institutes of Health, the National Retinitis Pigmentosa Foundation, Retinitis Pigmentosa International, Monsanto Company, and a Sloan Foundation fellowship.

In coming months, the scientists hope to test the transplant techniques in primates. If the studies are successful, they will organize a trial in humans.
Olin Ranks Among Nation's Top Business Schools

When the editors of Business Week magazine set out to find the nation’s best business schools, they discovered “hidden treasure” at Washington’s John M. Olin School of Business. The magazine surveyed students, corporate recruiters, alumni, faculty members, and business school deans to come up with Business Week’s Guide to the Best Business Schools, which profiles the nation’s 40 best M.B.A. programs. The new guide ranks the Olin School as one of the 20 second-tier schools, but one that “stands ready to break into the top ranks” of the premiere M.B.A. programs.

Inspired by the magazine’s November 1988 issue, which ranked the nation’s top 20 business schools and became an instant best-seller, editors of the book provided an in-depth look at the magazine’s top 20, and listed 20 second-tier or “Runners-Up” schools without ranking them.

“If a business school were a hit record on the Billboard charts,” the profile of Olin says, “Washington University’s B-school is a hidden treasure among the 20 second-tier schools. Like Duke University only a few years ago, it stands ready to break into the top ranks of the nation’s best business schools. Why? It has the two crucial ingredients: the money and an aggressive dean bent on making a difference.”

The profile describes Olin’s atmosphere as “small, close-knit, and informal,” and says: “At Olin you’d find one of the best-designed B-schools in the world with one of the more underrated faculties.” However, the book cautions, “Before you rush off to apply . . . remember that Olin is still a school making the climb.”

Newscaster Robert MacNeil Predicts Rapid Change

Last October, Robert MacNeil, newscaster for the public television program the “MacNeil-Lehrer NewsHour,” visited campus to give an Assembly Series lecture. In his speech “Coming to Grips with the World,” MacNeil addressed a sweeping range of current issues in a style both absorbing and provocative. Change was the underlying current of his narrative, both the revolutionary changes that the United States has witnessed in the last 40 years and those that we might expect to see in the next four decades.

MacNeil predicted, for instance, that the demographic trend toward an older population will have a profound impact on our society, particularly on women. “The average woman is likely to devote more years to an elderly relative than to caring for a dependent child,” he explained. But MacNeil argued that the aging trend will also greatly affect the economics of health care and the Medicare system, the direction of medical research, voting and political trends, retirement patterns, and traffic laws.

At the same time, science and technology will revolutionize medicine, particularly through genetic research and computer simulations, MacNeil predicted. Defense systems, space exploration, the world’s food and energy supplies, and the use of robots likewise will all undergo enormous change.

Perhaps most interesting were MacNeil’s forecasts related to human attitudes. He described competition as “a concept that is slowly beginning to creep back into the American psyche” after decades of U.S. economic and military supremacy in the world. He argued that the United States would soon lose its rank as the world’s largest unified market to the European Community and that our nation “is increasingly being beaten at games it invented, like car assembly lines.”

Robert MacNeil

Another plus for the school, Business Week says, is the on-campus recruiting program that saw 113 companies interview 2,151 M.B.A.s last year. Among the companies that hired Olin grads were Arthur Andersen, May Co., Procter & Gamble, Exxon, Ralston Purina, and Trammell Crow.
Societal Changes Needed as Women Evolve in the Work Force

If women are to "have everything"—that is, to participate in the work force and to raise families—fundamental economic and societal changes are necessary, says Martha N. Ozawa, Bettie Bofinger Brown Professor of Social Policy in Washington's George Warren Brown School of Social Work.

Ozawa, a specialist in income maintenance and social security, co-edited and contributed to Women's Life Cycle: A Japan-U.S. Comparison in Income Maintenance (Tokyo, University of Tokyo Press, 1989), which proposes such changes as a "horizontal redistribution of income" from men to women and from childless families to those with children, reforms in Social Security and pension programs to provide widows with benefits that would allow them to maintain their standards of living, formulas for child support and alimony so that living standards of divorced husbands and wives would remain the same, and guaranteed minimum child support payments to women with children.

Unless society supports women's evolving role in the work force, Ozawa believes, Japanese and American women will simply stop having children. "The fertility rates in both countries are declining," she says. In the United States, 57 percent of women are in the labor force; in Japan, the figure is 47 percent. Women's wages in both countries are about 60 percent of men's. And in both countries, says Ozawa, the total fertility rate has plunged below the 2.1 children per woman necessary to maintain a stable population. In the United States the total fertility rate is 1.8 children per woman, and in Japan it stands at 1.7.

Powerful incentives are drawing women into the workplace, Ozawa says. Among those she cites are the growing belief among women that they need their own, secure economic base, regardless of marital status; the greater opportunities for women in both societies; the prestige value of having a job (particularly in America); and the desire or need for additional money to support their households.

Just as powerful, she says, are the societal imperatives for women to work. More women working means that the countries can stay competitive in the world economy and continue to pay for social programs benefiting their aging populations.

In the United States and Japan, Ozawa says, women's economic fate is largely determined by two critical events: divorce and widowhood. Women's failure to earn as much as men stems in large part from their spending critical years in childbearing and child rearing.

"Unless both countries make appropriate adaptations to the changing role of women in the labor market," Ozawa adds, "women will make their own adaptations by refusing to play women's roles, including bearing and rearing children. Ultimately, the United States will become a nation of individuals pursuing their own economic security. This will be detrimental to national survival."
The heat is on: Claudia de Moreno, a Mazahua Indian, cooks with rootfuel in her three-stone fireplace. De Moreno and other women living in Delores Hidalgo, a deforested village in Atlacomulco, State of Mexico, typically spend eight hours or more on a trip searching for wood fuel.

Rooting for Fuel

Massive deforestation of the Third World, the cause célèbre of ecologists in the 1980s, has devastated the global environment. But according to two Washington researchers, followers of the phenomenon may be "missing the trees for the forests."

Eugene B. Shultz, professor of engineering and applied science in the engineering school's bioresources development group, and Wayne G. Bragg, affiliate professor of technology and international development, have discovered that the roots of a common gourd make excellent cooking fuel. In Third World countries where nearly 60 percent of the population still cooks food on a three-stone fireplace or by other primitive methods, "rootfuel" could provide an answer to the fuel shortage. It could also "revitalize what have become decimated rural areas in the Third World and could give reforested areas the decades they need for regrowth," says Shultz.

The researchers took the sundried roots, relatives of the cucurbitacea family, to native women in three countries—Mexico, Senegal, and Niger—for testing as a cooking fuel. In every case, reports Shultz, the women preferred rootfuel to corn stalks, dung cakes, or dried cactus leaves, which are commonly used sources of fuel that can give off harmful chemicals and offset the taste of foods.

Laboratory analyses revealed that the heating value of the roots is almost identical to that of wood. Rootfuel, too, was found to release heat more slowly than wood. The scientists presented their findings a year ago at the Conference on Energy from Biomass and Wastes XIII in New Orleans.

Shultz and Bragg envision eventual cultivation of the roots on poor or marginal soil where the plants would not compete with food crops. This notion of cooking fuel, say other scientists, offers a new option for some of the poorest people on the planet.

Class of 1993 Reflects Excellence and Diversity

What do 110 piano players, 69 merit scholars, 51 newspaper editors, 41 dancers, 29 soccer captains, 11 French club presidents, and 7 math/computer science presidents have in common? They're all members of Washington's freshman class.

