

2000

INSIDE RESEARCH

BINGHAMTON UNIVERSITY
STATE UNIVERSITY OF NEW YORK

Opening the doors of discovery

UNLOCKING MYSTERIES
THROUGH RESEARCH
AND CREATIVITY

Education is about discovery — for students, for faculty and for our society. Some might say not much is left to know. That has been said during every period in history, but it is never true. We are proud of the many discoveries that occur at Binghamton University, and through this publication we will illustrate some of them.



For example, in the tiniest environment, chemist Wayne Jones is seeking to build electronics on a molecular level. In the expanse of evolution, paleoanthropologist G. Philip Rightmire is searching for the origins of humans.

We plan to open the arena of discovery in the next year and beyond. Within the past few months we have created a new Division of Research, led by Vice President Frances E. Carr, formerly

vice provost for research and graduate studies. This reorganization confirms the University's commitment to enhancing research and scholarship.

But research itself is not enough. It goes hand-in-glove with teaching. At Binghamton, the enhancement of our graduate studies and research enriches our excellent undergraduate program. We must, after all, depend on those in the next generation to take these discoveries to the next stage of development.

Another important aspect of our work at Binghamton is applying research to real-life solutions. For example, the University's Integrated Electronics Engineering Center is working with local company Rainbow Displays Inc. to develop flat-panel technology that will revolutionize TVs and computer monitors. Within a few years, discoveries and assistance that Binghamton provides to Rainbow and other companies will help inform and entertain people through a wide, thin screen that hangs on their walls.

At Binghamton, we have discoveries in all fields of study, as illustrated in English Professor John Vernon's scholarship. His study of his brother's life sheds light on how objects relate to the way people live.

I hope you enjoy learning about these findings in the following accounts of some of our projects. We appreciate your joining us in opening the doors to discovery.

A handwritten signature in black ink, appearing to read "Lois B. DeFleur".

Lois B. DeFleur
President

Research is the leading edge of educational and economic development. It helps define the need for new pathways and then forges vision into reality, for the University and the community in which it thrives.



When I look at the scope of research and scholarship presented in this report, I see an “engaged University,” consistently bringing its commitment to excellence in research and scholarly pursuits to the larger community. This is research for the public good: visionary academic projects across the disciplines, carried out by an entrepreneurial faculty, that effect positive changes in our world and produce solutions to the important issues facing us all.

The success of the engaged university evolves from sustained commitment — commitment to providing rigorous educational and training opportunities, as well as to addressing urgent societal needs through discovery and partnership.

This year we established four new organized research centers — bringing the total number of University research centers to 19 — to enhance opportunities for collaboration and outreach. The newly formed Institute of Biomedical Technology, Center on Democratic Performance, Center for the Historical Study of Women and Gender and Roger L. and Mary F. Kresge Center for Nursing Research will enhance Binghamton's profile as a research institution. These centers will help us to continue to develop pioneering partnerships and attract federal, state and private funds to support the growth and vitality of the region.

We are especially pleased to acknowledge that our faculty received a total of 305 new awards this year, an 8 percent increase over last year. Further, our external funding is now in excess of \$20 million, marking an all-time University high. Such success translates into a direct economic benefit to the community. Not only does research activity benefit area companies, healthcare providers and schools, it is also key to the creation and retention of jobs in the region.

Overall, Binghamton University has benefited from the inherent and remarkable synergy between research and graduate studies. Not only do our researchers conduct groundbreaking research in University laboratories and libraries, they also enhance public life by helping to educate a new generation of scholars. Ultimately, these students are our future: They are the promising new teachers, scholars, scientists, critics and thinkers of the next millennium.

A handwritten signature in black ink, appearing to read "Frances Carr".

Frances Carr
Vice President for Research

INSIDE RESEARCH
Binghamton University

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UNIVERSITY ESTABLISHES FOUR NEW RESEARCH CENTERS

Binghamton University has established four new research centers: the Institute for Biomedical Technology, the Center on Democratic Performance, the Center for the Historical Study of Women and Gender and the Roger L. and Mary F. Kresge Center for Nursing Research.

The new centers are expected to enhance Binghamton's profile as a research institution, leverage increased federal support, garner national recognition and propel innovative graduate and undergraduate education programs, said Frances Carr, vice president for research.

The new centers bring to 19 the number of organized research centers.

The point is not to promote a proliferation of research centers, but to encourage coalitions that build on the University's strengths, energize the natural evolution of faculty research, and unify approaches that amplify available resources, Carr said.

"I feel very strongly that scholarly pursuits are the leading edge for our graduate education and undergraduate programs," Carr said. "It's an integrated paradigm."

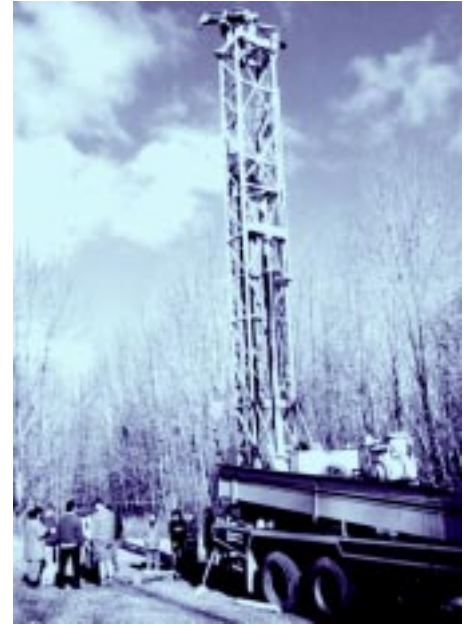
BINGHAMTON WINS NSF NOD FOR HIGH-SPEED INTERNET 2

Binghamton University will receive a \$350,000 grant over the next two years to support access to the next generation of Internet services — the high-bandwidth, high-performance Internet 2.

In making the award, the National Science Foundation recognized that Binghamton researchers have "meritorious scientific applications" that warrant access to the Internet 2, which connects some 160 research universities.

Most of these universities are members of the University Consortium for Advanced Internet Development. The consortium is overseeing the development of the technology used in the "very-high-speed bandwidth network services" (vBNS) offered through Internet 2 and in the Abilene Network, which will offer even more capabilities and provide a research test board for new technology.

Binghamton applied for the grant as part of a group of six New York universities and was one of two to receive the maximum amount awarded by NSF.



FULL-SIZED RIG DRILLS FOR WATER KNOWLEDGE

It's not every day that you see a full-sized drill rig on a university campus. But for students of Karen Salvage and Joseph Graney, assistant professors of geological

NEW LABS SUPPORT HIGHER LEVEL OF RESEARCH

With the completion this year of a special suite of laboratories in Science III, Binghamton University has joined the ranks of major research institutions working to halt the spread of deadly pathogens.

The laboratories — Biosafety Level 2 and 3 facilities — provide a research home to a team led by Ralph Garruto, research professor of anthropology and neurosciences and a supervisory research biologist with the National Institutes of Health. Garruto is an internationally recognized authority on the study of natural experimental models of disease among isolated and modernizing non-Western populations.

The new labs will support research on a wide range of diseases and, in particular, the rapid spread of emerging and re-emerging pathogens, agents such as AIDS that create a global threat because of the movement of individuals and groups that accompanies modernization.

"These new directions of faculty research reflect the intensification and evolution of research at Binghamton University," said Frances Carr, vice president for research.



KUDOS

sciences and environmental studies, the rig is just phase one of a project to establish a readily accessible field station for students to gather hydrologic and environmental data.

"The immediate goal of this project is the addition of a field laboratory for several undergraduate geology and environmental studies courses," Graney said. "The long-term goal is not only to enhance students' lecture-based learning with field experiences, but ultimately to enable them to develop and conduct meaningful 'capstone' scientific projects at the undergraduate level."

A National Science Foundation grant paid for the purchase and installation of the hydrologic and environmental monitoring equipment.

The complete project will include the well field for monitoring groundwater levels and quality, a station on Fuller Hollow Creek for monitoring stream flow and sampling surface water quality, and a meteorological and atmospheric monitoring station capable of sampling air and rainwater for chemical analysis.

PROGRAM USES COSMETICS AS LURE TO THE SCIENCES

A \$99,993 National Science Foundation grant is supporting an innovative program that uses creams, lotions, shampoos and shower gels to interest girls in the physical sciences.

The program teams the University with the Lander Company, a Binghamton-based personal care product manufacturer; the Union-Endicott School District; and the Roberson Museum and Science Center.

It attempts to reverse a trend that sees significantly fewer students, particularly girls, in Broome and five surrounding counties enroll in physical science classes than elsewhere in upstate New York, said biology professor Anna Tan-Wilson, director of the program.

In 1997-98, the State Department of Education said only 51.2 percent of high school students in Broome, Chenango, Delaware, Otsego, Tioga and Tompkins counties enrolled in chemistry, compared to 69.8 percent of students in the rest of upstate New York. When it came to physics, the gap between local counties and the region grew even wider — 29.5 percent to 43.1 percent.

