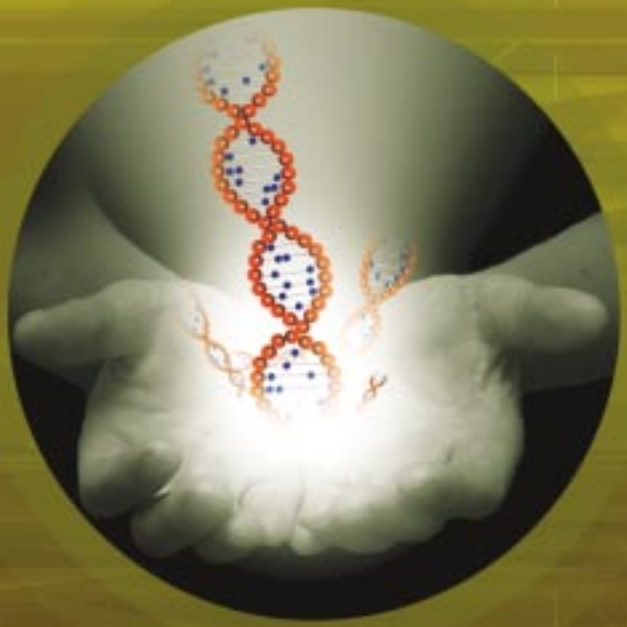
2002

INSIDE RESEARCH

BINGHAMTON UNIVERSITY
STATE UNIVERSITY OF NEW YORK



Sensing the future

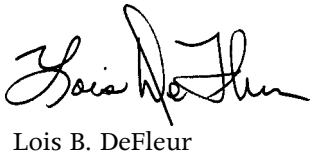
It was nearly 100 years before reality caught up with Jules Verne's fictional writings on the possibilities of science. In less than a 10th of that time, scholars and researchers at the State University of New York at Binghamton hope to unveil several innovations that sound fantastical today.

In *Inside Research* we report on the work of several faculty researchers who are shaping the future: Robert Ben and Omowunmi Sadik in biotechnology, Michael Lewis in computing science and Kevin Wright in criminology. You will also read about other researchers, such as paleobotanist William Stein, geologists Tim Lowenstein and Joseph Graney, and anthropologist Richard Antoun, who have explored facets of our physical and cultural past as a means of understanding the present and discerning the future. Others, such as philosopher Martin Dillon and mathematicians Dennis Pixton and Matthias Beck, ponder mysteries of a more ethereal nature. The breadth and depth of the scholarship is impressive.

Our researchers compete for public and private funding to carry on their important work. Hand in hand with money, up-to-date research facilities are needed. The purchase of the former NYSEG property at the eastern edge of campus is another significant step in our efforts to expand and enhance Binghamton's research facilities. The property will be the home for the Innovative Technologies Complex, which will house the Research and Engineering Building and the Advanced Biotechnologies Center.

Our research efforts also have critical economic development components. Their success will help to invigorate and diversify the regional and state economy. Every day, Binghamton University helps provide the needed intellectual capital for the future and prepares students to live in a high-tech, internationally driven and highly entrepreneurial world.

We are proud to share with the University and its wider community some of our research successes.



Lois B. DeFleur
President

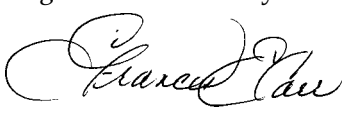
It has been said that the future is a product, not a place, and that the best way to predict it is to invent it. At Binghamton University, we value and nurture the entrepreneurial spirit embodied by such views. We believe that by understanding our past, and as a result of our active involvement in the present, "sensing the future" becomes easier and more productive — informing the daily realities of choice and consequence and providing a critical touchstone to progress.

Literally — as in the work of faculty researchers whose innovation and imagination has led to exciting discoveries that help us to better collect and analyze sensory data from the world around us — and figuratively — as in the case of scholars who help us to better understand the world and make more informed choices about our place in it — the University is visibly committed to the dynamic process of "sensing the future." The stories presented here celebrate and exemplify the breadth of important research and scholarship being conducted across the University.

As evidenced by three consecutive years of double-digit growth in sponsored funding and a 125 percent increase in sponsored research applications over the past five years, BU researchers are staking their claim on the future. From miniaturized medical diagnostic sensors and advances in materials science to explorations of fundamentalism, societal structures and human perception, our students and faculty routinely extend the boundaries of individual experience — igniting innovation, imagination and creativity in the process.

Just as they define the leading edge of academic programs, research and scholarly projects are also powerful catalysts of economic diversity and vitality. Our Office of Technology Transfer this year saw an unprecedented increase in faculty invention disclosures. Some of these will lead to patents and many will fuel our partnerships with industry, health care and institutions of public and higher education.

If the future indeed belongs to those who create it, it will most assuredly bear the imprint of Binghamton University.



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2002 INSIDE RESEARCH

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BINGHAMTON UNIVERSITY
State University of New York

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BRIEFS

MAJOR GRANTS ANNOUNCED IN SEVERAL DISCIPLINES

During the 2001-02 academic year, Binghamton University won several major grants in the sciences and humanities that will advance research and programs campus-wide. Among the significant awards:

• **New York State Museum** awarded a five-year, $10 million contract to the Public Archaeology Facility to manage state and federal historic preservation mandates on highway and bridge construction projects by the state Department of Transportation in a multi-county region in central and northern New York.

• **National Institutes of Health** awarded $1.1 million to a research team headed by biopsychologist Elena Varlinskaya to explain why teens who drink alcohol are at high risk for suffering long-term consequences.

• **U.S. Air Force Research Laboratory** awarded $1.1 million for the creation of a new laboratory at the University dedicated to uncovering data hidden in digital images. A team headed by research professor Jessica Fridrich of the Thomas J. Watson School of Engineering and Applied Science will perform the work.

• **Freeman Foundation,** a Vermont-based organization, awarded $1.75 million to significantly expand the Asian and Asian American Studies program. The four-year grant is believed to be the largest ever received by a humanities program at the University.

A BEAUTIFUL FIND

PUZZLE NINE TIMES OVER SETS NEW WORLD RECORD

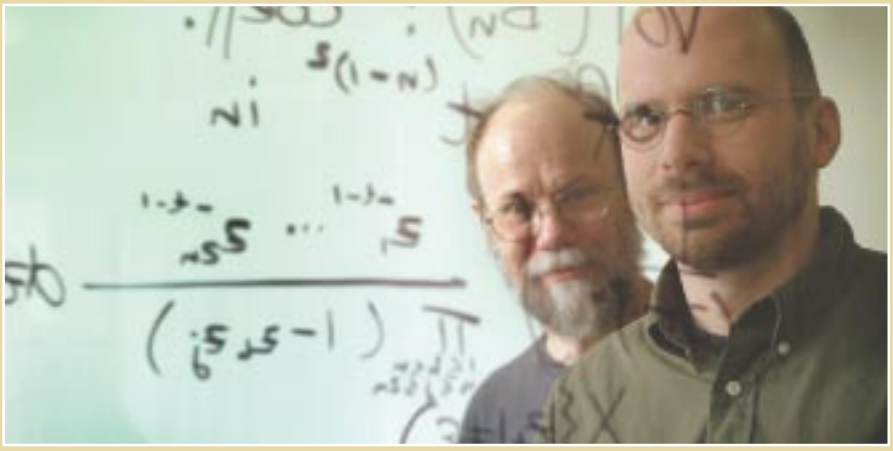
Two Harpur College math professors have taken the concept of a magic square — a mathematical challenge in which every row and column in a square add up to the same number — to the ninth level. In doing so, they achieved a new world record.

Matthias Beck, visiting assistant professor, and Dennis Pixton, associate professor, teamed up to compute the volume of a doubly stochastic matrix, also known as a Birkhoff polytope, of size nine. It wasn't easy. It took the power of 30 desktop computers to do it.

Even though making sure that each row and column add up to one at both ends looks like arithmetic, the puzzle that Beck and Pixton solved was geometrical. What's really being done, Beck explained, is calculating the volume of the Birkhoff polytope.

"You tell me the size of the square, such as five-by-five squares," Beck said, "and I'll give you back the volume, so I want to have a formula that gives you the volume depending on the size."

Beck said some mathematicians did not believe it was possible to come up with a formula for the volume of a 9 x 9 square, but BU's duo believed otherwise based on the success of two Princeton University researchers who developed such a formula for a matrix of eight.



MATHEMATICIANS MATTHIAS BECK, FOREGROUND, AND DENNIS PIXTON BECAME THE FIRST IN THE WORLD TO SOLVE A NINE-LEVEL MATH MATRIX. THE PAIR HARNESSED THE POWER OF 30 COMPUTERS FOR SIX DAYS TO DO THE JOB. THIS PICTURE WAS TAKEN THROUGH A GLASS PANEL SHOWING THE FORMULA.

To do this kind of calculation by hand simply isn't possible, Beck said, so an algorithm had to be created. That's where Pixton's computer expertise came to the rescue.

Pixton created a program that replicated the volume of the eighth Birkhoff polytope and then took it up one more level. Using the Linux operating system, the two linked the Mathematical Sciences Department's computers to do the computation. Applying their newly devised algorithm, Pixton and Beck split the major problem into 1,400 smaller problems to speed the process. What otherwise would have taken considerable computer time took only six days.

As for practical applications of the puzzle solution, Erik Pedersen, department chair, noted, "Some extremely theoretical mathematics that developed 350 years ago started to get some practical applications only in the last 10 to 20 years. Now they are the basis for every secret transmission between banks."

The two have written a paper describing their work and have submitted it to *Discrete and Computational Geometry* for publication.

KUDOS

- Seven BU faculty members were cited in 2002 by SUNY Chancellor Robert King for their imagination and energy as inventors and entrepreneurs: Ronald Miles, mechanical engineering, for developing the world's smallest directional microphones; Jessica Fridrich, systems science and industrial engineering, for developing ways to hide and detect information hidden in digital communications; Omowunmi Sadik, chemistry, holder of two patents for her work on sensors, including one that allows doctors to test for HIV in minutes rather than days; Kanad Ghose, computer science, for inventions that include a software simulation environment for real-time systems; John Baust and Robert Van Buskirk, biological sciences, founders of BioLife Solutions, Inc., which develops solutions to extend the time human cells, tissues and organs can be preserved; and Kathleen Horwath, biological sciences, for discoveries related to the genetic structure of antifreeze proteins of a winter-hardy insect.

- Michael Little, distinguished professor of anthropology, has been named a national associate of the National Academies by the National Academy of Sciences in recognition of his service to the organization.

- G. Philip Rightmire, an internationally known leader in human paleontology, and Albert Tricomi, a Shakespearean scholar and educational innovator, were designated distinguished professors by the SUNY Board of Trustees.

- Sandra D. Michael, professor of biological sciences, and Ralph M. Garruto, research professor of anthropology, were named fellows of the American Association for the Advancement of Science. The association, which includes 275 affiliated scientific societies, publishes the peer-reviewed journal *Science*.

IEEC OPENS NEW LAB TO TEST PRODUCT RELIABILITY

The University marked the opening of the Advanced Reliability and Diagnostics Laboratory in September, as part of the Integrated Electronics Engineering Center. The lab helps regional and statewide high-tech companies improve their products and extend their markets by providing high-end physical, chemical, surface and electronic analysis of electronics packaging technology products. "We want to show you the future," President Lois B. DeFleur told business, economic development and local elected officials at the opening. "Our goal is to continue to bring together scientists and industry and build on our current partnerships."

AFRICAN VOTERS, LEADERS GET HELP FROM BU

Several African nations that are attempting to build democratic governments received expert help from Edward McMahon, director of the Center on Democratic Performance, during the spring and summer. In May, McMahon was part of an international delegation from the National Democratic Institute for International Affairs that helped oversee presidential elections in Mali. In the summer, he was in Rwanda teaching workshops to members of the Mali Parliament on how to give proper oversight to the executive branch. His work was sponsored by the World Bank, the U.S. Agency for International Development and a non-governmental organization, Freedom House.

COMPUTER SCIENTIST AIDS BREAST CANCER BATTLE

University computer scientist Walker Land Jr. has teamed up with cancer specialists at Lourdes Hospital in Binghamton to test newly developed software that could speed the early diagnosis of breast cancer. The partnership will use a two-year, $100,000 grant from the New York State Research Science Board to test software developed by Land that determines whether non-palpable breast lesions are benign or malignant. Land, whose mother died of cancer 41 years ago, has been working for years on ways to improve breast cancer screening.