"I am most impressed by the quality of our freshman class," offers Charles S. Nolan, assistant provost and dean of undergraduate admission. "By all measures, this class excels academically and has been involved in a broad range of co-curricular and extracurricular activities."

The 1,216 freshmen enrolled in the class of 1993 hail from 47 American states and 21 foreign countries. They are represented in the following information:

- 602 students, or 49.5 percent, are female; 614 students, or 50.5 percent, are males.
- Minorities, comprising 16 percent, include Asian Americans (107), blacks (61), and Hispanics (24).
- Arts and sciences has enrolled 723 students; architecture, 59; business, 139; engineering, 226; and fine arts, 69.
- 42 percent of the freshmen come from the Midwest; 22 percent from the Mid-Atlantic states; 11 percent from the South; 8 percent from the Southwest; 8 percent from the West; 6 percent from New England; and 3 percent from foreign countries, Guam, and Puerto Rico.
- The top three hometown states are Missouri (162), Illinois (143), and New York (118).
- 59 freshmen, or 5 percent of the class, are children of alumni.

Contributing writers: Kate Berger, Debra Bernardo, Tony Fitzpatrick, Steve Kohler, and Carolyn Sanford
Playing Their Cards


When organist Ernie Hays strikes the opening chords of the national anthem, approximately 26,000 people rise to their feet and feebly sing. But when the anthem ends and the ump yells “Play ball!” these Redbird rooters, clad in red caps and jackets, cheer lustily.

Two faces in the crowd tonight belong to Fred L. Kuhlmann, A.B., LL.B. ’38, and Charles Dallan “Dal” Maxvill, B.S.E.E. ’62. Kuhlmann is president and chief executive officer of the baseball Cardinals. Maxvill is the team’s vice president/general manager. They’ve been “playing ball” since 7:30 that morning.

Still dressed in his coat-and-tie uniform, Kuhlmann occupies a front-row seat behind home plate. The epitome of a silk-stocking attorney, he props his black wing tips on the wall encircling the playing field. Next to him sits his wife, Mildred. The couple watches the game through a wire screen, which shudders with the impact of screaming foul balls.

Alumni Fred Kuhlmann and Dal Maxvill tend to the business of baseball.

by Robert Lowes

“That a boy, Ricky!” shouts the raspy-voiced Kuhlmann when Cardinal pitcher Ricky Horton fires a strike by Pirate slugger Bobby Bonilla.

“I can’t disassociate myself from the game,” says Kuhlmann. “My blood pressure goes up.”

Not so for Maxvill, seated in a private box 51 feet above the playing field. The former Cardinal shortstop leans forward in his chair and studies the game like a hawk perched in a tree. Unlike Kuhlmann, Maxvill is still on the job as team architect. He appraises Cardinal and Pirate players alike. Would any Pirate look good in a Cardinal uniform? Would any Cardinals make good trade bait? Who should stick around?

“I can’t let myself be a fan,” says Maxvill.

In the sixth inning, Cardinal shortstop Ozzie Smith demonstrates his Gold Glove ability in a double play. Maxvill nods in approval. In the seventh inning, Pirate second baseman Jose Lind puts his team ahead 2-1 with a single to left. “It was in the right spot, wasn’t it?” Maxvill asks matter-of-factly.

The Pirates walked away from the field with a 3-1 victory. After coming within a half game of the first-place Cubs, the Cards faded to a third-place finish in the National League Eastern Division with 86 wins and 76 losses. Some fans publicly castigated Kuhlmann and Maxvill for not acquiring a starting pitcher to boost the club’s chances, especially since injuries sent frontline pitchers Danny Cox and Greg Mathews to the bench. But the duo did give St. Louis a contender for several months.

Most fans apparently liked what they saw—3,082,000 spectators filed into the ballpark in 1989, marking the highest attendance in the National League. Considering that teams like the Dodgers and Mets hail from more populous metropolitan areas, the Cardinal attendance figure is all the more remarkable.

The attorney and the shortstop have put some numbers on the board, as players are wont to say. 1989 marked the second three-million attendance season under the leadership of Kuhlmann and Maxvill, who joined Robert Lowes, A.B. ’75, is a freelance writer living in St. Louis.
Go, team! Kuhlmann cheers a Cardinal hit. Seated next to him is his wife, Mildred.
Maxvill grew up with a poster of Cardinal legend Stan Musial over his bed. Years later, he played on the same field with the Hall of Famer.

the Cards in 1984 and 1985, respectively. After they arrived, the club won National League pennants in 1985 and 1987.

Both men have played on winners before—Kuhlmann as an executive with beer giant Anheuser-Busch Cos. Inc., owner of the club, and Maxvill as a defensive star with the championship Cardinal teams of the 1960s. Yet this pairing represents more than businessman and athlete. Kuhlmann has been avidly watching the team for 60 years, ever since he walked a few blocks from his childhood home to the Cardinals' old stadium in North St. Louis where Dizzy Dean wowed 'em.

Maxvill the athlete knows about reaching the bottom line, as well as home plate. An electrical engineer, he worked during his off-seasons for a local fuse manufacturer convincing other engineers that fuses were better than circuit breakers. "I learned about getting up and talking in front of 50 to 60 people who knew more than I did," Maxvill says in his typically brisk, self-deprecating way. He and former teammate Joe Hoerner also own a travel agency.

For all his marketplace savvy, Maxvill's office at Busch Stadium resembles a locker room. A dented briefcase and a box of Entenmann's cookies sit on the GM's cluttered desk. Papers and file folders are stacked on the floor. Except for his gray hair, the agile, 50-year-old Maxvill still resembles the shortstop of old. He weighs only seven or eight pounds more than his playing weight of 155.

A native of Granite City, Illinois, Maxvill grew up with a poster of Cardinal legend Stan Musial over his bed. Years later, he played on the same field with the Hall of Famer.

Maxvill, an easy-going sort, was the skinny kid everyone else wanted to fatten up. Yet a slender frame didn't prevent him from hitting over .300 for the Washington University baseball Bears. It was a different story when he joined the Cards in 1962. Over his 14-year career, 11 with St. Louis, Maxvill batted .220, hit six homeruns, and drove in 231 runs. Although a light hitter—some batters collect 231 RBIs in just two years—Maxvill has demonstrated talent in other areas.

His greatest contributions were his glove—a Gold Glove in 1968—and his coolness.
under fire, according to Albert "Red" Schoendienst, a Cardinal coach who managed Maxvill in the 1960s. "When you have a shortstop who could play the way he could play, you'd win," says Schoendienst. "If the game was on the line, you'd hope the ball would be hit to him."

Maxvill played in three World Series as a Cardinal and a fourth as an Oakland Athletic in 1974, his last year in the majors. At the age of 35, he succumbed to the youth movement known in every sport.

He returned to baseball in 1978 to coach, first for the New York Mets, and later for the Cards and the Atlanta Braves. In 1985, the Cards hired him as general manager. He became the third alumnus of Washington University to assume that post, following in the footsteps of John W. Claiborne III, B.S.Ed. '62, M.A.Ed. '63, and Vaughan P. "Bing" Devine, A.B. '38.

The Cardinal-Washington University connection also includes Mark D. Gorris, B.S.B.A. '78, vice president of finance and administration, and Louis B. Susman, J.D. '62, a member of the board's advisory committee. Susman, managing director of Salomon Brothers Inc., in Chicago, played a critical legal and advisory role as the ball team's lawyer for 12 years. He was also a close friend and legal counsel to the late August Busch Jr.