The program attempts to make chemistry and physics more relevant, first to girls and

History professor **Thomas Dublin** has been awarded two prestigious fellowships that he plans to fulfill back-to-back across the 2000-01 and 2001-02 academic years.

Dublin, who has taught at Binghamton since 1988, was awarded a Guggenheim Fellowship and the Institute for the Advanced Study of Religion at Yale Fellowship. He plans to take the Yale fellowship in 2000-01 and the Guggenheim in 2001-02.

Dublin was one of 182 artists, scholars and scientists selected from more than 2,900 applicants for the Guggenheim awards. Dublin won the Yale residential fellowship competing in a field of 150 applicants. The institute's theme for next year is "American Religion, Race and Ethnicity."

He will write and revise a book manuscript, "Facing Economic Decline: The Pennsylvania Anthracite Region, 1920-1990," during the fellowships. Based on research completed in collaboration with Walter Licht of the University of Pennsylvania, Dublin's book will examine the history of the decline of the anthracite coal industry.



Naomi E. Ervin, Decker Chair in Community Health Nursing at the Decker School of Nursing, was one of 65 new fellows inducted into the American Academy of Nursing for 1999.

The academy is an organization of 1,300 distinguished leaders in nursing who have been recognized for their outstanding contributions to the profession of nursing and to health care.

Ervin's contributions have spanned 35 years as a public health nurse, administrator, educator and researcher. She contributed to the development of the role of the clinical specialist in community health nursing and has worked to develop and evaluate effective methods for delivering nursing care in the community.



James E. Morris, a professor of electrical engineering at Binghamton since 1989, has been elected a fellow of the Institute of Electrical and Electronics Engineers (IEEE) in recognition of his "leadership in the development of electronics packaging."

The IEEE elects less than 1 percent of its members to become fellows and less than a 10th of a percent in any given year. Morris was recognized in the electronics packaging community for his work with electrically conductive adhesives, a no-Pb technology with the potential to replace solder in microelectronics applications.



later to all students, by showing them how the subjects relate to aspects of everyday life.

In the first phase of the program, 120 middle school girls took tours of the Lander Company and spent Saturday mornings and a week in the summer learning to make cosmetics.

In the second component, 24 teachers from districts within a 100-mile radius participated in a workshop learning classroom experiments. The workshop will be followed

by the distribution of classroom kits to local schools and on-site assistance from graduate and undergraduate volunteers, in an effort that is expected to reach an additional 2,000 students.

Tan-Wilson said she isn't concerned that the program reinforces gender stereotypes.

"We are just trying to find other angles — as many angles as one can — to attract students to science," she said.

Opening the doors of discovery

University, community reap benefits of innovative research

Matco had problems — good problems. The Binghamton technology company was trying to solve difficulties a potential client was having with a circuit board. The right answers could lead to a production contract worth more than \$1 million. But first things first — Matco had to figure out what was wrong with the existing design. So the company did what many high-tech operations do in Broome County: It turned to Binghamton University.

The University's Integrated Electronics Engineering Center examined the product, a printed circuit board to go into a faucet, and enumerated the flaws. The center and Matco then found the appropriate coating, tested it and discovered components in the circuit board that should not be in a moist environment. Matco fulfilled the reliability contract and parlayed it into a production contract. Now, 35 new employees are building the product in Broome County, making good money and putting it back into the community.

"Without a doubt they won us that contract," said Richard Welch, Matco technology team member.

That was just the end result in the commu-

nity. On the way to those solutions, students learned how to conduct research, interns gained valuable real-world experience and new technology was developed.

Matco benefited not only from the University's keen interest in helping develop technology in its Southern Tier home, but also from its ability to bridge disciplines in search of new combinations that open doors to discovery all over the world. In one look, it is difficult to absorb the myriad contributions from all of the different fields. Areas of study from engineering to chemistry, from nursing to pre-law, are all involved in expanding on- and off-campus partnerships with area schools, municipalities, clinics and businesses.

In the case of the Integrated Electronics Engineering Center, the IEEC mixes mechanical, industrial and chemical engineering with physics and computer science to concoct a new elixir for an emerging millennium's sophisticated demands.

Building on the University's success with multidisciplinary approaches, BU established four new centers for research this year. The new Institute for Biomedical Technology, Center on Democratic Performance, Center for the

Historical Study of Women and Gender and Roger L. Kresge Center for Nursing Research bring to 19 the total of University research centers.

The Institute for Biomedical Technology, for example, will expand on the IEEC model to enhance the relationship between disciplines and maximize resources. One of its initiatives is a cryosurgical probe that will freeze cancer tissue, allowing it to be harmlessly absorbed by the body, said John Baust, institute director.

Frances Carr, vice president for research, said it is an exciting time to be part of a burgeoning research institution.

"The new millennium finds Binghamton stepping to the fore as an engaged research institution, actively involved in sharing the fruits of discovery with local, state, national and international communities — from the definition of new and exciting research questions to the development of innovative solutions that promise to help improve the world and our place in it," Carr said.

The University recognizes its stake in the community, where the school is already the second largest employer during the academic



“THE NEW MILLENNIUM FINDS Binghamton STEPPING TO THE FORE AS AN ENGAGED RESEARCH INSTITUTION, ACTIVELY INVOLVED IN SHARING THE FRUITS OF DISCOVERY . . .”

— Frances Carr, vice president for research

year, with more than 4,000 workers. In addition to bringing research acumen, scholarly creativity and students' vitality to the region, the University also pumps more than \$400 million a year into the economy, according to conservative estimates.

The commitment to putting research and scholarship to work for the public good is a hallmark of Binghamton University and speaks to the changing role of higher education, said Christopher Fynsk, chair of the Comparative Literature Department.

Fynsk is quick to point out that research is not just learning to build better widgets. It is also contributing to the great issues of our time.

“If you look at the public debate going on right now around human rights, gay rights or abortion, those discussions happening at the Washington level are deeply marked by discussions going on in the academy,” Fynsk said.

Likewise, perceived divisions between the humanities and the “hard” sciences are more and more being seen as contrived, inaccurate and counterproductive, he said.

“All of the world's major physicists have been deeply involved in philosophy,” he noted. “It's not just, ‘Wouldn't it be nice if we complemented the sciences with the humanities?’ I think the sciences *need* the humanities in order to work through some of their basic theoretical paradigms.”

Francis Yammarino, a professor in Binghamton's School of Management and co-director of the University's internationally acclaimed Center for Leadership Studies, agrees. Breaking down barriers and sharing knowledge is important for the University and its larger communities as well, he said.

“Even basic or fundamental research has to get out to the world, and I think that's the university's job,” he said. “I also think the

model that will work is integration and cross-fertilization. The model that will work is government-university-industry partnerships.”

The Center for Leadership Studies is using that model to apply research and scholarly pursuits to a statewide problem. New York is dealing with a serious shortage of public-school administrators — a situation that, without intervention, could worsen. A 75 percent turnover in superintendent positions is pre-

dicted within the next five years.

“These are \$100,000-a-year-plus jobs, and they can't get anybody to apply for them,” Yammarino said.

Partnering with 15 area school districts, the center is identifying and developing 25 to 50 high-potential teachers from a pool of more than 100 candidates.

“We'll give them the skills and show them how exciting it is to lead a system. Our solution is, we'll grow our own,” Yammarino said. The program is similar to an effort several years ago to train 400 community leaders in skills they could take back to non-profit and philanthropic organizations, as well as to business and government offices.

Richard D'Attilio, executive director of the Broome County Industrial Development Agency and director of economic development for Broome County, said the healthy and growing symbiotic relationship between the University and community strengthens both.

“We — Broome County, Binghamton, New York — are not Cleveland or Phoenix. We don't necessarily compete in the broader scope,” D'Attilio said. “But we need to get more sophisticated about how we grow our community. It seems to me that we can best do that by developing a better understanding of the University asset, by taking advantage of advice and counsel from the University about how to take that to the market, and by capitalizing on the investment opportunities it presents.”

To accomplish this, the University stretches public funding to fit new needs. For example, the IEEC was founded with National Science Foundation funding in 1992. But it no longer

receives NSF money. Instead, it is fully partnered with New York state as a Center for Advanced Technology and has eight full-time, 10 participating and 40 to 50 associate member businesses, said IEEC Director Bahgat Sammakia. Member businesses benefit from the work of 12 faculty members and 50 graduate students in disciplines ranging from engineering and computer science to biology, physics and chemistry. In many cases, the Univer-

sity becomes the *de facto* research and development arm of companies that might otherwise founder for lack of access to the innovations and improvements.

Matco, for instance, is an IEEC member company and a contract assembler of electronic PC boards. The company's Binghamton technology center reviews customer board designs with an emphasis on improving them through modifications in components or manufacturing processes. Help from the IEEC provides Matco easy access to cutting-edge diagnostic processes and equipment, as well as invaluable research and development support. That translates to significant new contract awards and new hires, said Welch of Matco.