STUDENTS A WORLD AWAY VISIT BU LAB VIA INTERNET

Electrical engineer Victor A. Skormin's insight that sophisticated communications equipment no longer uses an on-off switch allows students from as far away as China, Great Britain and the Czech Republic to use Binghamton University's multi-million-dollar laser equipment to perform laboratory experiments over the Internet. Skormin won a $255,000 grant from the National Science Foundation to develop an Internet-accessible advanced laser communications research lab that could be used by anyone signing on to Skormin's Web page. With a few mouse clicks and keystrokes, engineering students can now run a series of calibrating tests that aim mirrors on a laser communications device at BU. The program partially solves a big problem for many engineering programs — lack of access to first-class labs and equipment. In addition to giving students near-instantaneous feedback on the correctness of their calculations, the program allows them a 360-degree view of the equipment they are using.

Stopping ice cold

ARCTIC FISH PROVIDE CLUES ON HOW TO KEEP FROM FREEZING

If Robert Ben and his research colleagues are successful, within 10 years there may be a way to eliminate freezer burn in frozen foods, protect fruit crops from killer frosts, shield roads and planes from dangerous icing, and protect transplantable human tissues and organs from the ravages of low-temperature storage. And that's just for starters.

Robert Ben and his research team have duplicated the protein that keeps Arctic fish from freezing solid in mid-swish.

Using the techniques of synthetic organic chemistry, Ben and his research team have duplicated the protein that keeps Arctic fish from freezing solid in mid-swish. This biomimetic antifreeze — and the derivatives that might result from research over the next five to 10 years — have a wide range of potential applications.

"The possibilities are very exciting," Ben said. "The data we're going to gather in the next several years will allow us to design better analogs that are more potent, more stable and that will open up all these other potential applications."

Ben's antifreeze, which mimics the effects of a substance produced by Arctic and Antarctic deep-sea fish, is safe enough for use in living organisms and boasts several improvements on its natural counterpart. It is thousands of times more biologically and chemically stable than the natural version and is much easier and cheaper to produce.

Ben's work has generated a lot of worldwide media heat. Featured in the September/October 2001 issue of *Bioconjugate Chemistry*, a peer-reviewed journal of the American Chemical Society, news of his discovery was picked up by national and international wire services, online science newsletters and several popular magazines, including *Popular Mechanics*.

An assistant professor of chemistry who joined the faculty in 1998, Ben recently received a five-year National Institutes of Health grant of just under $1 million to continue his antifreeze work. His work also enjoys ongoing support from the American Chemical Society, the world's largest scientific organization, and a small Boston-based biotech company, A/F Protein, Inc.

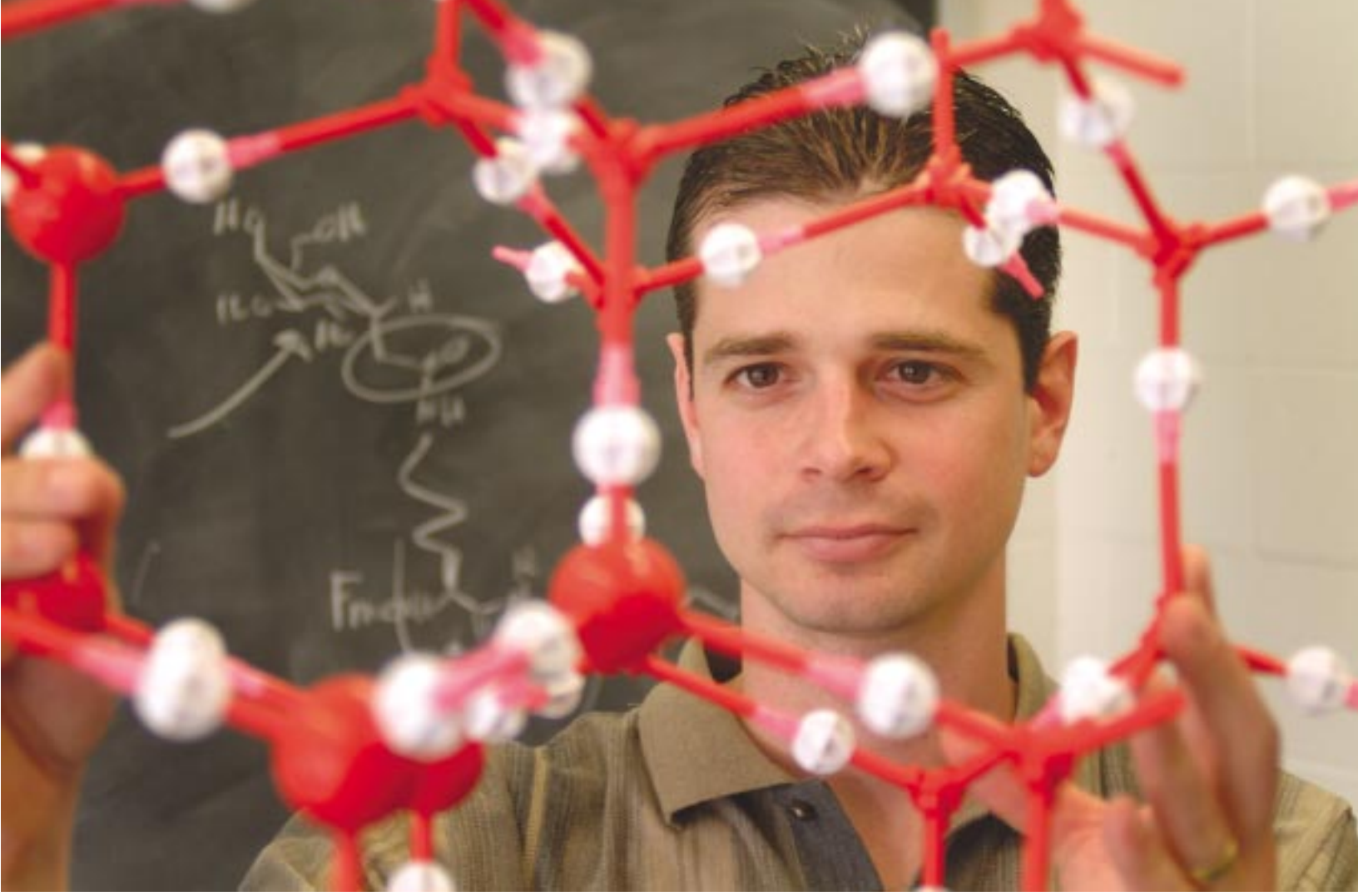
Many organisms, including plants, grasses, trees, insects, amphibians and fish, produce small amounts of antifreeze proteins, or AFPs, that help them survive or even thrive in the cold. But certain deep-sea fish from the teleost group, such as Atlantic cod and winter flounder, produce another substance — the substance Ben works with — called antifreeze glycoproteins, or AFGPs.

Ben's work focuses on AFGPs because they are more attractive for chemical synthesis than AFPs. They are structurally less diverse and offer a more standard model from which to work. AFGPs also demonstrate a unique ability to protect living tissues not only from the ravages of freezing, but also as they are cooled to just-below-freezing temperatures, a feature that greatly enhances potential applications.

Scientists have known about AFGPs for more than 30 years, but there is still much to learn about how the antifreeze proteins actually prevent the growth of ice at the molecular level, Ben said.

What is known is that the mitigating effects are not the result of heat, do not depend on physical encapsulation of the ice crystals and do not involve thawing of existing ice crystals, he said.

Indeed, ice crystals are routinely



CHEMIST ROBERT BEN, HERE HOLDING A MODEL OF AN ICE CRYSTAL, IS WORKING ON DEVELOPING SYNTHETIC ANTIFREEZE GLYCOPROTEINS MODELED AFTER THE KIND THAT KEEP ARCTIC FISH FROM FREEZING — EVEN IN THE COLDEST OF WATERS. ONCE THESE ARE PERFECTED, BEN WILL SEEK WAYS TO USE THE SYNTHETIC GLYCOPROTEINS TO RETARD ICE FORMATION IN SUCH EVERYDAY APPLICATIONS AS ROAD SURFACES AND FROZEN FOODS.

found floating within the cells of fish from polar waters, Ben said. The freezing points of both the fish and the polar waters they occupy are lower than zero because of their salt content. But these saltwater fish, which have a freezing point of -0.7 Celsius, are able to live in waters that reach temperatures of -1.8 Celsius because they produce AFGPs. Without the AFGPs, the fish would be frozen solid in a matter of seconds.

Though only tiny amounts of the biological antifreeze are needed to bind ice crystals and inhibit ice growth in fish, the use of naturally occurring AFGPs to combat ice in commercial or medical applications is impractical. To extract and purify naturally occurring biological antifreezes is labor-intensive and costly — in terms of fish populations as well as dollars. Up to a ton of fish might have to be ground up and liquefied to obtain just a few grams of natural AFGP, Ben said.

A glycoprotein such as AFGP is a protein with sugars attached. Though biological AFGP molecules are structurally more homologous, or standardized, than AFP molecules, they are not easily produced using standard molecular biology techniques. That not only means that scientists haven't studied them as well as they have AFPs. It also means that Ben's research team, which he says is the only organic chemistry laboratory in the world working on this problem, has a distinct advantage.

"You can trick a cell into making a protein for you, but it's very difficult to get that protein glycosylated [adding the sugar molecules] using standard molecular biology techniques," Ben said. "Our advantage is that we can use the protocols and techniques of modern synthetic organic chemistry to build AFGPs and to build analogs that can help us to better understand how they function."

Ben is quick to share credit for the new antifreeze with his graduate students. "While I provide the fundamental ideas, I have some really dedicated graduate students who make this very difficult chemistry really work," he said.

He expects his laboratory to continue conducting structure-function research with AFGP analogs over the next few years in order to better understand how antifreeze glycoproteins work to bind ice crystals and arrest their rapid growth.

"It's difficult to design something better if you don't know what you're designing from," he said.

Looking for love

PHILOSOPHER EXPLORES DIFFERENCE BETWEEN ROMANCE AND "THE REAL THING"

Everywhere people look — billboards, magazines, TV, books, movies, the media — they can see and hear messages about forbidden love, secret romance, candlelight and wine.

According to Martin Dillon, romance isn't all it's cracked up to be. In fact, he hopes to expose romance for what it really is: bad.

Dillon, distinguished teaching professor of philosophy, has been trying since 1976 to help students understand the difference between romance and genuine love in a course on the philosophy of love. The course, Philosophy 312, Philosophy of Love and Sexuality, is offered every semester and is never under-enrolled. Dillon teaches the course once every third semester, while colleague Don Weiss also teaches it regularly.

Now Dillon's taking his case to the public in a recently published book, *Beyond Romance* (SUNY Press, 2001), in which he offers a critique of romantic traditions of love and an alternative that he calls authentic love.

"Our culture is suffering from erotic malaise," Dillon writes in the book's preface. "We do not seem to know how to love well, and that is manifest in the problems we seem unable to handle, the problems of bodily health apparent in the rise of sexually transmitted diseases, the problems of social health apparent in the proliferation of babies born to parents who are still children, and the problems of moral health apparent in our inability to make coherent policy decisions about abortion, commercial sex, homosexuality, extramarital sex, sexual harassment and the like."

Drawing from the works of philosophers from the past such as Plato to those of more recent vintage, including Maurice Merleau-Ponty, Georg Hegel, Sigmund Freud, Jean-Paul Sartre and Jacques Derrida, Dillon argues that much of current erotic dissatisfaction is traceable to flaws in the romantic model.

"Romance is seriously bad," Dillon writes. "The idea of romantic love is unattainable. In romantic love you're in love with an illusion, an ideal. In authentic love you are in love with a flesh-and-blood person."

Looking at the history of love, as well as the philosophy and psychology of it, Dillon's book explores how ro-

MARTIN DILLON, DISTINGUISHED TEACHING PROFESSOR, TAKES A CRITICAL LOOK AT THE CONCEPT OF ROMANTIC LOVE IN OUR SOCIETY IN HIS NEW BOOK, *BEYOND ROMANCE*. IF IT WERE UP TO DILLON, A PHILOSOPHER, THE NOTIONS OF ROMANTIC LOVE THAT DOMINATE SOCIETY WOULD BE REPLACED BY WHAT HE CALLS AUTHENTIC LOVE, A MORE-DOWN-TO-EARTH CONCEPT.

mantic tradition and courtship in our culture impede our ability to develop genuine love, which he argues comes from knowledge and truth.