When Maxvill broke into the major leagues, general managers ran ball clubs singlehandedly. "Today, they concentrate on field operations and contract negotiation while other executives, such as Kuhlmann, control the purse strings of an increasingly big business.

"The toughest job today in baseball is general manager," says Cardinal manager Whitey Herzog, affectionately called the "White Rat." "Twenty years ago, before free agency, before long-term contracts, before agents, the toughest job was manager. I've been both."

Herzog says a general manager faces pressures from all sides. Fans expect him to assemble a winning team. The owner expects him to control costs.

Maxvill doesn't blow any fuses under the pressure, says Mike Bertani, director of ticket- and game operations for the Cardinals. Having worked under eight GMs, Bertani has witnessed a variety of managerial styles. "Being an ex-player helps him out," he offers. "He doesn't get depressed about a loss or ecstatic about a victory. That turns out to be an asset as a general manager. He doesn't do things on emotion."

General managers can create championship teams in three ways—cultivate players in the minor-league farm system, trade for them, and bid for them in the notoriously expensive free-agent market.

When Maxvill is not watching the Cards at home, he's in Springfield, Illinois, Savannah, Georgia, or some other burg evaluating Cardinal minor-league prospects. The Cardinals have eight minor-league clubs, more than most organizations. Maxvill says a strong farm system is the heart of the Cardinals' player development program. "If you get a player a year, you're lucky," he adds ruefully.

Trading is a speedier way to fill a position, although the club must give up something in return. Each day, Maxvill talks to between three and five other general managers about possible swaps. "Your needs change a lot," he claims. "You call and say, 'I have an excess of outfielders. Do you need any?' He says, 'No.' And then that night, one of his outfielders breaks a leg."

Depending on the trade, a general manager looks like either a genius or a jinx. Maxvill traded pitcher John Tudor to Los Angeles for first baseman Pedro Guerrero in
Kuhlmann is described as a fair and trustworthy man who, guided by his Lutheran faith, doesn’t bend the rules for short-term success.

1988. The result? Guerrero gave the Cards the firepower they needed for their 1989 pennant run by hitting .311 and knocking in 117 runs. Maxvill took some heat, however, when he traded outfields Andy Van Slyke, catcher Mike LaValiere, and pitcher Mike Dunne for catcher Tony Peña in 1987. While the three new Pirates blossomed into stars, Peña turned in some mediocre years playing offensively for the Cards. Even disgruntled fans on radio call-in shows demanded that Peña be shipped out.

General managers also court controversy in the free-agent market, where players go to the highest bidder. Why doesn’t Maxvill sign up this or that ace pitcher? the cry goes up. Why is he sitting on his hands? Herzog says appearances are misleading: “You can work for hours on end and not come up with anything.”

There’s no doubt Maxvill works hard. He shows up in his office at 7:30 a.m. When the Cards play a night game at home, he’s in his private box until the seventh or eighth inning. And all along, he’s giving himself an earache with a telephone receiver.

“That’s the most frustrating thing,” he says, grimacing. “I underestimated the amount of time spent on the phone. One phone call will lead to two more, invariably.”

While he considers baseball a hobby as well as a job, Maxvill, a father of four, says he sometimes escapes into a spy novel. His reading tastes run similar to those of Kuhlmann, whose need for relaxation is just as great.

Kuhlmann, 73, gets to work at 7:15 a.m. He attends about two-thirds of the Cardinal home games, leaving after the seventh inning. “The evening events are truly extracurricular,” he says.

Kuhlmann’s ballpark seats have improved dramatically since he cheered on the Cards as a member of the “Knothole Gang” six decades ago. Originally, the Knothole Gang referred to a scheme to find investors for the club. Anybody who bought $25 worth of stock could give a season’s pass to a needy youngster who otherwise watched the action through a hole in the fence. The Knotholers sat in the left-field grandstands. Later, schools, churches, and youth agencies distributed Knothole Gang passes with no strings attached. “We applied for the passes religiously,” recalls Kuhlmann.

Kuhlmann decided on a legal career in high school. He earned a law degree at Washington University in 1938, toiled in a small general practice for several years, and then obtained a master’s degree in law at Columbia University. During World War II, he tangled with Adolf Hitler. Working several months with the government’s Alien Property Custodian, Kuhlmann was assigned to impound the dictator’s royalties from U.S. sales of Mein Kampf.

After the war, he joined a St. Louis law firm that specialized in tax work. Kuhlmann and one of the partners, Hyman Stolar, LL.B. ’24, founded their own firm in 1956. Eleven years later, one of the firm’s clients, Anheuser-Busch, asked Kuhlmann to come aboard as general counsel. He obliged.

When Kuhlmann joined Anheuser-Busch—“I guess it was the best decision I made in my life,” he says—he fell into the orbit of the late August A. Busch Jr., the beloved St. Louisan who built the company into the world’s largest brewery (41 percent of U.S. beer sales in 1988). Gussie, as he was called, set high standards for his beer and his Cardinals—first place or nothing—and he minced no words when subordinates didn’t measure up. “You never had to worry about where you stood,” Kuhlmann says, chuckling.

Kuhlmann’s standing kept improving—vice president, senior vice president of administration and services, vice chairman of the board. Friends and associates point to a long list of traits that make Kuhlmann a key player at the brewery.

“He can grasp a situation with just a few words being spoken,” says John W. Gerber, president of St. Louis-based Concordia Publishing House, where Kuhlmann was a longtime board member. “I can see why all the Busches count on him considerably.”

Like others, Gerber describes Kuhlmann as a fair and trustworthy man who, guided by his Lutheran faith, doesn’t bend the rules for short-term success. “He makes the right move as opposed to the expedient move,” says the publisher.

Kuhlmann also is praised for his pre-
ciseness and organization, although he laughs off the notion that he schedules his day by the minute. He certainly feels at home in a brewery known for doing things right. Walter A. Suhre Jr., Anheuser-Busch vice president and general counsel, says Kuhlmann taught him “the Anheuser-Busch way of approaching things—attention to detail and immediate response.”

Gussie Busch, for years the chief executive of the Cardinals, put Kuhlmann in charge of day-to-day operations in 1984. Kuhlmann says he, Maxvill, and others have made a great organization even greater by structuring it more like a business. “Today, we budget. We have strategy review sessions. We have staff meetings. We've conformed in a lot of ways to the style of management at Anheuser-Busch.”

A month after Gussie Busch’s death September 29, Kuhlmann was named president and chief executive officer of the Cardinal team. He also chairs the board of Civic Center Corp., the Anheuser-Busch subsidiary that owns and operates Busch Stadium. Civic Center, he says, insists on an orderly, wholesome atmosphere at the ballpark—a big reason for attendance figures of three million plus in 1987 and 1989. “We've made it a fun place for families to come to,” says Kuhlmann, a father of two.

Kuhlmann's knack for organization also keeps him active in Washington's alumni affairs. An Eliot Society patron and former chairman of his 50th-year class reunion, Kuhlmann serves on the School of Law National Council.

Planner par excellence, Kuhlmann prepared Mark Sauer, former deputy chief operating officer of the Cardinals, to succeed him as chief operating officer. You get the impression that while Kuhlmann will miss his old job, he won't miss reading letters to the editor demanding that he be traded for not signing up some million-dollar slugger.