Without the University, the company would be forced to turn to distant, costly and potentially less reliable commercial testing, he added. Private testing companies have been known to sacrifice accuracy in the name of profit margins, he said. But because the University is a public institution and because its motive is not to turn a profit, its reliability testing services are seen as, and have proven to be, more dependable than those of some private enterprises, Welch said.

Yammarino of the School of Management said he is proud of the University's innovation in helping the community.

“Think about it,” he said. “It's going to be government money, put together with University personnel in a way that will eventually produce start-up businesses offering products and services that will improve the quality of life and eventually generate new areas of research. I think it's a great model. This is public money invested for the public good.”

Rainbow's end

University's
role crucial
to company's
flat-panel
display success

At Rainbow Displays Inc. in the Glendale Technology Park, the handwriting is on the wall — displayed on a 36-inch prototype flat-panel display that seems likely within the next few years to forever change home entertainment, electronic advertising and computer displays.

What the handwriting spells out is “success.” Like a little-known and heretofore overlooked mountain climber, RDI, with the help of many base-camp team members from Binghamton University, has managed to scale to heights where the rarefied air of technological innovation has dropped bigger names to their knees. And the company — small but growing by geometric proportion — is poised to plant its flag near the summit of the \$60 billion worldwide flat-panel display market.

Key to the company's success, says Donald Seraphim, the company's senior vice president and chief technical officer, have been ongoing alliances between RDI and Binghamton University's Integrated Electronics Engineering Center and Thomas J. Watson School of Engineering and Applied Science. The IEEC's work with RDI has been supported by the National Science Foundation, said Baghat Sammakia, director of the consortium.

All of this helped RDI finalize a deal with Philips Electronics, a multinational company that last year boasted \$34 billion in sales. The agreement is expected to speed the development and marketing of large flat-panel displays, which RDI expects to begin manufacturing at a rate of about 100 per month by the middle of next year, Seraphim said.

Under the agreement, Philips will make an equity investment in RDI and provide 16 engineers in exchange for access to its technology and products. RDI will retain the rights to all intellectual property, including its patents, which now number 29 and counting. The company will also retain the right to manufacture the displays, which will be sold under the Philips name.

Using unique technologies that make possible the seamless “tiling” of smaller LCD panels into one large display, RDI has targeted one aspect of the flat-panel display market, focus-

ing on the development of displays 36 inches and larger. This is a market the company expects to hit \$5 billion within the next few years, and industry experts have conjectured that RDI's “tiling” technology may cut the cost of such large-screen displays from \$15,000 to about \$4,000, making the displays affordable to retail consumers.

Seraphim agrees.

“These are perfect for the home entertainment market,” he said of the displays, which already blend amorphous silicon technology, fluorescent lights and fine-tuned mechanical, electrical and computer software technologies to produce images of eye-popping clarity on a screen less than four inches deep.

Enhancements are expected to make the displays even brighter, clearer and more visible from every corner of a room by the time they hit the retail market in a few years, Seraphim said.

While the prototype is worth about \$1 million, the cost of producing the displays for sale is much lower and will decline at a rate of about 15 to 20 percent per year, he said, making it likely that the first home units will sell for between \$3,000 and \$6,000. They will also last indefinitely, as opposed to today's plasma-technology big-screen televisions, which tend to see deterioration in picture quality within five to 10 years.

Cathode-ray tubes found in today's televisions and monitors won't be of consequence in the large-display market. Cathode-ray tubes cannot be manufactured larger than 36 inches. Moreover, a cathode-ray tube television of that size weighs more than 200 pounds and is about 3 feet deep. RDI's flat-panel prototype weighs less than 50 pounds and is less than 4 inches deep.

In addition, the company's proprietary technology, covered by 29 patents, is scalable well beyond the size of the prototype and is capable of achieving much larger display sizes, higher resolutions and multiple “tiling” configurations for use in applications like outdoor advertising.

Supported by a \$200,000 National Science Foundation grant, IEEC researchers James Con-

stable, professor of electrical engineering, and Gary Lehmann and James Pitarresi, both associate professors of mechanical engineering, last year began a two-year project working with RDI. They have been successfully collaborating with RDI engineers to develop a way to effectively bond circuitry to glass panels that can perform in the temperature range generated by large-display panels, and to determine how to best place flexible glass over the assemblies.

"This is a sophisticated process that really needs a significant amount of analytical confirmation that the mechanisms are working properly," Seraphim said. "RDI, being small, just does not have that kind of analytical capability, or the skilled people to do those things."

Binghamton University has been key to the process of developing RDI's new display since the beginning, he added. Company and University engineers used specialized laser equipment on initial design analysis, he said.

In fact, Seraphim pointed out, the lines between RDI engineers and University engineers and students are not as clearly drawn as one might think.

Two of RDI's key team members are Binghamton alumni — engineering program manager Dean Skinner, PhD '91, and software development engineer Benjamin Bristoll '97.

Skinner is responsible for mechanical design, mechanical analysis and light-source development at RDI. He has more than 30 years' experience in the development of high-technology printer systems and electronic packaging components. He holds 10 U.S. patents, has 18 published inventions and has published 29 technical papers. He earned his PhD in mechanical engineering through the IBM Resident Study Program.

Bristoll is responsible for creating software tools that support image quality in the development of large flat-panel displays. Ultimately, it's his job to calibrate software in each display to match brightness and color across tiles and to get rid of seams in the picture. His initial involvement with RDI was as a part-time consultant while still an undergraduate in com-



puter science at Binghamton. He joined the company full time upon graduation.

RDI also has links with many Binghamton undergraduates, Seraphim said.

Watson School senior projects involve students in testing the reliability of components used by RDI and in developing quality measurement systems to establish the criteria for matching colors, brightness and image quality across the tiles. "We love your engineers," he said. "Binghamton is producing really excellent engineers."

This is not Seraphim's first alliance with Binghamton University. An IBM retiree, he worked as a consultant for the IEEC before going to work with RDI. While at IBM, he controlled a significant amount of money that went to joint University programs, he said.

"I've always realized the benefits that can accrue from such relationships. And it's proven again now, for sure," he said.

As RDI moves into larger quarters at the Glendale Technology Park, Seraphim said he expects the company's growth will make even more room for Binghamton graduates.

"Success," he said, with a smile, "lasts one minute. Then it's on to the next problem."

RDI MANAGING ENGINEER DEAN SKINNER, PHD '91, PROFESSOR JAMES CONSTABLE, UNDERGRADUATE JAIME WEIDLER AND RDI TECHNICIAN SEAN MURPHY CHECK EQUIPMENT USED TO CALIBRATE AND TEST THE FLAT-PANEL DISPLAYS BEING DEVELOPED AT RDI. THE LCD DISPLAYS ARE SCHEDULED TO GO INTO PRODUCTION AT RDI NEXT SPRING. THE DISPLAYS ARE MADE WITH A "TILING" TECHNOLOGY THAT COMBINES FOUR IMAGES INTO A SINGLE SEAMLESS ONE.

Concealed weapons

TINY TOOLS MAY HELP FIGHT DISEASE

You and everyone around you will probably develop cancer several times today. During the time it takes to read this article, in fact, your body will likely develop, recognize and eradicate at least one and possibly more cancer cells. It's standard operating procedure for the healthy immune system.