According to Dillon, many romantic traditions, much like candlelight and wine, get in the way of real vision, so you see the object of your affection in a flattering light. In romantic love, there is very little in the way of genuine discourse.

"In romantic love, the person is the amorphous object that allows you to discharge your fantasy ideas," Dillon said. "And the more the real person intrudes, the more that he or she gets in the way of the fantasy. After carnal knowledge, he or she becomes less than the fantasy, so it's doomed to failure."

Movie plots and romance novels reinforce modern ideas of romance.

"The road map for a successful romance novel," Dillon said, "is: Boy meets girl; an obstacle is in the way; overcome that obstacle; another obstacle; overcome that obstacle; etc. And when you overcome that last obstacle, you pop into bed, or don't pop into bed, and the novel ends."

Romantic traditions are not just a thing of the past, as evidenced in the popularity of cyber-sex, an extension of the mechanics of the romantic love ideal — since most of the interaction takes place without ever knowing the real person, allowing one to keep up the fantasy.

Dillon suggests that only through real knowledge of the other person can you develop authentic love. "Authentic love deepens as you get to know the person," Dillon said. "So the claim is that the cognitive dimension of love is important for the kind of love that I am arguing for. And in that kind of love, the more you know the person, either the deeper the relationship becomes or the end of the relationship happens."

According to Dillon, people who are influenced by the romantic ideal are always looking for the infinite high that comes at the beginning of a new affair. He asserts that if that's what people are looking for, then all they'll get is a bunch of new affairs. While the excitement of the new will sustain a person's interest for a time, after a while, even the sense of newness will fade and boredom will set in.

But, said Dillon, if authentic love is the ideal, then people are more likely to respond to marital boredom in more creative ways, like pursuing common interests.

"I think boredom is the iterability of the same," Dillon said. "And I don't think people are the same over time. I think there are a lot of changes that take place, especially in people who are alive and growing. If your partner seems to be the same all the time, it could be that you're not listening — and it usually is that you're not listening."

Will exposing romantic traditions of love lead to greater happiness? "Scarred knees are part of the process," Dillon said. "You can't get it all from a book. There is a lot of luck involved. But, if you believe, as I do, that love is probably the one isolable phenomenon in life that's more important than any other as far as happiness is concerned, then the more you know about it, the better off you are. The more you understand it, the more you have your goals explicit rather than mystified. That's when I think you stand a better chance at being more successful."

Dillon acknowledges that some will contest the solutions he proposes, but he, like other philosophers, does not deal in absolutes. He simply hopes his theories will add to the discussion about love and perhaps bring about some positive change.

WILLIAM STEIN

Planted in stone

BU RESEARCH LAB HOUSES WORLD-CLASS DEVONIAN FOSSILS

To the untrained, it might look like an unappealing, discolored piece of rock. To William Stein's eye, the sediment reveals a world of research, history and opportunity.

Stein, associate professor of biological sciences specializing in paleobotany, the study of fossilized plants, runs a research laboratory that is home to one of the best and largest collections of Devonian Era plant fossils in North America, if not the world.

And in the fossil world, the Devonian Era is where it's at in the evolution of modern plant life. According to Stein, the Devonian period, dating back approximately 410 million to 363 million years ago, is the most significant period for the evolution of plant life on land.

"The Devonian period is responsible for the 'greening' of our Earth," he explains. "In this period, plant life exploded across the land. By the end of the Devonian, plant communities had grown to modern-scale forests, with some plants reaching the size of trees. During this period, we observe the origin of all major types of plants on land."

Scientists can track that evolution in a fossil record that tells the story in stone of a time when the major divisions of plant life such as ferns, horsetails and seed plants first evolved and exploded into many evolutionary branches. Thanks to a scholarly trail that dates back 35 years, Binghamton University's Paleobotany Laboratory is one of the best places to study that story.

"Our fossil collection is right up there with the best," Stein said. "Plants are well preserved, many with internal tissues remaining intact. Studying these fossils helps us understand one of the major events in the history of life on land."

Binghamton's collection, which has been visited by scholars from China, Europe and Russia and throughout North America, represents the accumulated efforts of many, including BU faculty and students.

The collection was first assembled from specimens found in New York and around the world by paleobotanists from Binghamton University — James D. Grierson, now deceased, and Patricia Bonamo, Bartle Professor of biological sciences. The collection has been expanded over the years by numerous researchers, including significant additions from Stein's fieldwork. Contributions also came from Cornell University paleobotanist Harlan Banks, with whom Grierson and Bonamo studied.

The collection includes specimens from the Rhynie chert in Scotland, which is so rich and well preserved that

A COMPRESSION OF THE PLANT *ARCHAEOPTERIS*, A SIMPLE, FERN-LIKE LATE DEVONIAN PERIOD PLANT, WAS FOUND IN SEDIMENTS IN NORTHERN PENNSYLVANIA, NOT FAR FROM BINGHAMTON. THE UNIVERSITY'S COLLECTION CONTAINS MANY SPECIMENS FROM BOTH NEW YORK AND PENNSYLVANIA.

A SLIDE SHOWS A CROSS-SECTION OF A STEM FROM AN *AGLAOPHYTON*, A PLANT FROM THE DEVONIAN PERIOD THAT WAS FOUND IN RHYNIE CHERT, A LAYER OF FLINT-LIKE ROCK DISCOVERED IN SCOTLAND. THE SPECIMEN IS ABOUT 400 MILLION YEARS OLD.

it offers unique insight into the Devonian world. Thanks to Grierson, Binghamton has some of the finest examples from the chert in North America, including some superb fossils that provide a snapshot of what life was like during that period.

Just recently, BU received an important collection from Southern Illinois University. Stein said a retiring faculty member there recognized Binghamton's reputation and offered the collection. Most of the unnamed fossils were originally found in New York, so it was only fitting they return here for research, he said.

Stein's scholarly work and strong connections with many other recognized paleobiologists have helped build Binghamton's reputation. He earned his BA in molecular biology and botany from Pomona College in Claremont, Calif. He went to the University of Michigan for his master's and doctorate, where he studied with Charles Beck, also a former student of Banks from Cornell. Stein did post-doctoral work at Michigan's Museum of Paleontology and the Department of Paleobiology at the Smithsonian Institution's National Museum of Natural History. He came to Binghamton in 1988.

Stein has published more than 20 articles in peer-reviewed journals and is an associate editor for the *American Journal of Botany* and *International Journal of Plant Sciences*.

He named a new order of vascular plants and developed a hormone-based computer model of vascular tissue differentiation to compare fossilized and living plants.

More recently, he has been attempting to synthesize his work in paleobotany with developmental logic. "This is a synthesis of many ideas I've been working on for some time," he said, "treating the evolution of development in plants from a theoretical perspective involving logic gates and other ideas borrowed from systems science."

He is also one of several contributors to a paleobotanical database being developed as part of a national database of paleontological records. The database is on the Web at http://flatpebble.nceas.ucsb.edu/public/index.html.

The fact that Binghamton is home to such a world-class collection is due in large part to a combination of recent history as well as prehistory. The state is a rich natural storehouse of fossils, and early efforts of paleobiologists at the State Museum, New York State Geological Survey, and colleges and universities made them some of the best-studied fossils anywhere.

"New York got off to an early start compared to other states," Stein said. "From the mid-1800s on, there's been strong work here. The stratigraphy and fossils of the state have been well studied, and many researchers worldwide compare their specimens with those from New York state."

BU's laboratory, located on the ground floor of Science III, resembles a cross between a stonecutter's shop and a high-tech laboratory. Diamond-tip saws whir as they cut through rock specimens to reveal the fossils within. Then, grinders are used to hone the fossils into thin slices. Fossilized plants are removed from ancient sediment by placing the rocks in hydrofluoric acid.

"The fossilized plant material can't be destroyed because it consists of carbon and is not subject to degradation by the acid," Stein said.

The laboratory uses computer-based morphometrics that can examine specimens in minute detail. "Predictions and models can be formed from the actual measurements of the specimens," Stein said.

For paleobotanists, the story the specimens tell, played out over millions of years, is one of exciting change and diversity.

"People think of dinosaurs and the bones that were found to reconstruct them," Stein said. "Paleobotany is much the same in that we are given these pieces of information and use them to piece together plant evolution.

"The best part about this laboratory is that it not only helps in the research of paleobotany, but also helps in the classroom. Use of this material in the classroom helps to bring a better understanding to the students."

TERMS OF THE TRADE

Paleobotany, like most specialized sciences, has its own language. Some key terms:

Paleobotany: The study of fossilized plant material. A branch of paleontology, which is the study of life forms existing in prehistoric or geologic times, as represented by the fossils of plants, animals and other organisms. The root word "paleo" is derived from the Greek word meaning "long ago."

Morphometrics: The branch of mathematics studying the metrical and statistical properties of shapes and shape changes of geometric objects. It may be applied to objects as various as molecules, fossils, brains, bird wings and cars, and can be modeled in 3-D using computers.

Standard measures

SCHOLAR DEVELOPING WAYS TO GAUGE CORRECTIONS SYSTEMS

Ask someone to describe a prison warden and the 1950s stereotype of a cigar-smoking, overbearing, authoritarian middle-aged man most likely comes to mind. Yet that stereotype is long gone.

Today's wardens are correctional managers who run highly complex organizations where senior staff are responsible for a wide variety of functions that cover personnel, safety, educational treatment programs, recreational facilities, food services, industrial and environmental protection, physical facilities maintenance and budgeting.

In addition, correctional systems are much bigger players in state and federal budgeting than they were two and three decades ago.

Increased responsibilities and larger budgets bring with them an increasing amount of scrutiny and frequent audits by legislative budget offices and the executive branch. The corrections business has become highly policy driven, and the need for standardization across prison facilities within a system has grown.

Charting the changes in this new world of corrections management is Kevin Wright, professor of criminology in the School of Education and Human Development. Wright is currently involved in two projects that explore how prisons function in this new world of less independence and more accountability.

The first project deals with performance. "The nation's prison executives have set as their number-one priority the development of a performance measurement system," Wright said. "In doing that, they're taking the accountability model present in their states and trying to institutionalize it at a national level, so there are clear standards and a clear understanding of them."

Kathleen Hawk Sawyer, director of the Federal Bureau of Prisons, recruited Wright as the lead consultant for the performance indicator committee.

The project is funded by the Bureau of Justice Statistics and will have a far-reaching impact on corrections management in the United States. "At the national level, we're currently not capable of comparing the prison system of any state with that of another on any

CRIMINOLOGIST KEVIN WRIGHT SAYS THAT AS MODERN MANAGEMENT TECHNIQUES BEGIN TO PREVAIL, THE PRISON OF THE FUTURE WILL NO LONGER BE RUN LIKE THE STEREOTYPICAL OLD-STYLE PRISON OF IRON BARS AND AUTHORITARIAN WARDENS.

performance indicator," Wright said. "Safety? Cost? We can't compare New York to Pennsylvania. I've been asked to develop performance indicators."

Three areas have been targeted initially — public safety, institutional safety, and mental health and substance abuse programming. Wright and a team have been developing a series of indicators within each standard.

For public safety, the indicators are escapes and recidivism; for institutional safety there is a series of measures including assaults, inappropriate sexual contact by staff, homicides, suicides and major disturbances.

The difficulty, Wright said, is that there are considerable differences in the organization of prison systems from state to state. "Our goal is to develop and implement a national reporting system.

"Right now there are lots of measurement issues, because states define things differently. For instance, Vermont has a unified prison system in which the state department of corrections houses all inmates, while in New York, the state houses only felons and others are in jails run by sheriffs. So, who gets counted?"

To develop indicators for inmate assaults on staff, Wright and the team needed to make several decisions. "One of the things we had to do was talk about which inmates get counted," he said. "Those who are on furlough, or those on electronic monitoring in the community? We're probably not going to count those. Also, what is a staff member? We had to define a staff member as someone receiving a salary, not counting visitors, interns or construction workers on a project within the facility. There needs to be careful delineation of what's being measured so there will be consistency.

"Under escapes, when does it stop being an attempted escape and become an escape?" he asked. "One thing we've really struggled with are the seven unified systems that hold prison and jail inmates, whereas the other 44 hold only sentenced felons, so we have to not count the non-sentenced."