“Once you get into sports, you become more of a visible person whether you like it or not,” he says, choosing his words carefully. “Too many of our great fans don’t know why certain things come about. It wasn’t as if we didn’t try. It was never because we were unwilling to spend the money.”

Aside from the public scrutiny that goes with the territory, Kuhlmann and Maxvill have had some rough innings at the helm of the Cards. The deaths last year of Gussie Busch and baseball commissioner A. Bartlett Giamatti rocked the Cardinal locker room and front office alike. How the locker room and the front office will get along in the 1990 season is another troublesome subject. Players and owners are now negotiating a new labor contract. The owners are talking possible lockout; the players’ union is talking strike.

Kuhlmann offers no comment. As a member of the owner's player relations committee, he's sworn to secrecy. Maxvill, a former players' representative during the brief 1972 baseball strike, has a new role in the fray. “I make no mistake about what side I'm on,” he claims.

Whether the 1990 season is played in the courtroom or in the ballpark remains to be seen. But it's safe to say that with Cardinal blood flowing in their veins, Kuhlmann and Maxvill would rather take their accustomed seats at Busch Stadium and hear the umpire yell “Play ball!” For the Knotholer and the born shortstop, those two words transform the business of baseball into the national pastime.
By any account, the groom’s wedding gift to the bride was extraordinary.

He’d given her caving gear—hard hat with carbide lamp attached, cotton gloves, knee crawlers, containers for carbide and water, and a small canvas bag. She’d never before set foot in a cave.

(He, on the other hand, had been caving about a year, an amateur geologist who’d tried it one weekend and quickly graduated to the challenges of the Mammoth Cave region of western Kentucky.)

Now, in the summer of 1955, the honeymoon couple from Sheffield, Iowa (population 1,100), sweethearts since high school, stood, outfitted for caving, inside the entrance to one of those Kentucky caves, he powerfully built as a farm boy, redheaded; she, slender, her dark hair cropped short as a boy’s. She peered intently into the darkness ahead.

If someone had told her that within 10 years she would transfer the focus of her work on the origins of horticulture from the vast treeless plateaus of the Near East, where it was now centered, to these dark labyrinthine caves of the Eastern Woodlands of North America, she’d have laughed. After all, she was an “Old World” archaeologist, and Kentucky was definitely “New World.”

(If someone had told him, he probably would not have been surprised. After all, she adapted well to change.)

The graduate student in anthropology from the University of Chicago, Patty Jo Watson, adjusted her glasses and exchanged glances with the graduate student in Cartesian philosophy from the University of Iowa, her husband, Richard “Red” Watson. Together they moved forward into the cave.

M. M. Costantin is editor of Washington’s Alumni News and the author of two novels and a book of essays.
A flare for the subterrane: In Salt's Cave, Watson shines her carbide lamp on a piece of charred cane that aborigines probably used for torches and campfires.

David Kiper
For Patty Jo Watson (née Andersen), the adventure had really begun half a dozen years earlier in Sheffield's one-room public library, where she'd sat enthralled with an Agatha Christie. The book, a memoir of Christie's travels with her archaeologist husband, Sir Max Mallowan, was titled, prophetically for Patty Jo, *Come, Tell Me How You Live*. “It is the question that Archaeology asks of the Past,” writes Christie, referring to the memoir's title, “and with picks and spades and baskets we find the answer.”

In 1988, more than three decades after her introduction to caving, Patty Jo Watson, now a professor of anthropology at Washington University, was inducted into the National Academy of Sciences, an honor the *New York Times* described as “second only to the Nobel Prize as a measure of scientific accomplishment.” The Academy recognized Watson for 35 years of research in several areas of anthropology; these included the origins of horticulture in North America and the Near East; archaeological theory and method; and ethnoarchaeology, the study of living peoples as an aid to the interpretation of archaeological remains.

Commenting on Watson's career, Frank Hole, a professor of anthropology at Yale and chair of the Academy's anthropology section, said her study of aboriginal culture in the eastern United States had influenced the entire field of archaeological anthropology. “Patty Jo Watson is probably one of the most versatile archaeologists around,” he said. “There are very few archaeologists anywhere, I think, who can match her in both theoretical approaches and service to the archaeological community.”

Begning in the years just after World War II, young archaeologists in the United States and England began to challenge the standard way archaeology was being practiced as idiosyncratic and unscientific. Their arguments were sufficiently convincing to place the method and philosophy of the field under serious scrutiny.

When Watson set out for the University of Chicago in 1952, with two years of pre-med at Iowa State under her belt, she knew nothing of this ferment and little about archaeology itself, except that it was how she wished to exercise her scientific bent. What she did know was “old school,” the sort now under attack, the sort described by Christie in the pages of *Come, Tell Me How You Live*:

“The system is a simple one,” Christie writes. “The pickman of each gang has the best chance of finding objects. When his square of ground has been traced out to him, he starts upon it with a pick. After him comes the spademan. With his spade he shovels the earth into baskets, which three or four 'basket-boys' then carry away to a spot appointed as a dump. As they turn the earth out, they sort through it for any likely object missed by the Qasmagi [pickman] and the spademan, and since they are often little boys with sharp eyes, not infrequently some small amulet or bead gives them a good reward. Their finds they tie up in a corner of their ragged draperies to be produced at the end of the day. Occasionally they appeal to Max with an object, and upon his reply, ‘... keep it, or Shiluh, remove it; its fate was decided.’

At Chicago, Watson encountered a different approach to archaeology when she began her studies with Robert J. Braidwood. He and other anthropological archaeologists aimed to uncover the culture, as well as the history, of their subjects. What Watson learned from Braidwood has shaped her career.

Watson and many other archaeologists believe, as Braidwood taught, that they have a special responsibility to extract as much information as possible from an excavation because they are among the few scientists practicing who have to destroy their primary source of information in order to work on it. Other scientists can recreate their work in order to verify or overturn their conclusions. Archaeologists, therefore, should be accompanied by specialists in other disciplines, for example, botanists, geologists, and experts in bone shards, pollen, and pottery, who examine the context of the excavated materials as well as the materials themselves, using established scientific methods. In this way, as much information as possible about the ancient people who once lived there can be extracted from the site.
Braidwood also believed that some members of the expedition should live in villages near the dig so that they could directly observe and document the village’s social and political organization, division of labor between the sexes, types and preparation of food, and other activity. Such study, he felt, might bring important insights to the interpretation of the material being uncovered in the nearby dig, material left behind by what were perhaps the villagers’ prehistoric ancestors.

In addition, Braidwood’s insistence on scientific methodology and a scientific approach to the field of archaeology stimulated Watson’s concern that archaeology did not have an established apparatus of general scientific laws against which hypotheses could be tested or to which new laws, once discovered and proven, could be added. Some existed, to be sure, but other “laws” were created more in the nature of fiats declared by prominent archaeologists.


Another significant influence in Watson’s life has been her husband, Red, who introduced her to caving and later co-authored with her *Man and Nature: an anthropological essay* (1969). A member of Washington’s philosophy faculty since 1964, Red interrupted his doctoral studies in philosophy at Iowa State to earn a master’s degree in geology at the University of Minnesota. There, he studied under Herbert E. Wright Jr., Braidwood’s geological consultant, to serve as geologist for Braidwood’s 1959-60 field season in Iran, where Patty Jo would conduct her postdoctoral research.