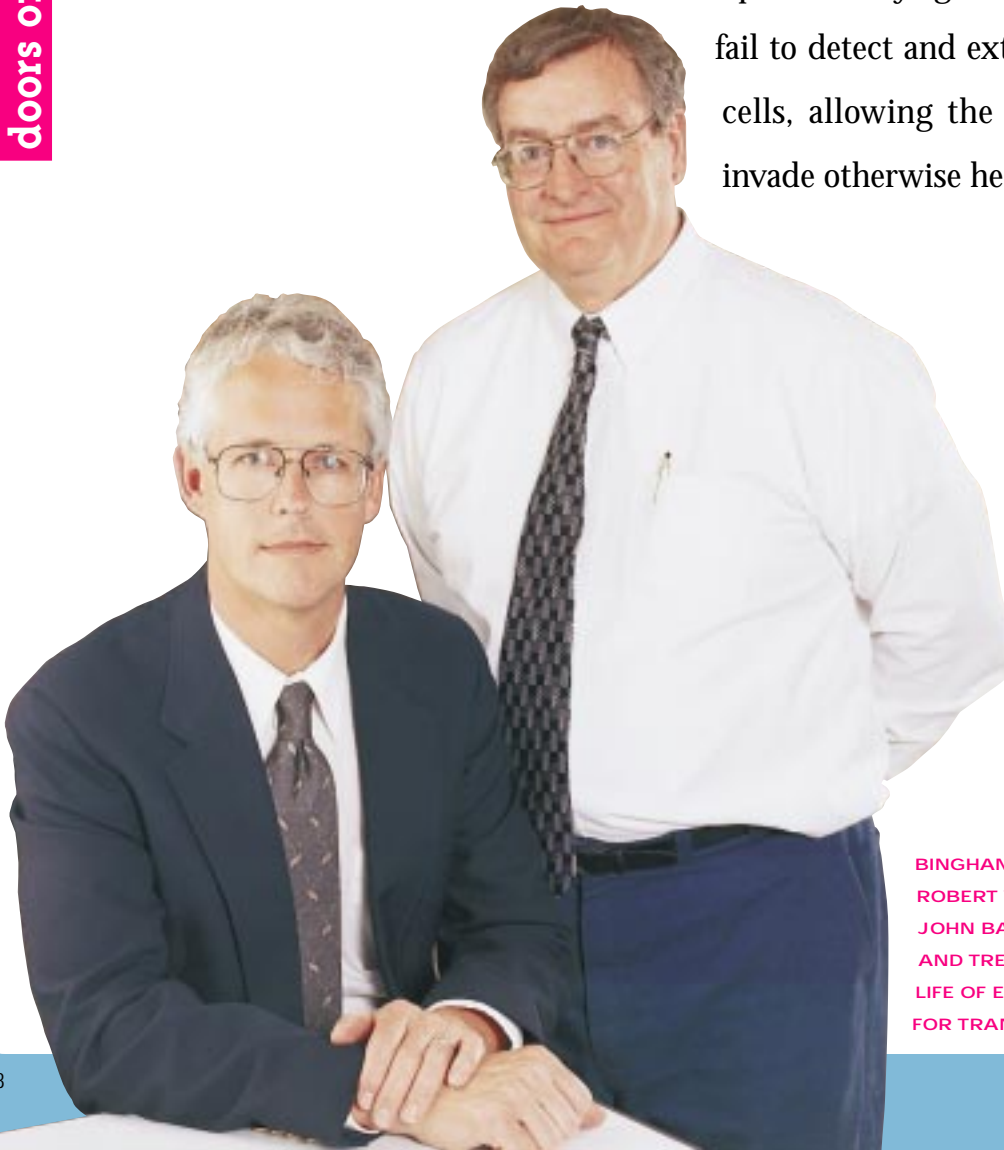
Cancer, after all, isn't the problem. The problem is that some immune systems, compromised by age or genetic or environmental factors, fail to detect and exterminate certain types of cancer cells, allowing the cancer to grow unchecked and invade otherwise healthy tissues and organs.

Using technology to help identify and eradicate cancers that the body fails to recognize and respond to is high on the list of priorities for researchers at Binghamton University's Institute of Biomedical Technology.

The IBT was recently tapped for a New York State Urban Development Corporation grant that will help move Binghamton to the national forefront of research institutions working to improve the diagnosis and treatment of diseases such as cancer, diabetes and Alzheimer's, said John Baust, IBT director.

The \$82,441 grant will go toward the purchase of a \$150,000 protein chip microarray processor. The equipment uses biological principles and computer and laser technology to

BINGHAMTON UNIVERSITY MOLECULAR CELL BIOLOGIST ROBERT VAN BUSKIRK (LEFT) AND CRYOBIOLOGIST JOHN BAUST COLLABORATE TO IMPROVE THE DIAGNOSIS AND TREATMENT OF DISEASES AND TO EXTEND THE LIFE OF ENGINEERED HUMAN TISSUES AND ORGANS FOR TRANSPLANTATION.



Through off-campus partnerships

with business and industry,

University researchers are

increasing their efforts to see

that basic science is more quickly

used to improve the quality of

daily life in the larger community.

screen small-volume fluid or tissue samples for disease by tracking the protein “fingerprint” of cellular activity at the molecular level. This affords researchers a “ground zero” look at disease processes. The technology is so new that the equipment could not have been purchased at any price just last year, Baust said. Only a limited number of processors are in operation in the United States today, he added.

From fraction-of-a-drop blood or tissue samples, researchers using microarray technology will be able to identify different types of cancer based on the inevitable protein fingerprint left by cellular interactions. Postage-stamp-sized protein chips that match the protein profile of different kinds of prostate and breast cancer and Alzheimer’s disease have already been developed, Baust said.

“When we talk about prostate or breast cancer, we often talk about them generically,” Baust noted. “But it’s not just one cancer. It’s classes of cancer — many dozens of classes, in some cases — and not all cancers respond to certain therapies. You can treat cancer much more effectively if you know what kind it is.”

Using the protein chip microarray processor, Binghamton researchers will be some of the first in the country to begin isolating and identifying other protein fingerprints that will speed the development of protein chips to be used in the diagnosis of specific types of cancer and other major diseases, he said.

Another important use of the equipment will be to improve preservation of human cells, tissues and organs for transplantation, Baust noted. In partnership with the Diabetes Research Institute of the University of Miami, Binghamton researchers are specifically looking for ways to improve the preservation of pancreatic islets. The islets are clusters of cells that produce insulin and control glucose metabolism. In what amounts to a minimally invasive organ transplant, islets are harvested from a donor, isolated from the pancreas and injected into the liver of the recipient, where

they take up residence and begin producing insulin, Baust said.

“This is a leading-edge approach to treatment of diabetes and transplant science,” he added.

Matching funds for the equipment purchase will come from BioLife Solutions, Inc., the University’s first incubator. Baust and his research partner, biologist Robert Van Buskirk, are principals in the company, which was incorporated in 1998.

Acquisition of the microarray processor will position the University to more completely realize its vision in regard to biomedical technology, Baust said. Faculty from the life sciences and engineering for several years have been establishing rewarding cross-disciplinary partnerships, working with each other and with off-campus associates, always with an eye toward economic development in the region, he said.

“We’re trying to do something different,” said Baust. “We’re not trying to simply get this kind of technology here so that we can do basic research, although basic research is of course important. We’re trying to bring the technology in so that it forms a building block or magnet to attract other biotech industry to the area.”

More than 37 University faculty members from fields as diverse as math, biology, physics, engineering, chemistry, nursing and psychology are working on biomedical applications and issues, with a particular focus on life

processes, human and artificial tissues and the ways that technology can support the life sciences, said Vice President for Research Frances Carr.

In the past three years, Binghamton faculty have been awarded more than \$11 million in grants related to biotechnology and have submitted an additional \$36 million in pending applications, she added.

Richard D’Attilio, executive director of the Broome County Industrial Development Agency and director of economic development for Broome County, said

he is excited about the promise inherent in University efforts to help develop a regional biotechnology industry.

“One of the big challenges is always the difficult stage of development when venture capital and seed capital is required,” D’Attilio said. “It’s a chicken-and-egg situation. We could probably attract venture capital into this community if we had enough opportunities to pursue.”

Provost Mary Ann Swain said acquisition of the protein chip microarray processor is exciting and in keeping with the University’s expanding role in biotechnology and in technology transfer as a whole. Through off-campus partnerships with business and industry, University researchers are increasing their efforts to see that basic science is more quickly used to improve the quality of daily life in the larger community, she said. At the same time, access to equipment like the microarray processor will give students unparalleled educational opportunities and enhance Binghamton’s recruitment of the best and brightest students, she noted.

Baust and Van Buskirk expect to acquire a DNA microarray processor for the IBT by year’s end. Theoretically, DNA processors will allow scientists not only to see what is going on in the body in the present day, but also to determine from infinitesimal tissue samples what diseases infants could be troubled by 60 or more years into their lives, making possible early and lifelong interventions.

An intellectual capitalist

PROFESSOR'S CONNECTIONS
LINK UNIVERSITY WITH ADVANCED
LASER EQUIPMENT



The entrepreneurial spirit of a professor

who came to the United States 20 years ago as a political refugee from communist Russia is at the heart of a deal in which the U.S. Air Force is lending about \$1 million in laser communications equipment to Binghamton University's Research Foundation.

Though the terms of that agreement call for the University to move the equipment to campus only when space and funding allow, it seems clear that if Victor Skormin has anything to say about it, that will happen sooner, not later. Talks are already under way that could see the equipment permanently donated to the University.

Skormin, a professor in Thomas J. Watson School of Engineering and Applied Science's Department of Electrical Engineering, has already secured a \$400,000 National Science Foundation grant to develop satellite communications as a supplement to the school's electrical engineering curriculum. Monish

Chatterjee, associate professor of electrical engineering who specializes in electro-optics, is the co-director of that project.

Lasers come in two types: power lasers and communications lasers. The lasers commonly portrayed in movies cutting through doors of solid steel are power lasers. Communications lasers use much less power — just enough to carry the ones and zeros that constitute the coded message. They do no physical damage but must be very accurately aimed to do their job, which is where Skormin comes in.

His areas of expertise include modern control theory and applications, process control, adaptive control, optimization techniques, mathematical modeling and computer simulation.

That makes the Skormin-Chatterjee alliance an ideal match for the new curriculum. Skormin can teach students how to control lasers and oversee research aimed at finding new ways to point them with the accuracy necessary to transmit data to a moving target like a satellite or jet airplane across a thousand or more miles. Chatterjee can teach students about the electro-optical properties of lasers.