Wright said the performance indicator definitions help determine what and how to measure. "Will we look at all assaults the same, or only serious events?" he said. "Only those that require medical attention? Or those that involve weapons? We need the specific definitions for consistency."

Wright and the team have completed development of the standards and indicators and are close to being done with the counting rules that go along with each sub-measure.

In the second project, Wright is helping develop a procedure to measure and evaluate prison culture.

The National Institute of Corrections (NIC) is often called on to assist systems with major problems, Wright said. "A prison might be dealing with an issue such as excessive use of force, high staff turnover or sexual harassment," he said. "What NIC has learned is that we cannot simply address the presenting problem, such as sexual harassment. We have to study the entire culture. You can't go in and do a training program on creating a safe workplace and expect the problem to go away. Rather, you have to find out what's going on in order to find out what allows that problem to exist, and then address the culture."

Wright worked with a team of representatives from the Criminal Justice Institute, current and former corrections leaders, substance abuse experts and academics to develop a procedure to systematically evaluate prison cultures. After assessing and modifying current procedures, Wright evaluated the new model during on-site prison visits.

"We've now gone to three institutions — two state and one federal — to test the instrument, and we're in the second cycle of funding," he said.

"We made a three-day visit to each institution, meeting with the wardens, touring the facilities and conducting focus groups on each organization's culture. We met with five separate groups of staff and inmates at each facility, looking at a variety of field indicators such as schooling, medical facilities and food services."

Phase two of the project has begun, according to George Vose, former director of the Rhode Island and Massachusetts prison systems and head of the NIC prison culture team. NIC will provide technical assistance for 18 to 24 months and then NIC-trained culture assessors will return to measure the model's success.

This year, 15 cultural assessors will be trained, Wright said. "Once they're trained, they'll go to four institutions that have major presenting problems and do an assessment," he said. "Then they'll provide technical assistance to bring about change."

The people to be trained will already be knowledgeable about corrections. "It's all kind of an organic process, not rigid," he said. "We look at information from diverse sources. In our assessment so far, we've found some interesting issues. Some big differences among correctional staff from one shift to another, for instance.

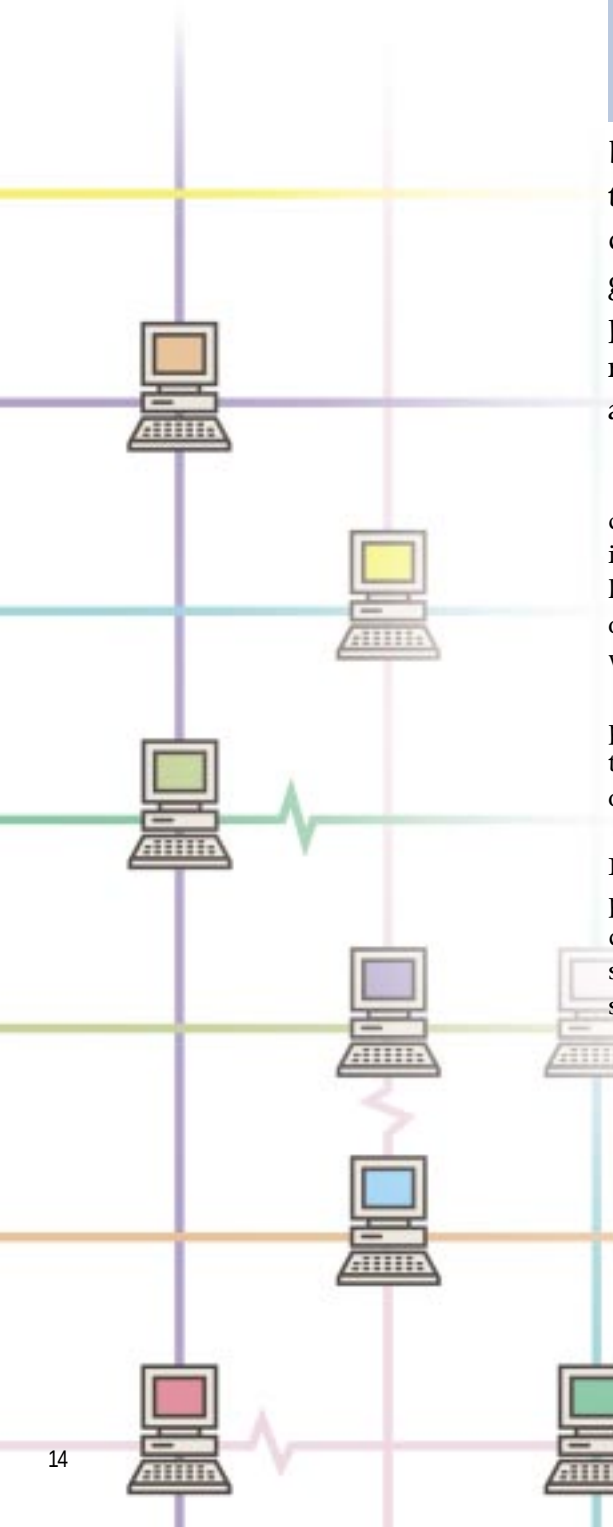
"We found considerable stress among middle administrators coming from the external pressure to do more with less. We found institutions that had been managed by a senior group of individuals for a number of years, and when they began leaving, there was a lot of instability and insecurity around that. We were able to detect that.

"One of the institutions' line staff felt they had been there for a long time and they knew how to run the facility. With wardens and chiefs coming and going, they were going to be resistant to change," Wright said.

"This is an important process in that it will give NIC an important tool and a cadre to use the tool to look at a system in a consistent way before they try to provide technical assistance. It's all incredibly valuable information in trying to effect change when you have a troubled prison."

Unlocking the grid

CONNECTING COMPUTING POWER REPRESENTS FUTURE OF THE INTERNET



When you plug into an electrical outlet, you may be using electricity generated in the West and shipped through the South before it reaches your office in the Northeast. Such seamless delivery is made possible by a grid system that transports power where it is needed, regardless of where it is generated or how it is being used.

Now imagine turning on your office computer and tapping into the computing power of a PC in the office of a colleague at Berkeley, as well as hundreds of other computers across the country with the same ease.

Welcome to the world of the computing grid, which researchers say is the next stage of evolution in the power of the Internet.

Binghamton University's Michael Lewis, an assistant professor of computer science, is among those who are developing a distributed computing system that promises to bring together scattered computing resources, integrate them, manage them, and take advantage of them as if they were one huge, virtual computer.

Lewis' efforts were recognized this year by the National Science Foundation (NSF), which has awarded him a $395,000 grant from its prestigious Faculty Early Career Development (CAREER) Program for young researchers. Over the next five years, the funds will support Lewis and his research group in their efforts to make grid systems dynamic and automatic.

"Grid computing is not a reality yet, but it's something that lots of people are shooting for," said Lewis. "This is a very big initiative for open scientific research."

Grid computing has attracted the interest of such computing giants as IBM, Microsoft and Oracle and is the focus of intense research interest at NSF centers and universities because of its huge potential to advance computing capabilities.

In effect, the grid will make the Internet an automated computing platform, Lewis said. This "virtual computer" will provide disk storage for users, transparently swap files and optimize users' collective performance, all with no central administration. This means that users will have access to a host of resources through their personal computers.

"The technology is important for research, because with that kind of computing power, we could solve bigger problems faster," Lewis said.

Lewis said grid technology will enable scientists from different parts of the world to collaborate on complex projects that require lots of computing firepower, including things like climate modeling, high-energy physics, genetic

COMPUTER SCIENTIST MICHAEL LEWIS SAYS THAT IN THE SAME WAY THAT ELECTRICAL DISTRIBUTION GRIDS ALLOW ELECTRICAL POWER GENERATED THOUSANDS OF MILES AWAY TO BE ACCESSED WITH THE EASE OF AN ON-OFF SWITCH, THE FUTURE OF THE INTERNET LIES WITH CONNECTING INDIVIDUAL COMPUTERS TOGETHER IN A GRID AS A MEANS OF TAPPING MASSIVE AMOUNTS OF COMPUTING POWER.

research and earthquake simulations.

For example, one project being pursued at the University of San Diego is brain-mapping, which is critical to better understanding and treating Alzheimer's disease, schizophrenia, Parkinson's and a whole set of neurological diseases. The problem now is that each MRI, or map of a brain, uses huge amounts of storage space. And because many images of different brains are needed for comparison, research must rely on collaboration among many centers, so each can share their data. Grid computing systems will make that possible.

According to Lewis, breakthrough discoveries depend critically on computational and data management infrastructure as a scientific tool. Grid computing systems promise to be far more powerful and flexible than any single super-computer.

Because of Lewis' research, BU has become a member of an experimental grid environment, called NPACI-Net, using 200 or so machines connected over a high-speed network and using software called Legion.

"With a single Legion account on NPACI-Net, researchers here at BU can now build and run their scientific applications on this grid," Lewis said. "Their programs may be executed in San Diego, Virginia, Minnesota or on any of the other machines that make up the grid. The grid itself decides where to execute the programs and automatically returns results back to applications programmers."

One of the challenges in developing these super systems is to make them operate automatically, making adjustments and updates as needed. Lewis' research focus is on giving the system such flexibility. "What I'm working on is allowing grid objects to evolve their behavior on the fly, so they are able to change or update without having to shut down or restart," Lewis said.

According to Lewis, this is important because for some applications it is inconvenient or impossible to shut down. "Some components of the grid need to be available 24-7," he said. "If you have to shut an application down, it would cause a disruption in service and inconvenience users. What I'm working on would allow changes and updates to be performed seamlessly."

Much like the change from telephone operators to automatic switching systems, grid technology will require less human intervention and be able to take care of its own needs.

"If it needs more computing power, it goes and gets it, and doesn't keep looking for a human to help," Lewis said.

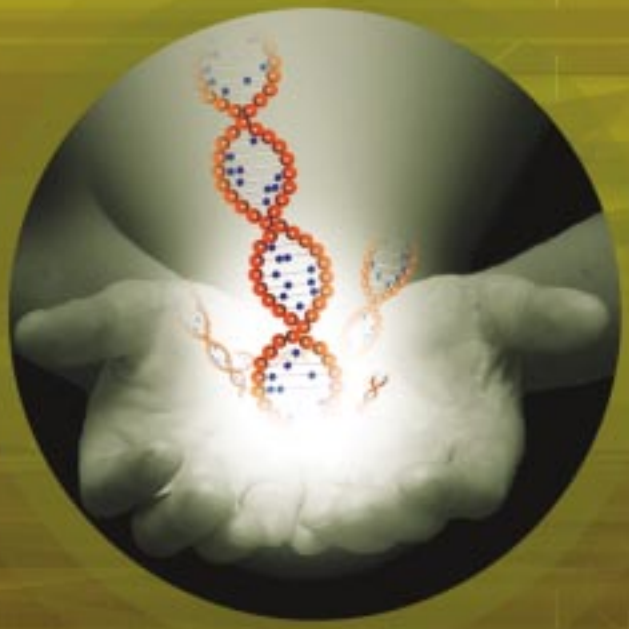
Lewis' award is the first NSF Career award received by the BU Computer Science Department. Career awards recognize and support the early career-development activities of teacher-scholars who are most likely to become the academic leaders of the 21st century. Career awardees are selected on the basis of creative career-development plans that effectively integrate research and education.

"The award will allow me to hire and attract talented graduate students to work with me on this project," Lewis said. "And attracting the best students is an important component to the success of this project."

Lewis was also one of the original researchers to submit meritorious projects for BU's Internet2 grant proposal in 2000.

Sensing the future

Technology that mimics human senses will be common within a decade



Welcome to the future.

Here, tiny, custom-designed sensors implanted in your body stand silent sentry, guarding your health. A DNA sensor, developed by Binghamton University researcher Omowunmi Sadik, monitors your cells, 24/7. It is an early-warning device designed to detect and alert you to the first appearance of cancer's calling card — any mutation in the unique pattern of your individual DNA. Its presence will permit the earliest possible therapeutic intervention should cancer strike.

A second sensor, also developed by Sadik, traces and calculates enzyme activity, another reliable marker of your health and disease state. Responsible for triggering the chemical action of every bodily process from reproduction to the disposal of waste, enzymes provide important diagnostic and research tools. Each enzyme converts a particular set of reactants, called substrates, into specific products. By measuring the products of enzyme activity in your cells, Sadik's sensors can tell whether too much or too little of a specific enzyme is being mobilized, aiding in the speedy diagnosis and effective treatment of a host of illnesses, including diabetes.