Red’s interest in geology and caving led to his membership in the fledgling Cave Research Foundation (CRF), the cavers’ group that later discovered the connection between...
Partners: Below, the Watsons, standing in the background, and a fellow explorer take a break from the rigors of caving in Crystal Cave, part of Kentucky's Mammoth Cave system. The photo was taken in 1955, the year the couple married. Bottom right, Patty Jo and Red Watson walk to their offices together nearly every morning. Opposite page, to conduct her research, Watson must navigate through all types of terrain, including this treacherous passage-way in Salts Cave.

Kentucky's Mammoth Cave and a second—what was thought to be discrete—set of caves, the Flint Ridge system, that established Mammoth Cave as the longest cave in the world.

Red's expertise helped produce the shift in the location, if not the content, of Watson's research. She had taken to caving right away, and by the early 1960s was aware that CRF members surveying and mapping Salts Cave in the Flint Ridge system had come across perfectly preserved (due to the dryness of the cave) prehistoric remains, including cane torches, braided moccasins, human feces, and fragments of gourds.

A meeting with an old graduate school friend, Joseph R. Caldwell, inspired Watson to exchange the far-flung field sites of the Middle East for the pitch-dark environs of Kentucky caves. Watson and the CRF invited Caldwell, then head curator of anthropology at the Illinois State Museum, on a long cave trip to Salts, hoping to convince him to initiate research there. Afterward, Caldwell discussed with Watson a sample of paleo-feces, ancient human fecal material, they retrieved from Salts. "Everything you need to know is here," he said, indicating the sample.

The prehistoric human excrement preserved not only what these New World aborigines had been eating, but also when they had been eating it, Watson learned. A systematic study of paleo-feces and other artifacts in Salts might well reveal when prehistoric people in the Eastern Woodlands had begun to cultivate plants for food and other uses—a New World version of the topic she had been working on in the Near East.

In 1963, Watson, as CRF's representative, was awarded an Illinois State Museum Society grant for archaeological fieldwork in Salts Cave. It was her first big project as leader, and subsequently, she became officially known as Director of the Cave Research Foundation Archaeological Project, which now also encompasses work in other parts of the Mammoth Cave system, other caves in Kentucky and Tennessee, and the Green River shellmound project near Logansport, Kentucky.

Early on in the project, Watson, Caldwell, and a colleague wrote a grant request for a study they called "20 Dated Dinners." In it, they proposed collecting 20 samples of paleo-feces from different parts of the cave, analyzing and carbon-dating them, and, thereby, establishing a chronological look at what was being eaten (and, presumably, being grown,
collected, and hunted) by these prehistoric cave dwellers. "They turned us down," Watson says dispassionately, adding, "Can you imagine how much farther along we'd be if we'd been able to start that kind of work in 1963?"

Cave research, by its very nature, requires workers of considerable physical and emotional stamina. In her monograph, *The Prehistory of Salts Cave, Kentucky* (1969), Watson describes the commute from the surface to a work site deep within Salts Cave. She and her crew are already some distance into the cave, having just finished carefully picking their way down a steep slope of breakdown (limestone debris, fallen rock slabs, and boulders) that is, ominously, nicknamed Tom Wilson's Accident. Watson writes:

"Crossing Mummy Valley, you climb up the far side and continue a short distance to Grand Forks, a junction of two large passages. Keeping to the left, you climb down a tumbled mass of breakdown and finally reach the Corkscrew, the narrow tortuous, nearly vertical passage which leads to Lower Salts [cave]. Entering the Corkscrew feet first, you slide and twist your way down to the bottom, there to emerge into a low, horizontal passage. For the next half mile you must walk in a crouching position, crawl on all fours and occasionally slide along on your stomach to reach the high but very narrow passage leading into Indian Avenue. The whole trip from the entrance [into the cave] to Indian Avenue requires an hour to an hour and a half for experienced persons thoroughly familiar with the route and not burdened (as we always were) with extra equipment such as pressure lanterns, cameras and accessories, notebooks and collecting bags. It requires another thirty to forty-five minutes of steady progress (walking, climbing, and crouching) to reach the pit at the end of Indian Avenue."

It is only then that the day's exacting work of documenting remains or further cave exploration begins. When it ends, often eight to 10 hours later, the long, return journey to the cave's entrance awaits, with the Corkscrew to be negotiated, this time from the bottom up.

To accommodate their research at Salts, Watson and her varied crew have had to juggle their schedules as scientists, teachers, and writers. For example, in the period between 1964 and 1969 when she joined Washington's anthropology faculty, Watson also served as a research associate of the University of Chicago's Oriental Institute (1964 and 1967); as project associate and unit director for the Anthropology Curriculum Study Project of the American Anthropological Association (1965 through 1967); and as archaeologist on the Turkish Prehistoric Project for Chicago and Istanbul universities (1968 and 1970).

Despite a busy schedule, Watson has imposed on her work meticulous methods and high standards to produce outstanding results. She and her colleagues have shown that, in fact, the Indians of the eastern United States began cultivating several plants before, not after, agriculture reached the American Southwest, overturning a theory that had been held as gospel.

With a variety of interdisciplinary crews, including paleoethnobotanists, she has found evidence that the aborigines of the Eastern Woodlands were growing several kinds of plants—some native to the region, such as sunflower, sumpweed, and goosefoot, and some naturalized, such as gourd-like squash and bottle gourd, which appeared to have come from Mexico.

In 1989, Watson received a distinction of particular relevance, an Honorary Life Membership in the National Speleological Society (NSS), the highest award the 8,000-member society bestows. She was cited for distinguished contributions in cave archaeology, for which the NSS had earlier made her a fellow and given her a Certificate of Merit. In its 48-year history, the NSS awarded only 28 Honorary Life Memberships, including one to Red Watson in 1988.

Perhaps the greatest thrill for Watson in her nearly 30 years of cave research is the discovery of human footprints first pressed into cave mud 5,000 years ago.

"Nothing makes the cave dwellers quite so real," she says, "as seeing the actual marks of their bare feet. Time seems suspended, and I feel that if I followed the footprints around the next bend in the passage, I would come across the person who made them."
Surrounded by 3,250 raucous fans springing to their feet in thunderous applause, the women's volleyball team captured the 1989 NCAA Division III championship by defeating Ohio Northern University, 15-10, 15-9, 15-6, on November 18 in St. Louis. The victory marked the first national championship honor won by a Washington team in the University's 104-year history of athletic competition.

The Bears, who finished 39-7 for the season, stormed through the two-week national competition to advance to the Final Four. Determined to clinch the title, head coach Teri Clemens arrived at the final match with 25 cans of Silly String. As match point came on a fierce stuff block by junior Kathy Bersett and senior Kristi Owen, streams of the string were released in a shower of victory. Exclaimed Bersett, "It feels like we won the world!"

Top left, junior Diane Stites reaches for the block as senior Lori Nishikawa covers her. Left, junior Brooke Hortin attacks from the outside while team members take coverage positions. Far left, Teri Clemens, coach, and Joe Worlund, assistant coach, focus on a long rally.
The summer of 1989 brought an alarming message to the world: The heinous practice of poaching was forcing the African elephant into extinction. TV specials revealed shocking scenes of poached elephants lying mountainously mute, their ravaged skulls mutilated by chain saws, knives, and chisels. In desperation, conservation groups turned to advertising. By autumn, posh New York department stores joined forces with Wildlife Conservation International to announce they would no longer sell ivory objets d'art. In October 1989, representatives of the world’s nations declared the elephant an endangered species, triggering a ban on the global ivory trade.
The delegates signed the Convention on International Trade in Endangered Species, the treaty that regulates the trade of products from threatened animals. Past attempts to control the ivory trade, which generates annual revenues estimated between $500 million and $1 billion worldwide, have failed.