One such property is that communications lasers stay within a very narrow angle across many miles and never diverge or divert, making the information they carry very secure and making laser communication particularly interesting to the military, Skormin said. Satellite communications, particularly free-space laser communications, is the only technology capable of meeting the demands of today's communications revolution, he explained. That's because laser communication allows for the secure transmission of 2.2 gigabytes of data per second — essentially the contents of a complete hard drive — in the blink of an eye.

"When a military airplane is flying toward the target, it wants, every 30 minutes, and sometimes every 15 minutes, to get a complete update on weather, targets, support and changes in assignment," he said. "With laser communication, they will be able to shoot a

VICTOR SKORMIN, ELECTRICAL ENGINEERING PROFESSOR, HAS ALREADY SECURED A \$400,000 NATIONAL SCIENCE FOUNDATION GRANT TO DEVELOP SATELLITE COMMUNICATIONS. NOW HE HAS THE U.S. AIR FORCE AGREEING TO LEND \$1 MILLION IN LASER COMMUNICATIONS EQUIPMENT TO THE UNIVERSITY.

Satellite communications, particularly free-space laser communications, is the only technology capable of meeting the demands of today's communications revolution.

'bullet' — a burst of laser energy that will carry enough information for a complete update for the pilot, and will be virtually impossible to intercept. Then, for the next 15 minutes, there will be nothing, and then they will send another pulse."

Skormin holds an MS in electrical engineering from State Polytechnic Institute, Alma-Ata, USSR, and a PhD in control engineering from the Institute of Steel in Moscow. Since his arrival in the United States on January 23, 1980 — a day he refers to as his personal "Columbus Day" — he has regained both his profession and his son, who now owns a successful dental practice in Buffalo.

When Skormin left Russia in 1979, his son was 9, and Soviet authorities claimed that he would never see the boy again. But times changed, and his son came to the United States at the age of 18. He then "put a lot of effort into turning him into a nice American gentleman," a goal Skormin is proud to say his son has achieved.

Before coming to Binghamton, Skormin worked as an associate professor at Rochester Institute of Technology and as a consultant to Eastman Kodak and Milton Roy companies in Rochester. In November 1999, his last employer in the USSR, Kazak National Technical University, awarded him the title of honorary professor.

Lately, Skormin's efforts have focused on bringing the loaned satellite communications equipment to the University. Due to his efforts, some of it has already been moved and is being used by a handful of graduate students.

But Skormin knows it's going to take more money and more space to provide a home for the rest of the equipment.

"Eventually, I plan to bring all this equipment to Binghamton," he said, "so we're writ-

ing more proposals."

His recent negotiation with the Jet Propulsion Lab of NASA has resulted in the lab's commitment to contribute \$50,000 in research funding to Skormin and Chatterjee. He has also secured an additional \$50,000 from the Air

Force and expects another \$100,000 to \$200,000 from the same source in "the nearest future," he said.

"Also, on the back burner I have another call for proposals from NSF on the development of new educational technologies," Skormin added. "By fall we should be able to offer someone in Australia or any place in the world the opportunity to access our very expensive laser communications equipment — which they would never get a hold of on their own — through the Internet," he said. "And if this is not a new educational technology, I don't know what else is. It would not even be a 'virtual' lab, because they will be driving and tracking the actual physical equipment across the Internet."

Skormin is a senior member of the Institute of Electrical and Electronics Engineers and a member of the American Society of Electronics Engineers. He is a 1999-2000 senior researcher at the Air Force, appointed by the National Research Council.

Skormin has collaborated with the Air Force Research Laboratory in Rome, N.Y., on laser communications research since 1992. During that time he has graduated two doctoral students who specialize in satellite communications and who also worked with him at the Rome lab for a time.

"This is how I became known at Rome Lab," he said. "Because this particular line of research was closing at Rome and because they had this very sophisticated equipment and wanted to see the research continue, they

loaned it to me under this special agreement.

"My dean told me in order to bring the equipment here, I would have to get a sizable grant which would allow him to make modifications in the Watson School and give me the personnel and so on," Skormin said.

Watson Dean Lyle Feisel, who called Skormin a well-trained engineer and a creative and imaginative researcher, isn't surprised that Skormin took his challenge so seriously.

"When Victor decides he's going to do something, he just goes out and does it," Feisel said. "In fact, the only thing that would surprise me about Victor is if he didn't surprise me from time to time.

"He's a jewel," Feisel added. "If he were in Russia today and was not honest, he'd be a millionaire."

In addition to the other grant proposals he has in the works, Skormin expects to team with Jose Delgado-Frias, associate professor of electrical engineering, and Dennis McGee, associate professor of biology, on a project that stands an excellent chance of securing \$450,000 in Air Force funding. That project, titled Biological Approach to System Information Security (BASIS), would explore a new paradigm for protecting communications systems, including the Internet, Skormin said.

"Just like biological systems, communications systems are highly interconnected and have many entry points," he said. "Because of this it is really easy to put a malicious program in the system or destroy the whole system through some kind of unauthorized access."

Skormin's proposal is to work with Delgado-Frias and McGee to develop an artificial immune system capable of evolving in response to exposure to "pathogens" like computer viruses and hacker attacks, in much the same way that biological immune systems develop immunity to viruses and bacteria. This approach would attempt to use "natural" defense strategies developed in biological systems over millions of years of evolution.

Surreal estate

MOLECULAR ARCHITECTURE
CREATES DESIGNS FOR A
NANOMATERIAL WORLD

IMAGINE a house that builds itself to your design specifications. Imagine, too, that its self-erecting walls come replete with electrical wires and switches and that the circuits are all completed as soon as the building, which boasts as many rooms and floors as you desire, finishes assembling itself.

Finally, imagine that this “house” is so small that it can’t be seen, even with the aid of a high-powered microscope, and you will have some idea of what chemist Wayne Jones and his Binghamton University research group are up to.

Though neither Jones nor his students are architects by training, they are working on the design of an edifice that, despite its infinitesimal size, could change the face of the modern landscape more dramatically than any of the world’s tallest buildings.

Like players in a high-stakes, three-dimensional Tetris game, Jones and his research team are using their knowledge of molecular bonds to devise self-assembling molecular architectures that will ultimately afford them control over the physical and electronic properties of the materials that result.

Once the process is refined, probably within the next three to five years, it will require only a small step to build the aforementioned molecular house. And because the self-assembling walls of that “house” will contain all the necessary molecular wires and switches to conduct and control the flow of electrical current through the material, its potential uses are mind-boggling.

When it is honed, in fact, the process and the materials that result from Jones’ research could spur quantum leaps in the electronics industry — from previously impossible breakthroughs in biosensors to an unprecedented wave of miniaturization in microelectronics.

Exactly how “micro” could microelectronics become if Jones and other researchers in his field are successful in developing and refining nanomaterials of this ilk?

“The current PC would fit on the tip of a finger,” Jones said.

Jones and his group are working to optimize specific molecular interactions so that larger molecules will bind together in ordered groups with desired properties, eventually forming a complete material built “from the ground up” according to the researchers’ plans.

Their work falls under the heading of nanotechnology or nanomaterials research. That means it involves molecular components of one billionth of a meter or less. The process



PHD CANDIDATE DAVID SARNO, RIGHT, AND CHEMIST WAYNE JONES WORK ON A MOLECULAR ARCHITECTURE EXPERIMENT IN JONES' LAB IN THE SCIENCE II BUILDING. ULTIMATELY, THE WORK COULD SPUR A NEW WAVE OF MINIATURIZATION IN THE FIELD OF MICROELECTRONICS.

they are working with is aptly known as “dip chemistry.”

“Our approach is actually to start with a bare silicon surface or a metal surface and then, on a molecular level, to begin building on that surface,” Jones said. “In essence, we’re just dipping the substrate into solutions that contain the molecules, and the molecules line themselves up and build one layer at a time — binding layer, spacer layer, floor layer — all built on top of each other to create an architecture.”

Working on such a small scale is nothing new to chemists, Jones noted. Molecular bonds generally are on the order of one-tenth to two-tenths of a nanometer.

“Every chemist studies things in nanoscale,” he said. “It’s funny. Everyone else is trying to go smaller, but I think what is really exciting for chemists is to take what we know about small interactions and to get them to go bigger. We understand how Atom A and Atom B come together. Now we’re trying to get thousands of them to come together in an organized three-dimensional technology.”

Among other things, Jones’ group is working with polymer materials that will self-assemble into an adhesive that could eventually eliminate the need for lead solder in circuit board assembly.

“What we’re doing is completely and radically different from all the production processes in industry today,” said David Sarno, who has worked with Jones on the project since the spring of 1998.