A third sensor developed in Sadik's laboratory launches waves of preselected antibodies into the bloodstream to track down and bind with their corresponding antigen — things such as viruses, bacteria or toxins. If the antibodies find and bind with an antigen, measurable changes in the conduction of electrical current through them will allow the sensor to make a quick and certain determination about the interlopers. The sensor will use readings from the bonded antibodies as homing beacons to deliver controlled-release drugs directly to the disease site. As a result, harmful side effects to your healthy organs and tissues will be mitigated.

If all of this seems just a little too sci-fi, hang on to your seat and take another look. In most respects, this world should actually seem quite familiar. It is less than a decade away, according to Sadik and other University researchers involved in sensor design.

"The chemistry is done," Sadik said. "In no more than five to seven years, all of these different applications should be available."

Miniaturization and appropriate packaging are all that stand in the way of real-life applications. Already reduced to the size of the eraser tip on a pencil, Sadik's sensors are only a few years away from being small enough to be comfortably implanted and from being packaged so the body won't reject them. Researchers in BU's Integrated Electronics Engineering Center are working to solve both of those problems. Timothy Singler, associate professor of engineering, is collaborating on miniaturization, and Bahgat Sammakia, director of the IEEC, is working with Sadik on packaging issues.

The future is not some place we are going to, but one we are creating. The paths are not to be found, but made . . .

—John Schaar, futurist

SUNY Chancellor Robert King cites Sadik's work as an example of the kind of innovation that is enhancing SUNY's worldwide reputation for research while offering real-time contributions to enhance people's lives.

"We are proud of Dr. Sadik and the exciting work she is doing at Binghamton," he said. "Her groundbreaking research in biosensors is fostering the development of new diagnostic tools and detection devices that have numerous medical, environmental and military applications. These discoveries will improve our quality of life, both as individuals and as a society, and help create a new, vibrant and healthy economy in New York's Southern Tier."

King notes that because of work by Sadik and others, SUNY ranks among the top 10 U.S. institutions in patents issued each year and in the top 15 for royalties from inventions. In the past three years, SUNY earned more licensing income than either Harvard or Johns Hopkins.

Across the board at BU, faculty creativity led to a record number of patent applications and invention disclosures during the past year. Donald Colbert, assistant vice president for technology transfer and economic development, said these disclosures are very often of interest to corporations. For example, Sadik's research has attracted more than $300,000 in support from such companies as Creatv MicroTech of Maryland, Dionex Corp. of California and Utah, Daikin Corporation of Japan and Aromascan, Inc. of New Hampshire. Each of the equipment manufacturers is interested in using Sadik's technology to build sensing equipment for commercial sale.

That kind of enterprise could be right around the corner. Sadik envisions that within the next few years, many people will be wearing miniature environmental sensors that will be less conspicuous than wristwatches. Their purpose? Just as canaries once warned coal miners of poisonous gases, the sensors will sing out an alarm whenever environmental toxins — whether purposely or accidentally released — are present.

Wayne Jones, a BU chemist who has more than $125,000 in National Institutes of Health funding for sensor development, believes it's reasonable to expect a wide range of portable chemically and biologically inspired sensors to be in use within the next five years.

"There are many developments that are not nearly so far over the horizon," he said. "Some of our work will be improving existing sensors within the year."

Jones says work on sensor development at Binghamton and elsewhere is proceeding on two different fronts: the development of new platforms, which is basically Sadik's approach, and the development of new sensor materials. Jones and several other faculty researchers, including Alistair Lees, chair of the Chemistry Department, are pursuing this approach.

Lees and several other Binghamton researchers are making significant strides pursuing luminescence or "cold light." Unlike incandescence, which is light from heat energy, luminescence results when an energy source kicks an atom's electron out of its grounded state to a higher energy state. The electron, in turn, hands the energy off as light so that it can return to its ground state. Two examples of luminescence are fluorescence and phosphorescence, the kind of delayed luminescence displayed in many glow-in-the-dark toys.

Throughout the early 1980s, Lees was one of only a few people to employ luminescence in the characterization of organometallic systems. Today, he said, even as the field expands rapidly, BU has an "impressive aggregation" both of faculty research expertise and the specialized equipment requisite to such studies.

OMOWUNMI SADIK'S RESEARCH IN BIOSENSORS COMBINES ASPECTS OF BIOCHEMISTRY AND BIOENGINEERING. SEVERAL APPLICATIONS ARE WITHIN FIVE TO SEVEN YEARS OF COMMON USE.

"There's a lot of very important synthetic chemistry here, and the results are maybe just several years out," Lees said.

By building molecules that luminesce and that bind like a lock and key with target compounds to change the color of the light emitted in predictable ways, Lees and others are developing sensors that can measure infinitesimal quantities of many compounds. In Lees' laboratory, the current focus is on detecting industrial pollutants such as cyanide and hydrocarbons.

Jones has been building on the lock-and-key concept in developing new fluorescent polymer sensor materials that behave like molecular wires to detect hazardous metals such as lead or mercury in drinking water. Although a number of laboratory-based methods are available for determining the presence of trace metals in the environment, there is an increasing need for the development of field-based sensors and remediation devices. That calls for new chemosensory materials and novel, low-cost synthetic designs, Jones said.

C. J. Zhong, assistant professor of chemistry, is developing other nanostructured sensing materials. In his approach, sensors detect the changes in mass that result when targeted ions bind to the sensing material.

The devices that result from all these efforts will be portable and will make it possible for scientists and others to collect and analyze environmental samples in the field. "In theory, you'll be able to take these sensors up to the Adirondacks to measure acid rain or into the field to monitor waste water, chemical plants, whatever," Lees said. "There will no longer be any need to collect samples and transport them back to laboratories."

Biologically inspired sensors are central to the work of several faculty, including Ron Miles, professor of mechanical engineering. He works on motion and sound detection and is building the world's smallest directional microphone for military and civilian applications. His work, which incorporates a mechanism modeled after one found in the ears of a small fly, is only about two years from commercialization. And if Miles' microphone will make it "all the better to hear you with" for some of the more than 25 million Americans suffering from hearing loss, Sadik has yet another "all the better to smell you with" offering.

She has designed an "electronic nose" and is refining it so that it will be able to accurately locate everything from land mines to invisible nerve agents, hidden drugs and carcinogens. She even expects it to be capable of sniffing out spoiled foods. Given a quick whiff, the electronic nose will be able to discern between foods that are fresh and unadulterated and those that are spoiled or contaminated, a function that could improve the safety of our food supply, Sadik said.

Because of their keen sense of smell, dogs have traditionally been trained to conduct drug, contraband and explosive searches. More recently, some have even been used to sniff out cancers. They are capable of such feats because some breeds boast as many as 225 million receptor cells in their noses (compared to about 5 million in the human nose) and scent glands along the roof of their mouths that capture and transmit additional smells. But dogs are not always easy to keep on task, and most can work for only about 30 minutes at a time before tiring. By comparison, Sadik's electronic nose will work around the clock.

With funding from the National Science Foundation, she is working with Walker Land, a research professor of computer science, to enlist support vector machine technologies — borrowed from the field of computational intelligence — to train her electronic nose to "remember" and differentiate smells, much like the human brain. Knowing that dogs sometimes bark up the wrong tree, Land and Sadik hope to build an electronic nose that can discern smells with 100 percent accuracy.

Getting the most accurate sense of the world around us is critical to making sound choices. Sadik and her BU colleagues say that affording us better information and the opportunity for wiser decisions is a major motivator as they work to enhance the scope and the usefulness of the data at our command. They also seem to agree on one other thing: Just as the side-view mirror of your car suggests, when it comes to the future of new and ever more astonishing sensors, objects seen here may indeed be closer than they appear.

Object lesson

RESEARCHER SEEKS CLUES FROM INFANTS ON HOW WE LEARN THE BASICS OF SHAPES

Peter Gerhardstein is relying on infants to help him unravel one of the most perplexing developmental mysteries: How do humans come to recognize objects in the world around them?

While most of us unconsciously accomplish this task hundreds of thousands of times a day, object recognition is something that computer-vision researchers, adult perception psychologists and others have been attempting to understand for more than 40 years. For all their best efforts, researchers have made remarkably little progress.

"People have this ability to see and to recognize objects in the world," Gerhardstein said. "In general, we don't even think about this, because our vision system is so good at it. It turns out, though, that this is actually a horrendously difficult thing to do. The ability, for example, to see a chair from all different orientations and to understand and know that it is the same chair — this is terribly difficult."

Gerhardstein, who earned his PhD in experimental psychology from the University of Minnesota, came to Binghamton as a research assistant professor in 1997 and is currently an assistant professor of psychology. In fall 2001, he received a five-year, $588,961 grant from the National Institute of Child Health and Human Development to support his research. Working with three- and six-month-old infants, Gerhardstein hopes to discover how humans develop the ability to perceive objects — a task that relies not just on sight, but also on memory.

By studying vision at early developmental stages, Gerhardstein hopes to bring a better understanding to the considerable knowledge already collected on adult object-recognition ability. "We have a pretty good understanding of how good adults really are at this," he said, "but we don't really know how they get to be that good or exactly what they're doing."

The most rudimentary theory suggests that people become capable of recognizing an object when they see it in enough detail to form a picture in their heads. That theory suggests that the next time a person sees the object or a similar object, no matter the angle, he or she can perform a mental rotation of the object and recognize it.

Gerhardstein says there is strong evidence that this explanation doesn't account for the complete process of object recognition. Studies suggest, for instance, that adults are generally capable of recognizing objects more quickly than would seem plausible if they had to rely on their brains to mentally pick up and examine an object from all angles.

Instead, Gerhardstein thinks a theory developed by Irving Biederman, his doctoral adviser at the University of Southern California, offers better insight into what is really going on. Biederman posits that objects and scenes are represented in the human brain as an arrangement of simple, viewpoint-invariant shapes that he terms "geons." Geons include such shapes as bricks, cylinders, wedges and cones. They are called viewpoint-invariant objects because, as a general rule, they are perceptually recognizable when viewed from the top, bottom or side — the angle doesn't really matter.

Using Biederman's theory as a starting point, Gerhardstein and his research team began working with three-month old infants to examine the development of object recognition. Initially, the infants are taught to kick a mobile from which brick-shaped objects are suspended. When they kick the mobile, the shapes move and a compact disc plays a *Sesame Street* song. Because babies love activity in which they gain some control over their environment, Gerhardstein said they generally take to this activity easily and enthusiastically engage in it for long periods.

The babies learn this game for two days, during which time their kicking rate tends to increase. They are then given 24 hours' downtime. On the third day of observation, except in the control group of infants who are allowed to go on merrily kicking the same mobile, the brick shapes are exchanged for cylinder shapes. If the babies are unable to discriminate between the two shapes, they may be expected to kick at the pre-exchange rate. If they stop kicking, it can be presumed that they recognize the cylinders as different from the bricks.

Gerhardstein's preliminary findings suggest that even 3-month-old babies can discriminate between bricks and cylinders. Their kicking comes to a quick halt when the bricks are replaced with cylinders. In what was perhaps even more revealing, the researchers also found that the babies don't react differently if only the angle of their view of the bricks is altered.

"According to the infants," he said, "a different viewpoint doesn't matter. What this is suggesting is that if these geons, or parts, are the basis of the way we construct object representations, infants may indeed already possess this knowledge. They might not need to learn these parts; they might start out in life with a sort of visual alphabet."

This is the first test, however, and the infants are allowed a lot of time to learn. With less learning time, they might not show this ability, Gerhardstein added. He said he also won't be surprised if it turns out that the interplay of genetics and environment is key to a fuller explanation of the phenomenon of object recognition.

"This is an attempt to describe how the development of the vision system normally progresses so that we might then start to make conjectures about what exactly is happening when something goes awry," he said.

"If we are going to come up with a reasonable explanation for things that go wrong during development, we need first to understand the normal course of development. It will also be extremely useful if we can divide things into 'This just matures' versus 'This is probably affected by experience.' We can then start to understand better how we might best go about treating things that go wrong."

There would be little point, for example, to using cognitive behavioral therapy if the ability to recognize objects is something that either matures or fails to mature because of biological or physiological factors.

"In that case, you are much more likely looking at a pharmacological treatment, or you may, in fact, be looking even earlier at gene screening," Gerhardstein said.