Two Washington University researchers have taken up the plight of the elephant in a humane and scientifically based effort to rescue the ailing giants.

It is six o'clock on a cool, moist June morning in the tropical rain forest of the Congo. Michael Fay, 33, an anthropology doctoral student at Washington University whose research is centered at the Missouri Botanical Garden, falls in with a queue of pygmies—a dozen forest dwellers who are assisting him on a hunting excursion.

Toting a briefcase and personal computer in one hand, a machete in another, Fay, an angular, wiry man with the build of a distance runner, follows the lead of a local tribesman as the line snakes through verdant foliage, thick underbrush, and the furtive movements of dozens of wildlife species. Several porters ahead of him carry tents and backpacks of flour, cassava, oatmeal, rice, coffee, chocolate—the only luxury—and cigarettes, for the pygmies are ardent smokers. Wild game, fruit, honey, and wild yams are plentiful. But except for a few breaks during the day, the expedition will not stop to eat for another 10 hours.

Hacking the underbrush, slapping at tsetse flies, bees, and filaria flies, watching for pythons and vipers, Fay and his entourage will cover seven miles today in the quest for clues to the number of forest elephants left in the woods of the Congo. Fay walks transect lines along compass bearings with a specified width and scouts not the number of elephants he sees—a relatively rare sight—but the “dung density,” or elephant waste, he encounters. He uses a sophisticated algorithm involving degradation rates, number of sightings, and distance between lines that provides him and wildlife biologists an accurate estimate of the forest elephant population in this part of the country. While such sightings may lack romance, they are preferred to the obscene encounter with an infant elephant whose immature tusks have been carved out of its skull, the cranium resembling not so much that of an elephant as the shell of a scooped-out squash, and the carcass left to rot in the warm sun. This atrocity Fay has seen far too often.

From February through July 1989, Fay covers more than 700 miles and presents a grim report to Wildlife Conservation International, under contract to the European Economic Community/Worldwide Fund, which funded the expedition. The forest elephant population in the Central African Republic is down to 20,000, a two-fold decrease since 1980, the year he first glimpsed this area as a young Peace Corps volunteer who became

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poaching paraphernalia includes amulets, such as nwnpt pamphlets spread to discern distant sounds from the bush. Sudanese poaching paraphernalia includes weaponry and an array of amulets, such as monkey skulls and necklaces fashioned with DNA identification techniques, examines the Komn. Patches of DNA (deoxyribonucleic acid), the genetic material in all living cells that is often referred to as the "blueprint of life," He will search the DNA for chromosomal clues, or fingerprints, that eventually will reveal what form of elephant—savanna or forest—the animal was, what line of female gave birth to it, and what part of the continent the elephant once roamed.

What's more, Patton thinks his use of DNA fingerprinting and other genetic sleuthing techniques can tell authorities where a particular elephant was poached and, through meticulous backtracking of paperwork, which black market port the tusk entered and which authorities signed the documents. The system Patton envisions will help authorities delineate the source of ivory by matching the sample's genetic point of origin.

While some African countries have outlawed hunting elephants, others have set quotas on the number of elephant tusks allowed for sale or export. The rules are often lax, and clever dealers get around them by selling through another country (often by finding officials willing to falsify papers), as well as working through the black market.

"Some countries become conduits for poached ivory," Patton says. "They may export more tusks per year than they have elephants; in some cases they may have no elephants but still have an export quota. The paper trail is dirty. Authorities can point to their books and say they are falling within the quota, yet ivory is still smuggled through their ports. From a conservation standpoint, the system is so well entrenched it makes it almost impossible to prove anything unless the suspects are caught red-handed."

Like Fay transecting the African forests to track the giant beasts, Patton must weave through a labyrinth of minuscule chemical components that are the clues to life's origins.

DNA is a long, linear, double-stranded molecule that consists of the chemicals adenine (A), thymine (T), guanine (G), and cytosine (C), with A always pairing with T, G with C. Each couple, called a base pair, links with other pairs to form a long chain that looks like two strings twisted together. One human gene—and other mammalian genes, including those of the elephant—contains between 10,000 or 20,000 base pairs, strung together in a long, double-stranded helix. In genetic fingerprinting, scientists identify segments of DNA that make up a sizable fraction of the one-thousandth portion of DNA that makes an individual unique.

In his research, Patton also relies heavily on sex-related clues, such as mitochondrial DNA, found in the cytoplasm outside the nucleus and passed only from females to their offspring, and the Y chromosome, which only males carry. Because the elephant society is a matriarchal one—the bulls are loners that wander many miles from the herd, returning only to breed, and the females generally stay hooked on the beauties of the Dark Continent. The decline is part of the massive destruction of the giant pachyderm whose numbers worldwide—about 625,000—are less than half of what they were just a decade ago. In 1989, conservation officials estimated that 200 African elephants were being slaughtered daily by poachers whose sole purpose, in an international trail of killing, bribes, and deceit, was to get precious ivory to the markets in Europe and the Far East.
within one region in herds that are like an extended sorority—any genetic mixing he finds most likely can be traced to migrating males.

Patton uses a combination of technologies to disseminate this information from the small bits of tissue he chisels off the tusk. After chemically separating proteins and amino acids from the tissue, he uses restriction enzymes that recognize part of the code that makes the elephant unique.

A technique he uses with greater frequency, because of its facility in using minute and more decomposed samples of DNA, is called “polymerase chain reaction” (PCR), a novel alternative to traditional cloning techniques that allows him to amplify in three hours up to 40 samples of DNA from a tusk; traditional methods involving yeast or bacteria as a host for the DNA to replicate would take him three weeks or more for those samples. PCR is effective with old DNA as well as with fresh DNA. It has been used to amplify DNAs from 7,000-year-old tissue samples taken from Egyptian mummies and from brain tissues of bog-preserved American Indians.

The PCR unit is computerized, resembling an avant-garde cash register. Tiny tubes of DNA are inserted into a grid, and on a screen commands pop up that help Patton regulate temperature and other parameters. The finished product looks remarkably like the bar codes of products that computerized registers “read” at the checkout line in supermarkets. “These techniques give us ‘markers,’ or areas in the animal’s genome, that are different,” Patton says. “We use these markers to differentiate between the species and subspecies. In many cases, there is very little distinction.”

If, indeed, the African elephant may some day be relegated primarily to zoos, or its habitat crowded out by the burgeoning deforestation of the continent’s republics and the eventual settlement of its broad savannas, genetic matchmaking of elephant pairs will be vital to saving and proliferating the species.

According to Oliver Ryder, a geneticist at the Center for Reproduction of Endangered Species at the San Diego Zoo, Patton is launching an exciting, major contribution to wildlife management. “His work will make wildlife management of threatened and endangered species more similar to management in zoos by identifying appropriate mates for animals,” says Ryder, who has fingerprinted all 28 remaining California condors and is developing a genetic database of Galapagos tortoises.

Patton has been assisted in his work by Nicholas Georgiadis, a conservationist with Wildlife Conservation International, and Linda Park, a Washington University graduate student in biology. The researchers say DNA fingerprinting can help them propagate a species that is suffering a needless slaughter in Africa as well as Asia.