Local industry has been supporting Jones’ current project through a collaborative grant from the Integrated Electronics Engineering

Center (IEEC) for the past year. Working with Biological Sciences Professor R. Stimson Wilcox, Jones is exploring application of self-assembly involving biological adhesive model systems. The IEEC receives funding from the New York State Science and Technology Foundation, the National Science Foundation and a consortium of industrial members.

Because the process Jones is using to assemble molecular architectures begins with a silicon substrate, the task at hand could be likened to building a tiny house on a bed of sand. And though traditional allegories suggest the foolhardiness of such an undertaking, Jones and his associates have no worries about the stability of their substrate because of the small scale of their work.

“What makes sand seem loose to us is that there are lots and lots and lots of grains in a sand pile or on a beach, where we typically experience sand,” Jones noted. “In our case, the sand is stable because, in essence, we’re building on a single grain, which, given the relative dimensions, might be the equivalent of saying we’re building on the state of New York.”

Necessity may be the mother of invention . . .

but if Wayne Jones’ current research project is any indication, serendipity is the midwife.

After all, it was an experiment by an undergraduate student — an experiment that Jones thought had no hope of succeeding — that turned his research team down the promising path of molecular architecture it is currently exploring.

“It was luck that this experiment worked when statistics said it wouldn’t work,” Jones said. “Even the materials [the student] was using said it wouldn’t work. And I certainly said it shouldn’t work.”

The Binghamton researchers are now convinced that the student’s initial experiment in multi-layer molecular architecture succeeded only because he happened to conduct it during the dead of a Binghamton winter,

when the humidity was extremely low. All attempts to replicate the experiment failed for the next nine months, until researchers decided to try conducting it in humidity-controlled conditions.

“Basically it worked in the middle of winter, and if he had done the same experiment in the middle of the summer, it almost certainly would not have worked and we would not be talking about this stuff today,” Jones noted.

An initial failure in the experiment would have surprised no one and, probably, no further thought would have been given to the matter. Instead, researchers were confronted with the one-time success of the experiment and the hunt was on to explain it and replicate it.

Brain Food

Researcher links glucose and mental function

PSYCHOLOGIST PAUL GOLD'S RESEARCH PROVES THAT A 50-YEAR-OLD THEORY ABOUT THE BRAIN'S USE OF GLUCOSE IS WRONG. BECAUSE OF HIS WORK, STUDENTS COULD SOON BE EATING THEIR WAY TO BETTER GRADES OR IMPROVED MOTOR SKILLS, AND THE ELDERLY COULD BE OFFSETTING AGE-RELATED COGNITIVE DEFICITS OR MEDIATING THE EFFECTS OF DEMENTIA WITH A PILL.



Though his image is unlikely ever to grace the front of a Wheaties box, Paul Gold's work brings researchers that much closer to devising a real "breakfast of champions," and promises to alter significantly the way we think about nutrition and its relation to cognitive functions.

More than that, as a result of his research, students could soon be eating their way to better grades or improved motor skills, and the elderly could be improving age-related cognitive deficits or mediating the effects of dementia with a pill.

By working with rats in a maze, Gold, a Binghamton University psychology professor, recently showed that a 50-year-old theory about the brain's use of glucose, a simple sugar that is the brain's primary energy source, is wrong.

An article based on Gold's research, which was performed with two students, Ewan McKay and Thomas Fries, recently appeared in the *Proceedings of the National Academy of Science*, a prestigious journal.

Unlike traditional views that suggest the brain can be seen as a single compartment that always has supplies of glucose adequate to its needs, Gold's work shows that at least one area of the brain — the hippocampus — experiences a depletion of glucose supplies during the performance of complex cognitive tasks.

His research also shows that the extent of the drain is proportional to the complexity of the task as experienced by the individual. In other words, while it might take something akin to a complex calculus problem to cause significant glucose drain in the brain of a college student, an Alzheimer's patient might experience the same effect while trying to open a carton of milk.

"In fact, while it certainly is true that it's possible to improve cognitive function in healthy people," Gold said, "it could be that dysfunction actually generates the best conditions for significant improvement."

The changes Gold sees during the training of rats on a maze are localized to brain areas that are involved in processing that particular

kind of information. Because similar and simultaneous changes do not occur elsewhere in the brain, it is safe to say that the brain can no longer be accurately viewed as a single compartment, he said.

"The brain can, in fact, use up glucose in a region-specific manner, depending on the brain activity of the moment," he noted.

A new analogy suggested by Gold's research is that of the brain as a complex landscape of plateaus and enclosed basins, or sinks. While a steady "rain" of glucose keeps the basins generally full, complex tasks that call upon a specific region of the brain seem to "pull the plug" on that basin and allow its resources to drain away. Once the cognitive demand eases, the plug drops back into the drain and the basin refills.

What Gold's research shows is that supplementing systemic glucose reserves with additional glucose is like pumping water into an emptying basin with a fire hose. Glucose depletion and its negative effects on cognition can be mitigated, even during times of ongoing cognitive demand.

These recent findings substantiate Gold's past results, which showed that glucose enhances learning and memory not only in rats but also in many populations of humans, including healthy elderly subjects and subjects with Alzheimer's disease.

"This research may lead to changes in views about nutrition and education," Gold said. "One implication is that the cognitive effects of the content of meals might become a consideration important in designing school breakfasts and lunches."

Glucose levels in the brain fluctuate after a meal. Initially, they rise, but then, particularly if the meal contained a high sugar content, they dip into the hypoglycemic range. Parents and school officials may want to take into account the timing of classes relative to meals when planning children's class schedules, Gold said.

"Do you want your child going hypoglycemic in terms of brain function just before algebra, or do you want it just before gym? I think those are questions individual families



would have to decide," he said.

Some families might actually prefer to send their children to gym at their peak cognitive state because they might value the motor skill learning that goes on there more highly than algebra, he added.

Even though Gold isn't sure what the "breakfast of champions" will look like, he knows it will not be chocolate, or any other source of glucose that contains or is accompanied by the ingestion of a lot of fat. Fat, which is common to the traditional American "big breakfast," blunts the glucose response, thereby negating the cognitive benefits of the meal, he said.

"I also want to make sure that no one thinks I am suggesting that they just feed their children glucose for breakfast," he said. "That's not what I'm saying."

Like almost every drug that improves cognitive function, glucose has an "inverted-U" dose curve, he said. That means that as the dose increases, cognition gets better and better, until it reaches a peak and begins getting worse and worse. The inverted-U curve is empirical proof of what most people learn fairly

early in life: You can definitely get too much of a good thing.

So, while Snickers bars or Oreos will certainly not meet the definition of a proper breakfast, and while Gold thinks that definition still needs a lot more work, he is confident that guidelines will be discovered and quantified eventually.

"One of the first constraints could be to think of a proper breakfast not only in terms of overall health, but also in terms of cognitive functions," he said. "And I don't think those will prove to be mutually exclusive. I think you can probably do both at once."

As they attempt to derive the formula for a proper breakfast, Gold said researchers will also have to take into account individual differences in biochemistry and meal-to-meal interactions. That's because what you had for breakfast will determine your glycemic response to lunch more than what you eat for lunch, he said.

As a result, if the goal is to maintain the optimal level of glucose to support cognitive functioning throughout the school day, whole-day meal plans will likely be needed, Gold said.

In addition to showing that the hippocampus, a brain area that controls and affects learning and memory, is depleted during complex

problem solving, Gold's research shows that when glucose levels are replenished in parts of the brain that are involved in cognition, the performance of cognitive tasks is significantly enhanced.

In studies with healthy elderly and college students, when their baseline morning glucose level was supplemented with glucose prior to testing, participants in both groups showed an average 30 to 40 percent improvement in individual performance on standardized memory tests modified to an appropriate level of complexity for each group.

In similar research, Alzheimer's patients were tested with a much simpler version of the standardized memory test, and scores as

much as doubled when the patients were given glucose, Gold said.

"Of course, to keep that in perspective, these were Alzheimer's patients who were performing at 20 percent and who improved to

40 percent," Gold noted. "There's a long way between that and normal."

Nevertheless, Gold admits that he sees the most likely and immediate implication of his work as the probable development of a drug strategy that will either mimic the effects of glucose or act at the same level to control glucose depletion.

"I personally think that there is a promise for change in the quality of life for Alzheimer's patients. Given the robust enhancement of memory we and others have seen in experimental settings with humans, an understanding of the cellular mechanisms by which glucose acts to modulate brain functions may lead to new classes of treatments for memory problems that plague seniors," he said.

Gold doesn't think glucose will be the treatment of choice because it would require complex coordination of the entire lifestyle of dementia patients, he said.

"That's too complicated. The more likely product of this research is the development of pharmacological strategies," he added.

A whole class of drugs was developed for the treatment of diabetes, for instance. Those drugs act on the pancreas, which regulates the release of insulin based on available glucose. A similar pharmacological approach could conceivably work on the brain, he said.

"I don't know if that's the right model or not. But I think it's safe to say that cell biology is the real key."



Challenging preconceptions

Does “teacher thinking”
result in biased classrooms?