If his preliminary findings hold up, Gerhardstein said they could help flesh out Biederman's theory as well as support the theories of Albert Yonas, a noted child development professor at the University of Minnesota, on how infants and preschool children come to perceive the visual world. Partly as a result of Yonas' work, it's clear that infants don't develop stereo vision until about four months. They are also unable to understand the implied depth of drawings, Gerhardstein said.

"All of this points to the notion that infants are working with an impoverished world to begin with," he said. "We very much want to know what kind of consequences this sort of thing has for them in object representation and recognition."

POST-DOCTORAL RESEARCHER KIM KRABEL AND ASSISTANT PROFESSOR OF PSYCHOLOGY PETER GERHARDSTEIN OBSERVE INFANTS LIKE KRISTEN CIURZYNSKI OF KIRKWOOD TO DISCOVER HOW SHE RECOGNIZES OBJECTS, SUCH AS THE SHAPES IN A HANGING MOBILE. THE RESEARCH AIMS TO UNDERSTAND THE COMPLEX PROCESS OF OBJECT RECOGNITION THAT MOST ADULTS DO THOUSANDS OF TIMES A DAY WITH SEEMING SIMPLICITY.

Salt of the earth

ANCIENT SEAWATER OFFERS CLUES TO PREHISTORIC PAST

Tim Lowenstein, a professor of geological sciences who specializes in low-temperature geochemistry, is proving that the salt of the earth is peppered with important clues about the planet's prehistoric past.

His research has as many facets as the salt crystals he studies. It is helping to reclaim from lake sediments ancient data that could help us understand worldwide climate changes. It is providing new contexts for the evolution of ocean-dwelling plants and animals. And, as documented in an article in the Nov. 2, 2001, issue of *Science*, it is debunking age-old presumptions that the chemistry of seawater has remained unchanged for the past 600 million years.

"The relative amounts of salts in today's oceans are the same everywhere," Lowenstein said. "What we're saying is that the levels of specific salts have fluctuated over very long time frames of 100 million to 200 million years, and that the fluctuations we're documenting seem to correspond quite nicely with the fossil record, indicating that certain organisms have risen and fallen with the change in seawater chemistry."

Coral, the animal that constitutes

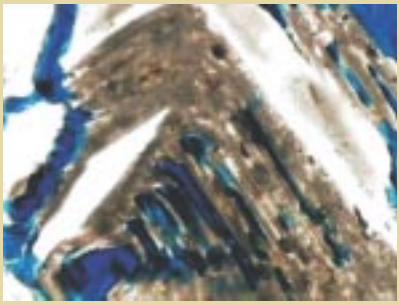
today's coral reefs, for instance, builds its skeleton out of a type of calcium carbonate called aragonite, Lowenstein said. "At other times, reefs were made up of other animals, not coral, and those animals built their skeletons out of calcite," he said.

These changes correspond with the oscillations in seawater chemistry that Lowenstein and his research group have recorded.

Another application of Lowenstein's work could shed light on the origins of life on Earth. Lowenstein has been collaborating with scientists at West Chester University in Pennsylvania to unravel the mysteries surrounding a Methuselan bacterium that was revived in 2000 after surviving 250 million years entombed in salt crystals. The bacterium, dubbed 2-9-3, is a contender for the title of the world's oldest known organism, pushing back by hundreds of millions of years the timeline of life. More than that, it opens up the possibility that life, in the form of bacteria, could have been transported to Earth by meteorites. Salt crystals similar to those containing the 2-9-3 bacterium were found in a meteorite in 1999, Lowenstein said.

Granted nearly $525,000 in National Science Foundation awards over the past four years, Lowenstein received the University's Excellence in Research award this year. He is an authority on the origin and significance of evaporites. These are sedimentary rocks composed of 50 or more saline minerals, the most common of which is halite, or common rock salt. His main research focus, however, is fluid inclusions, the small pockets of ancient seawater or other fluids trapped in salt or rock formations. The bacterium being studied at West Chester was discovered in a fluid inclusion retrieved from a salt bed about a third of a mile beneath the surface near Carlsbad, N.M.

RESEARCHER TIM LOWENSTEIN IS SHOWING THAT THE CHEMISTRY OF SEAWATER HAS FLUCTUATED GREATLY OVER TIME BY ANALYZING ANCIENT SEAWATER TRAPPED IN FLUID INCLUSIONS IN SALT CRYSTALS. BECAUSE OF HIS EXPERTISE, LOWENSTEIN HAS BEEN INVITED TO WORK WITH SCIENTISTS WHO DISCOVERED AND REVIVED A 250-MILLION-YEAR-OLD BACTERIUM THAT HAD BEEN ENTOMBED IN A SIMILAR FLUID INCLUSION. THE BU RESEARCH TEAM DEVISED A CONTAMINATION-FREE TECHNIQUE TO DISSECT AND ANALYZE THE CONTENTS OF FLUID INCLUSIONS, MAKING THE ACCURACY OF THE DATA REVEALED BY SUCH STUDIES LESS SUBJECT TO CONTROVERSY.



A SALT CRYSTAL TAKEN FROM THE BAJA CALIFORNIA AREA OF MEXICO IS ILLUMINATED IN THIS MICROSCOPIC VIEW. THE GRAY AREA SHOWS TRAPPED "FLUID INCLUSIONS," OR ANCIENT SEAWATER TRAPPED IN THE CRYSTAL.

Some fluid inclusions appear as bubbles large enough to be seen by the naked eye. In fact, such bubbles in clear salt crystals were used as early leveling tools, Lowenstein said. Most fluid inclusions are only a fraction of the width of a human hair, and until recently, it was difficult for researchers to work with them. Every analysis was subject to charges that the ancient fluids might be contaminated in the process.

Today, however, reliable analysis is possible because of a new technique developed by Lowenstein's research group, most notably Michael Timofeeff, Sean Brennan and microbeam specialist William Blackburn. The technique involves freezing and slicing open the inclusions and then using x-rays to determine their chemical composition.

Using this technique to analyze salt crystals gathered from Australia, the Middle East and the Americas, Lowenstein and his research group are showing that the chemistry of seawater has actually oscillated every 200 million years or so, perhaps based on major shifts in the tectonic plates.

Some of the samples Lowenstein has examined contain seawater up to 500 or 600 million years old. "These fluid inclusions are like tiny little time capsules of seawater, and, sometimes, of life that could have been trapped in it," he said.

Lowenstein's work also has major implications in the study of ancient climates. Since salt is formed by evaporation, salt itself provides "beautiful records of past climates," he said, by helping researchers determine whether the climate was wetter or drier, hotter or colder. More specific temperatures may be determined because fluid inclusions serve as little thermometers, he said. Researchers can determine the temperatures at which salts were grown by using the homogenization temperature of fluid inclusions as a gauge.

Increasing our knowledge of ancient climate changes could eventually help predict future climate changes, Lowenstein said, but it isn't likely to do much to improve the accuracy of the weekend weather forecast. His work on samples taken from a dry basin in Bolivia indicates, for instance, that about 20,000 years ago, the area was the site of a freshwater lake, probably hundreds of feet deep.

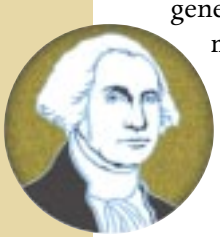
"I guess the hope for us is that we will eventually have a better understanding of long-term records of climate change so that we can look for clues about what might be driving it," he said.

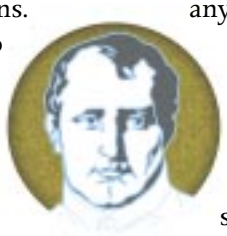
Lowenstein isn't yet used to seeing his research reported in places like *The New York Times* and *Science*. But with journals, journalists and research scientists from around the world taking notice, one thing seems certain: Lowenstein's research is worth its salt.

Leading the way

SOME LEADERS ARE BORN, BUT OTHERS LEARN TO LEAD

If you ask Francis Yammarino, professor of management and director of Binghamton University's Center for Leadership, the age-old question, "Are leaders born or made?" he will disarmingly answer, "Yes."





While the question has been argued from battlefields to boardrooms for generations, Yammarino isn't much interested in engaging in the chicken-or-the-egg debates about the origins of leadership. All of us, he says, seem to be naturally endowed with some leadership skills, although we're not all created equal as leaders. But, unlike a person's IQ, leadership skills can be improved with training and practice.

"It's true that all leaders are born," Yammarino said. "It's also true that every leader is made. No matter where someone starts out in life, he or she can almost always move further along the leadership continuum."

That's cause for gratitude, according to Yammarino. "Otherwise, we would have to identify all our leaders early on and put them in the right slots, or all of society would be lost."

Analyzing leadership across its myriad levels and exploring what Yammarino sees as the crucible of leadership dynamics — individual relationships between leaders and the led — has fueled his research for more than 20 years. Yammarino's work was recognized this year with a University Award for Excellence in Research.

He recognizes that some people perceive his discipline as "touchy-feely" and humanistic, Yammarino said. "While it has that side, we're all human beings, and that's what's involved here — human interactions. But when we get into the scholarly, rigorous side, we have to follow the same canons of science as any other discipline.

"Studying leadership is just like studying chemistry or physics," he said. "You're studying it using the scientific method. You go through the same rigorous procedures and protocols. You have to develop accurate and precise measures that are valid and reliable. And you have to use the latest analytic tools to test your ideas."

Researchers across several disciplines have Yammarino to thank for the availability of one analytic tool. Working with Fred Dansereau, a professor of organization and human resources at State University of New York at Buffalo, Yammarino was instrumental in developing a statistical tool called Within and Between Analysis, or WABA.

As its name suggests, WABA allows researchers to perform multilevel analyses. In reviewing leadership variables, for instance, WABA not only allows statistical analysis of individuals, dyads, groups and organizations, but also gives researchers a handle on variables that may operate on more than one level at the same time.

"It's possible you could be a very high-performing individual on a terrible team, in a great department, in a so-so organization," Yammarino said. Using WABA could help a researcher tease those variables apart, while also exploring them more closely in context. WABA may also be useful for analyzing leadership strategies by answering whether certain approaches work best depending on variables found at any of the levels.

Yammarino said the most surprising thing he has learned from two decades of research flies in the face of conventional wisdom. His studies suggest that the taproot of leadership is not about throngs or masses, countries or companies, teams or task forces. Leadership, first and foremost, he said, is about one-on-one relationships.

"These dyadic relationships literally build and destroy the larger units and organizations," he said.

Termed dyadic because they represent such intuitive pairs or dyads as mother and child, husband and wife or leader and follower, these relationships are at the heart of all human relations across all cultures.

"If you think about human beings, our most powerful connections are dyadic connections," Yammarino said. "If you think about best friends, spouses, parent and child — if those bonds are broken through someone moving, or by death or divorce — these are the most traumatic times of our lives.

"Even in collectivistic cultures, where the family is the most important unit, where there is no emphasis on the individual, these individual dyadic bonds are still the basic building block. The magnitude of their impact is eye-opening."

Yammarino's research suggests that the connection between a supervisor and subordinate in an organization, or a leader and a follower in a social movement, is essentially as dynamic and powerful as other social and familial dyadic relationships.

"It takes time for these attachments to form and strengthen, but once they're there, they are difficult to break," he said. "And if they do break, the break is devastating."

A growing body of anecdotal evidence involving workplace violence seems to support the empirical evidence that is Yammarino's stock in trade.

But what exactly is leadership? At its best, Yammarino said, it is a one-to-one process in which the leader's only job is to enhance the self-worth, the development and the success of the followers.