“It’s unbelievable how fast and efficiently the poachers work,” says Michael Fay, having just returned from an African sojourn. He is
Continental tourist: J. Michael Fay pauses for a photo while crossing a bridge in Bayanga, southwestern Central African Republic.

seated in a conference room at the Missouri Botanical Garden's Lehmann Hall on a crisp November day. There is something of the British explorer in Fay, mustached and bespectacled, as he leans forward earnestly and elaborates in a torrent of words:

"Caravans of professional poachers will form, say, in Sudan, fronted by a rich merchant who may possibly be backed by the Sudanese government. These caravans of 60 or so men ride on camels and horses loaded with supplies that will last them six months. They cross the border into the Central African Republic unnoticed—there's more than 2,000 miles of unguarded border between the countries—and begin their assault, moving with incredible speed.

"Three or four horsemen will charge a herd and stab the elephants in the hind quarters, slashing their tendons so the animals fall to the ground incapacitated but still very much alive and conscious of what is happening because they probably have been confronted previously with a similar assault. The poachers then slash the elephants' trunks, making it impossible for the animals to get to a standing position. Then, they'll either spear the elephants to finish them off or simply let them bleed to death.

"On the savanna, while all the poachers carry AK-47s for protection, their weapon of choice is the spear—it's quiet and cheap. In the forest, it's a .458 or .375 hunting rifle, quick and powerful. It's not at all unusual for these Sudanese caravans to travel a couple of thousand miles in six months and take hundreds of tusks back to their designation. They're professional hit men, scum of the lowest nature who would put a human away as easily as they dispatch an elephant."

This nightmarish attack has been repeated so frequently in the past decade that the savanna population of elephants is becoming decimated far faster than the forest form. "The only reason the forest form has survived longer is because of the nature of the kill," Fay says. "The elephants are being picked off one by one in forests because they have protective cover. On the plains, they're sitting ducks."

"They [poachers] are taking the backbone of the ecology out of the forest."

J. Michael Fay

Patton and Nick Georgiadis peer at a graph on Patton's cluttered desk in Monsanto Hall. The drawing illustrates genetic models of East African elephant types. Since September 1989, the scientists have analyzed 30 samples of East African elephant tusks from Kenya and Tanzania and have found genetic differentiation between regions and populations.

"We've passed our first tests and met our objectives," says Patton. "First, we've shown you can actually get DNA from the elephant tusk. Second, we've proven that elephants representing different regions do come from different genetic pools. And third, migration between these regions is not sufficient to homogenize populations all over East Africa. We're very happy with the results, but we see a long road ahead of us."

Genetic variability among elephants differentiates enough, as Patton's preliminary
Once again, Michael Fay is returning to Africa. He will accompany representatives from National Geographic magazine to gather information on poaching activities and primate populations in the northeastern part of the Congo. He will gather data on the forest population of elephants west of the region, an area that holds an important concentration of elephants. In June, he will spend a year in the Dzanga-Sangha region, a 3,000-mile proposed reserve in the southwestern part of the Central African Republic that has a healthy population of gorillas, chimpanzees, and elephants. He will conduct research there and complete his thesis. In cooperation with government authorities, he plans to send Patton tissue samples from confiscated elephant tusks and poached carcasses.

"In Africa, you're overwhelmed by species of both plants and animals, how they relate and coexist," Fay says. "You see the beauty and cohesiveness of the ecosystem. My first experience completely changed from a plant orientation to that of the interrelationship between plants and animals. While primates like the gorilla and chimpanzee are my major interest, I've taken an exceptional interest in the plight of the elephant. The elephant plays the key role in maintaining the natural ecosystem of Africa."

Elephants, especially in the forest, touch and shape the habitat, affecting countless species. Searching for food and water, they uproot trees, letting sunlight through and encouraging the growth of vegetation. They bring water to the surface by digging with their great tusks, providing watering holes for many species. Through their eating patterns, they propagate species of fruit trees, such as the balanites tree, by dispersing seed through their waste.

"When you see the atrocities of poachers," Fay says, rising to his feet and staring out upon the frosty, overwintering grounds of the Botanical Garden, "the first thing that comes to your mind is you want to kill them. You feel no kinship with these people as fellow humans. They're taking the backbone of the ecology out of the forest. The whole ecosystem is in peril of falling apart. We can only hope that all our efforts are not too late."
CAPTAIN TYCOON! GOOD NEWS AND BAD NEWS... THE GOOD NEWS IS OUR FISCAL 3RD QUARTER TOOK OFF AND WE WERE CRUISING! THE BAD NEWS IS WE FLEW THROUGH AN ECONOMIC WIND SHEAR, FLAMED OUT OUR NEW MARKET, CRASHED AND BURNED!

TYCOON
The management game business students play
by Gerry Everding
Greg Fox had barely finished his first year in Washington's master's of business administration program when he was asked to head an upstart team of young managers seeking to revive a failing business. Although the company, a small regional producer of quality clocks, was losing more than $250,000 a year, Fox and his management team recognized its potential. They renamed the company "Montrons Nous," fractured French for "Watch Us," and within three years turned it into an industry leader.

The tactics Fox and his colleagues used to save the company are no different from those used every day in the business world, but Montrons Nous and its clocks exist only in the computer-simulated world of a complex management game known as TYCOON. Playing TYCOON has become something of a rite of passage for graduate students at the John M. Olin School of Business. It is the final hurdle for students who have endured business boot camp, the M.B.A program's tough first year of basic training in core principles of business management. In the Executive M.B.A program, TYCOON allows experienced managers, perhaps for the first time, to assume the role of CEO.

"The game gives students a chance to try their own strategies for increasing production, improving market share, or raising profits," says Lyn Pankoff, professor of quantitative business analysis and faculty director of Olin's M.B.A. program. "It touches just about every aspect of running a large, multinational corporation."

Despite lighthearted moments, TYCOON is a far cry from a relaxing night of popcorn and Monopoly. Teams make hundreds of complex decisions in a matter of hours. Many rely on regression analysis and other sophisticated management tools to come up with the right move.

TYCOON begins as a fairly simple production and scheduling game developed at Carnegie Mellon University. The Tuck School of Business at Dartmouth College obtained a copy about 20 years ago and added programs featuring strategies in research and development, finance, and advertising, among other areas.

"TYCOON is easily 10 times more complex than any other management simulation game available," says Richard D'Aveni, assistant professor of computer strategy at Tuck. "It's much more sophisticated, and thus more realistic, than most management games."

Gerry Everding is the business issues writer at Washington University.
Students work day and night, pitting their knowledge and decision-making skills against those of competing teams in an unpredictable, sometimes cruel marketplace.

late at night. It’s a very demanding, intensive experience, but most of them come out of it with nothing but praise.”

TYCOON comprises more than 60 complex computer programs. The system models reality by reacting according to dozens of basic business theories and known economic patterns. Operators can simulate a range of economic conditions by entering data on inflation, foreign exchange rates, gross national product, and other factors.

“TYCOON allows you to set parameters for several hundred economic and market conditions,” Pankoff says. “These conditions can be modified at any time to simulate changes in the business climate caused by events such as a recession, stock market crash, or a new protective tariff.”

Game operators—usually doctoral candidates or top second-year M.B.A.s—go by such titles as “Gods,” “Tycoons,” and “World Managers.” They become omnipotent manipulators of local markets, world economics, and fate itself. “World Managers” have been known to throw out such challenges as tornadoes, floods, and labor strikes. Last year “terrorists” kidnapped one team’s chief executive officer.