Before embarking on her career in higher education, Monica Miller Marsh, an assistant professor and supervisor of student teachers in the School of Education and Human Development, spent six years teaching in elementary school classrooms.

In teaching at public schools straddling an urban-suburban border, she came face to face with systemic inequities in educators’ treatment of children and found herself more and more troubled by what she saw. Though charged with teaching such principles as democracy and justice, the schools did not appear to practice what they preached.

For instance, one of the schools in which she taught included very few black students

in its gifted education program, even though the student population was 70 percent African American.

“When I walked into my gifted education class and saw so many white faces, I thought, ‘I cannot accept this,’” Miller Marsh said. “‘I cannot accept that there are so few African American kids, whom I know are articulate and bright, in this program.’”

Miller Marsh found the administrators of the schools closed to change. But that didn’t keep her from becoming a staunch advocate

for anti-bias curriculum — a curricular approach created by Louise Derman Sparks in 1989 to address issues of race, class gender, physical ability, sexual orientation and religious diversity with young children.

Even as a kindergarten teacher, Miller Marsh embraced Sparks’ approach because it challenged two preconceived notions that she thinks still keep too many teachers from talking to children about these important issues.

“Some people think that children are innocent and color blind and too young for this,” she said. “Teachers are also sometimes afraid to talk about issues of race, class and gender because they don’t know how to talk about them. It’s not something we talk about, even as adults.”

Miller Marsh knows firsthand that the preconceptions of classroom teachers can undermine the implementation and success of any curriculum, no matter how needed or well developed. She has been researching the impact of teacher choices on students for a number of years.

As a result, though still a vocal champion of anti-bias curriculum, Miller Marsh has turned her more immediate attention and research to the seemingly mercurial issue of “teacher thinking.”

Today, when Miller Marsh expresses concern about the biases that teachers bring to public school classrooms, she isn’t talking about individuals acting out biases they obtained from processing family and general life experiences — people with their own ax to grind. Instead, she forwards the more controversial postulate that teacher thinking is not by and large defined at the level of the individual at all. Although much of traditional teacher education research has focused on individual teachers, she claims, teacher thinking is more clearly shaped and defined by the discourses inherent in teacher education itself.

“I don’t think teacher thinking is individual,” she said. “I believe that it’s social. I believe that teachers use the language and the actions that are based in the history of early childhood education — say, the discourse of child-centeredness.”

MONICA MILLER MARSH BELIEVES
“TEACHER THINKING” IS SOCIAL, NOT
INDIVIDUAL, AND THAT PHILOSOPHICAL
PARADIGMS COMMON TO THE PROFES-
SION NEED TO BE EXPLORED BEFORE
TEACHERS CAN EFFECTIVELY SUPPORT
ANTI-BIAS CLASSROOMS.

That discourse, which may be one among hundreds, is still the prevalent discourse in early childhood education today, and provides a very solid history that tells us how we should speak and act with young children, Miller Marsh said.

"It's a history that is embedded in the profession of teaching and the whole teacher education process. And in order to become a member of the teacher education community or the early childhood education community, you have to take that language on. You have to take that discourse on."

That's a problem, Miller Marsh suggests, unless teachers are aware that they have bought into such discourses and are alert for the ways in which those discourses are affecting their choices.

One example of this, Miller Marsh said, is the concept of "readiness." On one hand, teachers educated to primarily favor the dis-

course of child-centeredness will resist introducing a child to new challenges until they think the child is "ready." This discourse presumes that development precedes learning, and that indeed children cannot learn until they have reached an appropriate level of development.

"Now, if you're a middle-class student and you come to school and you've had a lot of advantages at home, you're obviously going to be 'ready' for a lot more than some of your lower-income counterparts who don't have the same resources," Miller Marsh said.

On the other hand, teachers trained predominantly in a socio-cultural discourse, based on the principles of collaboration and rooted in the idea that development and learning can happen in tandem or that learning can happen in advance of development, will always be more comfortable presenting children with slightly challenging information to "push"

them along, she noted.

"If I'm coming from this approach," Miller Marsh said, "I don't say to my class or to particular students in my class, 'You can't read yet because you're not ready.' I say, 'Here's a book; let's stretch you.' And the more advanced students and the teacher work to support the less advanced, which benefits all.

"My feeling is that we need to produce teachers who are multi-discoursal, who can pick up all these different discourses and use them to create possibilities for themselves and for children and families," she said. "No matter what curriculum is available, if a teacher has preconceived notions against it, you can be sure the curriculum won't be implemented as it was meant to be."

When teaching prospective teachers, Miller Marsh often resorts to children's books to illuminate the issues, she said. A book called *Yolanda's Genius*, for instance, is a poignant story about a fifth-grade African American girl who thinks her younger brother is a genius, even though his teachers have labeled him as learning disabled.

"We look at him through the various discourses and talk about how different possibilities open up or close down for Yolanda's brother based on which discourse we are using," Miller Marsh said. "We talk about the possibility that he could be both learning disabled and a genius, and see how different discourses support these conclusions."

What Miller Marsh is committed to doing, both in the classroom and in her writing, is to provide opportunities for prospective and practicing teachers to look at how their thinking affects the lives of the students entrusted to their care and guidance.

"My hope would be that people become aware of the discourses and the ways they open things up or close them down, and then that that awareness leads to responsible choices," Miller Marsh said. "I don't want teachers going into the classroom blind to these influences. I want them to think more deeply about what kinds of identities they're making available for kids based on the discourse they are teaching from."



Tracking human evolution

Anthropologist travels the world to unravel clues



For the past 31 years, G. Philip Rightmire has been chipping away at mysteries as old as time, studying people as old as dirt. A Binghamton University paleoanthropologist and one of the world's foremost experts on *Homo erectus* and the Middle Pleistocene era, Rightmire makes no bones about the fact that he doesn't plan to give it up anytime soon.

"I expect I have at least another decade in me," he said. "There will always be more questions, more fossils, so there's no end to it, really. I'll just have to quit eventually, and probably without much resolution of the big problems."

Until then, Rightmire intends to "chip away at this *Homo heidelbergensis* business," the latest focus in his career-long exploration of human evolution and prehistory.

His is a passion that has taken him to Africa and back more than 20 times, and to France, Spain, Germany, Indonesia, Japan and China on more than a few occasions. His reputation is as international as his travels, and his expertise has made him one of the "go-to" guys whenever a new Pleistocene fossil or *Homo* skull is found.

Last spring, for instance, when *Science* published an article on the discovery of fossils of a previously unknown pre-human species in

Ethiopia, a *Los Angeles Times* science writer let his fingers do the walking directly to Binghamton to see what Rightmire made of the whole thing.

Last fall, when an unidentified man sold a *Homo erectus* skull to a scientific curiosities shop in New York City, the proprietor fortunately recognized the skull as important, which was validated by the American Museum of Natural History. Rightmire, however, was the expert *The New York Times* contacted to confirm the identity of the skull as one of a handful of Java Man skulls excavated in Indonesia. As a result, "the skull was very quickly returned to Java where it belongs," Rightmire recalled.

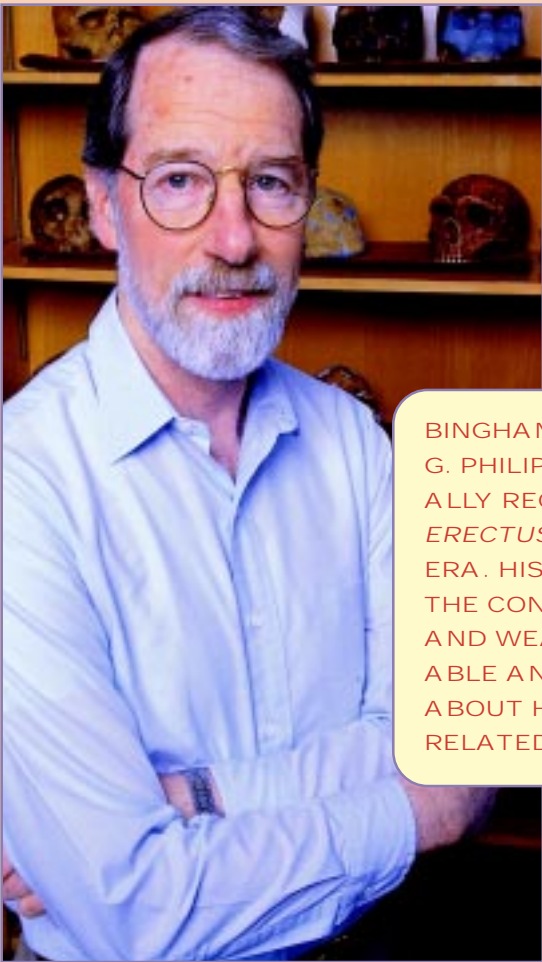
These incidents were far from the first and hardly the last of their kind for Rightmire. For the past 20 years, almost any time an important new human or pre-human fossil has been discovered, he has been asked by newspapers the world over to comment on the discovery.