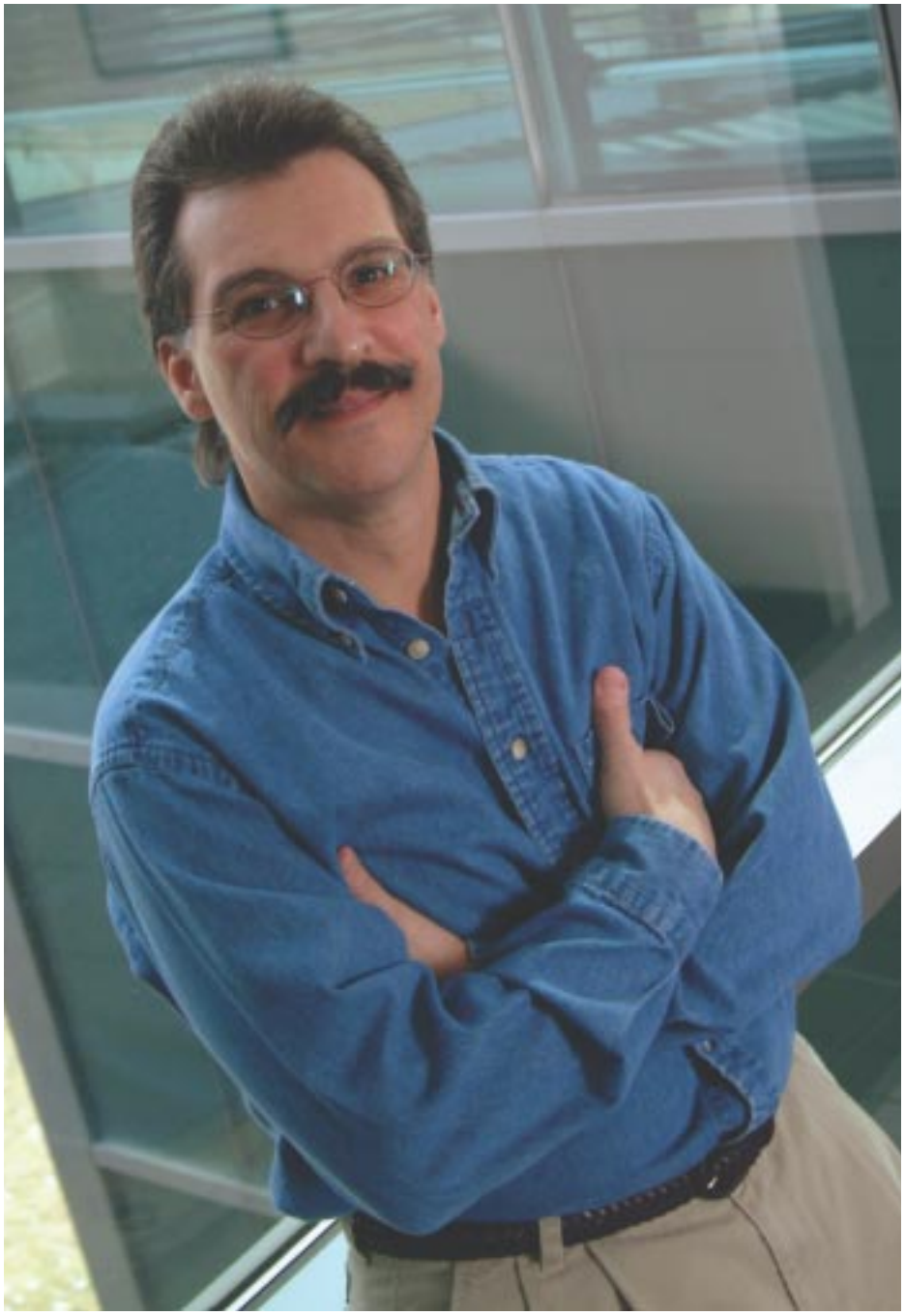
"What you need to get a kick out of your workplace, or to challenge you or to be successful — all of this might be very different from what the person next to you needs," Yammarino said. "A leader's job is to know you well enough to identify that and to make those matches happen. If a leader works that right, people get personal gains, but the larger organization also benefits."

Another thing Yammarino is sure of is that the leadership style of the person at the top of an organization — the style the person displays in interactions with his or her immediate team — will have a cascading effect throughout the organization.

"If the original style is a positive form of leadership, you have very successful organizations," he said. "The data show that over and over again. I'm convinced, in fact, that if you take two identical situations — the same number of people making the same product or delivering the same service — and you resource them the same, supply them the same, give them all the same equipment or tools, and you put a good leader in one and a poor leader in the other, at the end of a five-year window, the good leader's organization will be successful and the other one will be filing for bankruptcy."

Leadership studies are important because leadership itself is crucial in an increasingly complex world, Yammarino said.

"As we saw after September 11, leadership can overcome a lot of adversity, problems and crises," he said. "One of the positive things about a time of crisis is that it often gives rise to great leadership, which can create opportunities where none existed before. Frankly, I couldn't think of anything I'd rather be studying."



FRANCIS YAMMARINO'S WORK ON THE PRINCIPLES OF LEADERSHIP EARNED HIM A UNIVERSITY AWARD FOR EXCELLENCE IN RESEARCH. YAMMARINO NOTES THAT THE EVENTS OF SEPTEMBER 11 RE-EMPHASIZE THE IMPORTANCE OF PERSONAL QUALITIES OF SUCCESSFUL LEADERS.

Cancer clusters

GEOLOGIST HELPS SEARCH FOR PIECES TO TOXIC PUZZLE

When Joe Graney first began reading in the local paper about elevated rates of childhood cancers in the hamlet of Hillcrest, it piqued his interest.

Graney, assistant professor of geological sciences and environmental studies, thought he might be able to add to the discussion. "I realized I might be able to help," he recalled. Graney is an environmental geochemist whose doctoral and post-doctoral studies in Michigan centered on the use of geological research to track the transport and deposition of environmental emissions.

In Hillcrest, a residential community in Broome County, N.Y., with a population of 2,300, residents were questioning whether six cases of cancer in children who lived within a 1-mile radius of each other were linked to the presence of two local industries and a U.S. Army warehouse complex.

The issue for Hillcrest residents was whether anything in the area's water, soil or air was associated with the cancers or posed other health concerns. To answer the question, Graney mapped a plan to look at possible sources of direct and indirect contamination. Direct — or point — sources include industrial and power plant smokestacks and sewage treatment plants. Indirect — or non-point — sources are non-stationary emitters of contaminants that can be carried by wind, rain and runoff.

Graney saw the Hillcrest situation as an opportunity for continuing his research, which focuses on measurement of inorganic pollutants (metals), while lending his expertise to a project of local concern.

Public records indicated that the two businesses, the former CAE-Link manufacturing site and a plant formerly used by Triple Cities Metal Finishing, used processes that involved organic and inorganic chemicals known to have toxic effects or be carcinogenic. Records also showed that wastewater generated by the businesses contained arsenic, cadmium, chromium, lead, zinc and nickel, as well as organic solvents. The Army Depot also stored liquid mercury on site. It has since been removed.

With support from a $100,000 research contract from the Defense Logistics Agency (which operates the Army Depot), Graney investigated three components of what he sees as an interlocking puzzle. "We basically set up three interrelated projects," he said, "one to monitor mercury emissions, another to learn what is happening in the present day as far as surface water contamination [goes], and another to look at the past — to look at the historical record of pollutant pathways."

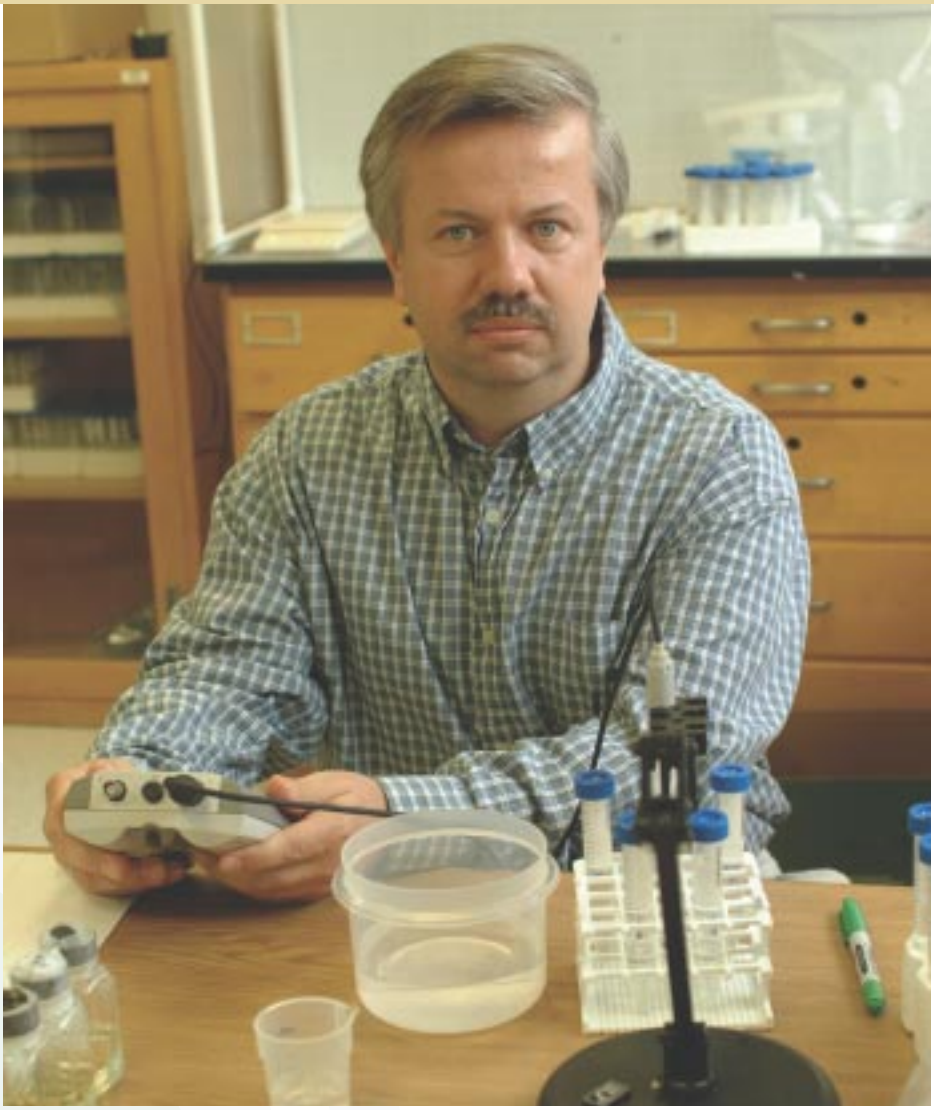
Inside and outside the warehouse where mercury was stored, Graney did find evidence of vaporized mercury in air samples, but in amounts far below the health-threat horizon. Elsewhere, he found some contamination in surface runoff from a variety of natural and other sources not specific to the site — mostly, pollutants washed from the air into the groundwater. But the contaminant levels did not exceed state standards for health threats — and further, he noted, Hillcrest draws its drinking water from a deeper aquifer that is shielded by a clay barrier so that currently, inorganic contaminants are not a major problem for the water supply.

In measuring the historical record of pollution, Graney noted that from a scientific standpoint, the layout of the Army Depot provides a unique laboratory. "There's 15 acres of surface on roofs depositing water into a 1.5-acre pond," he said, referring to the storm water retention pond adjacent to the buildings. "The roofs of these warehouses act to amplify airborne deposits of pollutants into the pond."

Graney sampled water and sediment entering the Hillcrest pond for trace metals after each rainfall during the spring, summer and fall of 2001. As expected, the amount of trace metals increased significantly after each rain when compared to normal amounts found in the water.

To put those results in context, Graney collected sediment samples elsewhere for comparison. He chose a large and a small pond near the Broome County Airport and the large pond at the Binghamton University Nature Preserve to serve as his control. One of the ponds near the airport was about the same size as the Depot pond; the other (approximately 30 acres) was about the same size as the Nature Preserve pond.

Five core samples were taken from the Hillcrest pond and two each from the other ponds. The sediment cores, which capture silt deposited over a 50-year period, were sliced into half-centimeter increments, each one representing about a year's worth of deposits. "The composition of the par-



ENVIRONMENTAL GEOLOGIST JOE GRANEY'S INTEREST IN AN APPARENT CANCER CLUSTER IN THE COMMUNITY OF HILLCREST, N.Y., LED HIM TO INITIATE A RESEARCH PROJECT THAT TRACKED THE AIR- AND WATER-BORNE PATHWAYS OF POTENTIAL CANCER-CAUSING INDUSTRIAL POLLUTANTS.

ticles can provide a geochemical fingerprint of past activities," Graney said.

The samples were analyzed for a suite of inorganic compounds such as lead, zinc, arsenic and mercury. After establishing the baseline for the amount of the compound that is naturally occurring (manganese, for instance, is found in relatively high amounts in this region), Graney then determined how much of the compound was added over a specific period.

The patterns Graney found can serve as a mute history to the industrialization and growth of the Hillcrest area — and, to a certain extent, the Susquehanna and Chenango river valleys. The trace patterns of several chemicals show when the industrial processes that used them started, stopped or changed. "It's apparent from the sediment record that the manufacturing processes changed over time," he said.