Olin divides its first-year M.B.A. class of roughly 150 students into three separate economic worlds. Players are randomly assigned to six-member teams, assuming top management roles at one of eight companies in each imaginary world. Teams battle to dominate the industry and maximize profits.

Each firm has a different profile, with traditional market leaders as well as perennial losers represented. Teams get full reports on company finances and reams of data on market conditions, interest rates, and costs.

Number crunching begins in earnest as players plug company data into forecasting models.

“Playing TYCOON helps students pull together concepts they’ve learned in courses ranging from organizational behavior to finance,” says Charley Fuchs, computing services director at Olin. “It allows them to make decisions in a setting far more realistic than we could hope to offer in the classroom.”

Before a team can begin analyzing company strengths and weaknesses, it must first turn to its members to determine who is qualified to handle such areas as finance, marketing, and production. Oftentimes most teams appoint a chief executive to settle disputes and make final decisions. “It’s a tremendous opportunity to learn team-building skills,” says Nicholas Baloff, professor of business and public administration.

Despite lighthearted moments, TYCOON is a far cry from a relaxing night of popcorn and Monopoly. Managers get a chance to modify business plans each quarter, a chore that can require teams to make hundreds of complex business decisions in a matter of hours. Many rely on regression analysis and other sophisticated management tools to come up with the right move.

“TYCOON really teaches you the big picture,” says Kern Maresca, a finance major and M.B.A. candidate from Seattle. “You get
a chance to see what it's really like to make business decisions based on the aggregate rather than the minute."

Maresca's stint as chief executive of "Precision Time, Inc." gave him a taste of how fate can devastate, in a roller-coaster fashion, even the best of business plans. His management team took control of a firm saddled with $10 million in short-term debt and a clock plant unable to meet demand. An unexplained fire later destroyed 30 percent of the plant.

"We had a lot of trouble getting loans to build our capacity," says teammate Curtis West, who served as Precision's vice president of production. "We were planning for a huge recession and playing very conservatively. The recession never came, and that hurt our strategy.

"The game really does teach perspective," West continues. "We learned that there's quite a relationship between what you do in one area of the business and what happens in another. It shows how important it is to get production, marketing, and finance all working together toward the same goal."

Each management team strives to make decisions that will maximize profits to shareholders, but as in the real world, plans can fail miserably. Facing the consequences becomes an important part of the TYCOON experience, as each team gets a chance to defend its strategies at a mock annual shareholders' meeting. There, teams can face tough questioning from a "board of directors" that includes Dean Robert L. Virgil and other top faculty.

Because of the controlled, measurable environment under which TYCOON is played, researchers at Olin have found it to be a nearly perfect laboratory for the study of organizational theories.

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... and feedback sessions perform any better than students who learned about teamwork through textbooks and lectures? Baloff and colleagues William P. Bottom, assistant professor of organizational behavior, and Elizabeth Doherty, postdoctoral fellow, tried to find out by exposing groups to different methods of team-building and monitoring the outcome.

"Final results aren't in yet, but it seems as if teams that had a chance to experience team-building came up with more creative organizational structures," says Doherty. "One team even took turns holding the position of chief executive."

Students who go through the simulated management experience say it offers them a chance to try new business strategies without worrying about the consequences of making a big mistake in a new job.

"TYCOON is not meant to replace on-the-job training," says Pankoff. "It's an effort to get students to integrate ideas, make decisions, and cope with the consequences. Obviously there is some value in allowing them to make serious errors without having their lives hang in the balance."

Pankoff is quick to admit that the game, like any simulation, has its flaws: "We're not saying that the game is an exact model of conditions in the real world, but there's no doubt it's closer to running a business than hearing a lecture on the principles of marketing management."

In fact, Pankoff argues that students learn a valuable lesson when a game as complex as TYCOON fails in some respect to model reality: "It illustrates just how hard it is to duplicate the invisible hand that controls the free market process," Pankoff says. "It shows why markets in the Soviet Union don't work. No central authority is capable of making all these decisions as well as the free market."
Twenty Years After Apollo—Shouldn’t We Be Back on the Moon?

Maybe some of you have noticed: Nobody seems to go to the moon much any more. Twenty years after the first moon landing, more than a decade after NASA’s Apollo planners envisioned an outpost on the moon, we were still stymied by myriad hurdles and debates—some economic, some scientific, and all political. Then, President Bush announced that we would return to the moon, this time to stay.

Since near-Earth space may become an important arena of human activity, we should bring the moon back into our plans. There’s no handier place to gain experience in living and working on another planet. We can get back and forth to it in a few days. We can make fuels and structural materials out of its soil. We can learn on it the effects of prolonged living in reduced gravity. We can constantly monitor the Earth from the side of the moon that always faces us.

If we leave the moon to others to explore, we take a serious political and economic risk. It takes a lot of energy to lift fuel and building materials out of Earth’s high gravity. If space manufacture or space power becomes economically important, the moon will be important. We’ll need to know all we can to compete for its use.

Some scientists have written off the moon as having much practical value because moon rocks don’t contain water. Indeed, the moon is very dry—by Earth standards. The moon, however, has plentiful amounts of the chemical constituents of water: oxygen and hydrogen. Oxygen is its most abundant chemical element. Though it doesn’t occur as an atmosphere, it can be separated out of any of the rocks or soils. In contrast, hydrogen is dispersed in the upper few meters of soil.

The other chemical elements needed for life support are available there, too. A typical cubic meter of lunar soil contains enough hydrogen, carbon, and nitrogen to make a lunch for two—the equivalent of two full-sized cheese sandwiches, a couple of 12-ounce sodas (with sugar), and two plums, with carbon and nitrogen to spare. Of course, there are a few steps of chemical extraction and synthesis between lunar soil and lunch, but the technology is straightforward. It takes quite a bit of energy, but most of it can come from the sun. So there is plenty of water, carbon, and nitrogen for agriculture. These would have to be recycled, of course, by keeping farms indoors. The soil contains all of the trace and minor elements needed to support life, too.

The first manufactured materials from the moon may be fuels for transportation. Hydrogen and oxygen make a great propellant. In addition to its abundant oxygen, the moon has more than enough hydrogen to supply fuel for use in low-Earth orbit and for interplanetary travel.

The next materials might be for space construction. Most processes that extract oxygen from lunar soil also produce metals—iron, silicon, and aluminum. Beams, rods, sheets, and pipes can be made by melting and casting lunar soil. Produced in the vacuum of the lunar surface, these may also have extra strength.

Someday, we might want to use lunar materials here on Earth. A material receiving serious consideration is the rare isotope helium-3, which has been proposed as a clean fuel for commercial fusion power reactors.

While the moon remains largely unexplored, we know that its abundant soils have much to offer. They can furnish the materials for the filling stations, the electric companies, and the lumber yards of space. It would even be possible to develop a self-sustaining colony on the moon. Now, more than 20 years after “One small step for man, one giant leap for mankind,” we should be back on the moon learning how we might be able to use it. —Larry A. Haskin

Professor Haskin, chairman of the Department of Earth and Planetary Sciences at Washington University, is a geochemist who studies lunar materials.
Latest edition: Resplendent form follows function in the new Library and Biomedical Communications Center on the medical school campus. Sunlight illuminates the Lehmann Atrium, pictured above. Completed last July, the seven-story, $15 million structure contains approximately 113,000 feet and houses more than 228,000 volumes.
Settling in: Patty Jo and Red Watson relax in the living room of their University City home. For story on anthropologist Patty Jo Watson, see page 14.