The patterns also reveal the effect of leaded gasoline on the atmosphere. Graney said the pattern of lead concentrations he found in samples was consistent with the timing of the use of leaded gasoline in automobiles and, then, its removal. "Taking lead out of gasoline has worked," Graney said, noting its decline in the sediment samples from every site.

Of all the compounds Graney measured, only lead and zinc were in excess of state guidelines for potentially causing severe health effects to biota, or flora and fauna, in the Hillcrest pond. While this is clear, the exact source of the chemicals deposited in the pond is not, giving Hillcrest residents a good news-bad news scenario regarding any environmental link to the cancer clusters.

"There were historical impacts coming from local sources," said Graney, "but fortunately, or unfortunately, they can't be directly linked to what happened up there. It's a piece of the puzzle."

Graney said his studies did point to further avenues of useful inquiry, however. "Is there something about river valleys that contributes to the issue?" Graney asks.

In a future study, he said, "We're going to use mercury as a surrogate substance, a tracer if you will, to determine how other elements behave. Mercury emissions travel with other pollutants from several sources to the Hillcrest area. For example, pollution builds up when wind velocity decreases overnight and during the daytime when conditions are right. We're not dealing with high pollutant levels, but incorporating meteorology is important to look at the big picture when trying to understand the movement of pollutants."

Further, Graney would like to examine how compounds in the soil, if they are ingested, are leached out through the action of stomach acids and the resultant effect on the body. He also said it's important to go beyond looking at how any single compound affects us — to study how compounds interact with each other and what their combined effects are.

"We have found a few answers to environmental issues at Hillcrest, but the issue of cancer is a complex one," he said. "Perhaps my work will inspire others to use non-traditional perspectives to work on environmental health issues."

Real-life lessons

COMMUNITY NURSING STUDENTS LEARN THROUGH EXPERIENCE

When Lisa Evans returned to school for an advanced nursing degree, it took her a while to settle on a program focus. But when she did, the Chenango County village of Greene reaped the benefits.

Evans graduated from the Decker School of Nursing in May 2002 with a master's degree in community health nursing. On her way to finishing her degree, she completed an assessment of the Greene community's medical needs and then set about helping to address the problems she had documented.

JUDY GLOVER (FOREGROUND), NURSE PRACTITIONER WITH THE OTSELIC VALLEY FAMILY CLINIC IN GREENE, N.Y., AND LISA EVANS, A RECENT NURSE PRACTITIONER GRADUATE FROM THE DECKER SCHOOL OF NURSING, WORKED ON A PROJECT TO ASSESS THE HEALTH NEEDS OF GREENE RESIDENTS AND TO OPEN THE CLINIC SITE THERE LAST YEAR. THE PROJECT WAS PART OF EVANS' TRAINING UNDER A COMMUNITY HEALTH NURSING GRANT RECEIVED BY DECKER. GLOVER IS A PAST GRADUATE OF THE PROGRAM.

Evans' real-world experience is typical of the approach promoted by the Decker School of Nursing's community health nursing program. The program recently received a major boost with a nearly $1 million grant from the U.S. Public Health Service. The grant is a renewal of a previous grant that established the community health nursing program, which was first established in 1985. It will fund new Internet-based courses on handling biohazards, courses to develop preceptors and master teachers to strengthen college-level nursing faculties, and a program to encourage teens to consider nursing and other health careers.

Gale Spencer, professor of nursing and director of both the Kresge Center for Nursing Research and the Community Health Project, said the new grant will support the education of 24 community nurse practitioners, community nurse educators and administrators over three years. It will also develop 20 new clinical sites in underserved or rural areas. Spencer and Masha Britten, associate professor of nursing, prepared the grant.

While the bulk of the grant will go toward the community health program that brought Evans to Greene, Spencer pointed out that the biohazard response segment is also important to communities. Biohazard education courses were added to the grant application in response to September 11. The courses will be developed using the expertise of Laura Terriquez-Kasey, a Decker clinical instructor and former U.S. Army nurse who is a member of the federal Disaster Medical Assistance Team. Terriquez-Kasey's team spent time at Ground Zero as part of a medical triage acute-care team.

The programs to strengthen college-level nursing education and to attract teens to nursing recognize two areas of shortages that affect nursing. The median age of nursing faculty is 54, Spencer observed. There has also been a shortage of students entering the profession for several years.

The crux of Decker's community health nursing program, which prepares graduates to be primary care nurse practitioners, will continue to focus on clinical fieldwork.

Students, like Evans, are required to seek out a rural or underserved area, perform a needs assessment and then devise a plan to correct deficiencies. Decker nurse practitioners have worked with non-profit groups such as the YWCA, SOS Shelter, the Southern Tier AIDS Program and the Imaginarium.

Evans, who decided to go back to school after 15 years in obstetric nursing, said she was attracted by the wider focus on the health needs of whole communities, not just individuals or families. "I think it has so much more of an impact," she said.

That's an assessment Spencer shares. In addition to graduating new nurse practitioners and nurse educators, she said, "The whole idea is to serve Broome County and the surrounding region while teaching graduate students how to do a community needs assessment, and then develop and implement projects that meet community needs."

Helping the helpers

LONG-TERM UNIVERSITY-SOCIAL SERVICES PARTNERSHIP HELPS WORKERS COPE

Helping people with no food, clothing or shelter, assessing child abuse, placing children in foster care, dealing with child support issues, determining eligibility for program help — those are just some of the issues Broome County Department of Social Services (DSS) employees face daily.

It's a high-stress environment that can quickly lead to employee turnover and burnout.

However, through a program developed by the School of Education and Human Development, DSS employees are getting help through a series of courses focusing on such skills as conflict resolution, working with diversity in the workplace, stress reduction and decision making.

The DSS training initiative started in 1993 with 15 people with help from SEHD and the Sociology and Political Science departments. Today, all 400 DSS employees regularly participate in programs coordinated by the school's Division of Professional Development and Research, the Dean's Office and the Division of Human Development.

"The purpose of the program is to improve employee performance and provide higher-quality service to clients," said Allison Alden, director of the Professional Development Division.

"This is much more complicated than it would appear," she said. "New York State Social Services regulations, directives and structures change regularly and often contradict previous practices and other directives."

After decades of operating in a regulation-driven environment, Alden said, the agency is striving to become more responsive and client focused, a change that requires workers to change the way they think and act and the skills they use.

GARY SMITH, AN ADJUNCT LECTURER FROM THE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT, ANSWERS QUESTIONS DURING A SESSION WITH DEPARTMENT OF SOCIAL SERVICES EMPLOYEES.

Initially, training targeted developing supervisors' administrative skills, but now several DSS units are looking at broader issues such as communications, conflict management and team development.

The program today is a true collaborative effort between the University and the DSS, said Nancy LeBlanc, who oversees DSS training. "The University and the DSS are full partners in this effort," she said.

"We identify training needs across broad areas that have an impact on the entire organization," LeBlanc said. The University then designs and offers programs to meet those needs and expectations.

"It's not like a computer-training course," LeBlanc said. "It's hard to directly measure the effect of the training. We're teaching soft skills that over time have an impact and shape behavior."

Adjunct lecturer Gary Smith, one of the program instructors, said the DSS has made tremendous strides toward its overall goals through the integrated effort. "The contract has helped the Department of Social Services to focus and move into the new world of requirements for employment," he said. "This process is very useful. People are telling us what they need, what their priorities are and where they need to do some changing."

The program seeks to balance theory and practice with applied exercises and opportunities for participants to learn their own strengths and grow as agents of change. Using an interactive teaching and facilitating strategy, students work in small groups, solve problems, make recommendations and present materials to the group.

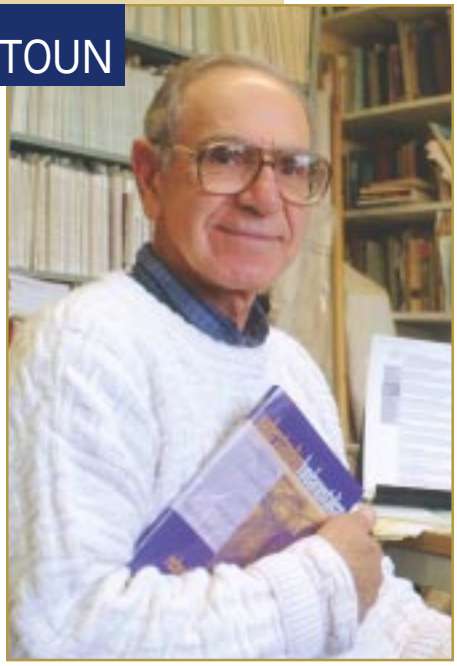
"Adult learning theory stresses the importance of being involved with the planning of class material," Smith said. "If they experience and work with it while they're in training sessions, it's more transferable when they are back at their desks."

Smith said the focused training is important, especially now with tighter state budgets. "This program helps train a better workforce to deal with the upcoming environment and the constant changes they face," he said.

profile
RICHARD ANTOUN

World views

A 1986 ENCOUNTER IN JORDAN LEADS TO BOOK ON FUNDAMENTALISM



Even 15 years later, Richard Antoun can recall with great clarity his first face-to-face encounter with Islamic fundamentalism.

Antoun, a social anthropologist, was working in the Jordanian peasant village of Kufr al-Ma, studying transnational migration and its effect on village life. He'd been in the village off and on for 25 years. He had read the Quran with the local preacher years before. On this particular Friday, he was confronted by several young men.

"I had read the Quran," Antoun recalled. "They were worried that I was going to hell if I did not convert."

Reflecting on the different attitude, Antoun recalled, "I suddenly realized that something had changed."

The anecdote about events of 1986 is one of several personal observations about the nature of Islamic fundamentalism that can be found in Antoun's latest book, *Understanding Fundamentalism: Christian, Islamic and Jewish Movements*.

AltaMira Press released the book in August 2001. But, since the September 11 attacks on the United States by Islamic fundamentalists, the work has received considerable attention.

Antoun, whose family has Lebanese-Christian roots, was working on a book on transnational migration when his editor noted his teaching experience in the area of religious fundamentalism and urged him to switch topics. After writing the introduction, Antoun was satisfied with the effort and agreed to complete the project.

Fundamentalism, in Antoun's view, is an intellectual and emotional way of looking at the world. Ironically, Antoun notes, fundamentalism is a label that is often rejected by groups considered fundamentalist.

"Fundamentalists are ideal types," he said. "No one individual or group is completely fundamentalist or completely lacking in fundamentalist attitudes."

While he sees the worldview of fundamentalists as the same across cultures, Antoun argues that the cultural content of the various brands of fundamentalism and the historical events that give rise to them vary.

What unites fundamentalists across religious boundaries, in Antoun's analysis, is their agreement on a number of broad themes, including:

- an opposition to the modern world, both emotionally and intellectually;
- an emotional attachment to scripture based on a belief in its infallibility and an orientation that uses scriptural and ancient traditions (including myth-based traditions) as a context for current events;
- an extension of their beliefs to all facets of their personal, business, community and political life, or "totalism";
- an attitude of activism that sees the world as split between good and evil, and that confronts the religious and political establishment through violent and non-violent protests;
- a process of selective modernization so that modern technology or ways of social organization are adopted and adapted to fit the group's ideals.

Anton notes that these themes are not played out in hard-and-fast ways. Christian fundamentalists, for instance, have adopted TV and radio as a way to push their message, but reject technology such as movies and the Internet as tools of immorality.

Antoun observes that all fundamentalists oppose "modernism" — a philosophy that values change over continuity, quantity over quality, and production and profit (commercial efficiency) over traditional values. Modernism as an ideology — an action-oriented system of beliefs that can explain the world, justify decisions, identify alternatives and create an intense social solidarity — enables consumer-oriented capitalism, competition, specialization and mobility, and repudiates established hierarchies.

The book looks at the historic roots of the various shades of fundamentalism. Antoun notes that Christian fundamentalism, exemplified by figures such as Pat Robertson, can be seen as a reaction to 19th-century liberal Protestantism that elevated nationalism to the same plane as religion.

Jewish fundamentalism, characterized by the Jewish Defense League and the Kach Party, began in late-19th-century Eastern and Central Europe as an expression of outrage over anti-Semitism. Its life was extended after the Nazi Holocaust.

Islamic fundamentalism, which started later, can be seen as a reaction to Western colonialism. It remains vibrant because it sees the post-colonial world as a "change of masters" from Westerners to Westernized Muslims.

Binghamton University Organized Research Centers

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