"It's exciting," Rightmire said of his work. "I don't tend to read a lot into it in terms of philosophy. I don't think that knowing about our prehistoric past is going to help us direct our future more intelligently, for instance. The rules of the game are a heck of a lot different now than they were 400,000 or 500,000 years

ago. But it's an area of science I find intriguing."

One of the biggest ways in which the rules of the game have changed, according to Rightmire, is that speciation can no longer be expected to decide our communal destiny.

"We're not going to evolve anymore in the way humans and other animals have done through the ages and in the way that other animals will continue to do," he said. "There isn't the scope for speciation among humans any longer. It's not possible in this age of globalization for a group of people to become isolated from all the rest over the long term and



BINGHAMTON PALEOANTHROPOLOGIST G. PHILIP RIGHTMIRE IS AN INTERNATIONALLY RECOGNIZED EXPERT ON *HOMO ERECTUS* AND THE MIDDLE PLEISTOCENE ERA. HIS WORK INVOLVES MEASURING THE CONTOURS OF FOSSILIZED SKULLS AND WEAVING TOGETHER, FROM AVAILABLE ANATOMICAL EVIDENCE, STORIES ABOUT HOW VARIOUS POPULATIONS ARE RELATED TO ONE ANOTHER.

to evolve new characters and thus speciate."

While the specific implications of this are unclear, it seems certain that from here on, humans will have to cope with environmental changes like global warming not by evolving biologically, but through technological development, he said.

Rightmire talks about evolution in general as a "bush-building" process in which many potential ancestors of modern humans failed to make the evolutionary grade and died off, some after producing "daughter lineages" that were more or less successful.

As he sees it, evolution was a process of experiments that progressed "in fits and

sputrs." He rejects the traditional model of straightforward progression that suggests one species followed immediately on the heels of another, with each successive species enjoying increases in brain size, reduction in the massiveness of the facial skeleton, shortening of the tooth row, smaller teeth and similar refinements.

"I'd argue that that's just the sort of thing that did not happen," Rightmire said.

Careful not to take credit for the bush-building idea, he is quick to make it clear that he wasn't the first to think of evolution in this way. "But I've been happy with that perspective for about as long as anyone active in the same area," he admits.

Homo heidelbergensis, Rightmire believes, is the species that gave rise to *Homo sapiens* — people more or less like us — 100,000 to 200,000 years ago in Africa. Evolving from *Homo erectus* about 600,000 to 700,000 years ago in Africa, *Homo heidelbergensis* followed *Homo erectus* out of Africa and, with a better command of fire and tools, spread into Europe, where glaciation made the landscape and cli-

mate untenable for *Homo erectus*, who did not have control of fire.

In Europe, Rightmire conjectures, one branch of *Homo heidelbergensis* became isolated or semi-isolated as a consequence of cyclical glacial encroachment and retreat. The population that was essentially trapped in Europe for the long term evolved more in the direction of the Neanderthals, as evidenced by "a pretty good progression of fossils" found in Europe, he said. That fossil record shows the presence of Neanderthals about 100,000 to 200,000 years ago.

Meanwhile, during the same time frame, another branch of *Homo heidelbergensis* in Africa, not subjected to the cold conditions that prevailed in Europe, seems to have evolved in another direction and given rise to *Homo sapiens*.

Neanderthals probably co-existed in at least some parts of Europe with more modern hu-

mans, Rightmire said. There was almost certainly a period during which the two species might have come into contact with one another. And while debate rages about whether interbreeding took place, DNA testing on the remains of the first Neanderthal discovered in the Neander Valley of Germany in 1998 seems to suggest that Neanderthals were "specifically distinct from us," Rightmire said. Similar DNA results announced earlier this year corroborated the earlier results.

"The Neanderthal DNA turned out to be quite different from average human DNA," he said. "A lot more than you would expect to see between Eskimos and Europeans or Australians and Africans, and more on the order of difference between humans and chimps."

Rightmire's work is in large part "a historical exercise . . . a matter of trying to work out all this complicated evolutionary history," he said.

He believes, for instance, whether or not Neanderthals are considered a distinct species, that they died out and were never significant competitors for the evolutionary success enjoyed by more anatomically modern humans.

Still, despite its often sweeping historical scope, Rightmire's work begins with and progresses by means of minute details: the measurement of the contours of the skull, the shape of the orbit, the slant of the cheek and the configuration of the teeth, palate and jaw.

Like a forensic pathologist attempting to identify a victim based on dental records and skeletal clues, Rightmire relies on calipers, tape measures, x-rays and CAT scans to learn more about the fossils that are his stock in trade. The approach is the same, but the goal is distinctly different.

"My interest isn't in how old the individual was when it died or what sorts of damage it might have suffered in the process of dying or getting fossilized," he said. "I'm interested in how these fossils relate to one another, how they compare to one another and others from the same time period and the same place."

He's also interested in broader comparisons, and uses fossilized bone to expand his worldview, just as some of the early humans he studies relied on tools fashioned of bone to expand their range.

"My work is about weaving together the hard evidence for evolution, weaving from the anatomical evidence in context a sort of story about how these populations were related to each other and how they changed through time," Rightmire said. "And then on a larger scale, how one of these species might have given rise to later species, or, if it didn't do that, just noting the fact that it died out."

How children survive sexual abuse

Multiple factors may define individual's trauma

After exploring issues of childhood sexual abuse for nearly 25 years, first as a therapist and more recently as an academician and researcher, M. Sue Crowley is sure of just one thing: Sexual abuse is not a uniform experience.

As a result, no single factor — not the severity of abuse or its duration, nor the closeness of a child's relationship with the abuser, nor the child's age at the onset of the abuse, nor even the number of abusers — is predictive of the long-term effects of the experience on individuals.

Her most recent study suggests that looking at the combination of those factors through “cluster samples” may allow prediction of long-term effects. Crowley, an associate professor of human development, gathered quantitative and qualitative data from a clinical sample of 88 adult women who reported having been sexually abused as children and whose lives are, to one degree or another, still affected by symptoms of trauma.

In Crowley's study, background information was gathered from women who voluntarily filled out questionnaires left at women's centers and shelters, rape crisis centers, private therapists and community mental health agencies in central New York and Pennsylvania. The data was sorted into four groups based on weighted scores on five variables: closeness of relationship between victim and abuser, duration of abuse, number of abusers, age of onset and severity of abuse.

The study shows that the group of women who had the most severe and persistent symptoms of trauma were those whose experiences ranked highest on all of the criteria. They were the youngest when the abuse began, closest to their abusers, and were abused the most severely for the longest period of time by the greatest number of abusers. It also shows that women in the groups that ranked progressively lower on those criteria also reported progressively fewer and less severe symptoms.

“I don't think it's surprising news,” Crowley said. “In a way, it's the sort of thing my grandmother could have told you.

“But what my grandmother wouldn't have

been able to tell you is how complex the picture looked,” she added. “I wasn't expecting the amount of variability I found. It's really no wonder that we can't find very clear relationships between characteristics of abuse and outcomes, because the degree of variability in terms of how children are abused, who abuses them, for how long and to what purpose, is incredibly complex.”

Abuse, for instance, might be fairly severe and persistent, Crowley said, but if victims do not feel particularly close to the perpetrator, that gives them an emotional buffer of sorts.

“So it's really how all of these elements combine that might influence the effect long term,” she said.

The multiplicity of abuse, Crowley said, flies in the face of common conceptions. Even researchers often think of abuse as a single event or relationship in a child's life, she said. But her study points to the fact that for many women, particularly those who seek therapy as adults, this may not be an accurate picture.

For instance, 57 women in Crowley's survey said they were sexually abused as children by two or more people. Thirty-eight reported being sexually abused by three or more perpetrators.

Although this may seem surprising, Crowley noted that in the 30 interviews she conducted, “almost every narrative describes deeply troubled families” in which multiple forms of abuse were reported.

“These are precisely the kinds of family circumstances where you would expect to find,



M. SUE CROWLEY, AN ASSOCIATE PROFESSOR OF HUMAN DEVELOPMENT, HAS SPENT NEARLY 25 YEARS EXPLORING ISSUES OF CHILDHOOD SEXUAL ABUSE, FIRST AS A THERAPIST AND MORE RECENTLY AS AN ACADEMICIAN AND RESEARCHER. HER WORK HELPS SHED LIGHT ON HOW WOMEN MAKE MEANING OF TRAUMATIC CHILDHOOD EXPERIENCES.

at least some of the time, sexual abuse as an extension of the physical, emotional and alcohol abuse,” she said.

In her study, the average age at onset of abuse was 5. The average duration of abuse was more than seven years. And on a scale of 1-12, the average severity of abuse was 10, meaning penetration of some form. Fewer than 9 percent of the women reported being abused by strangers.

Across the board, Crowley said her study revealed more severe abuse than is generally reported even in other clinical samples. As a result, she thinks some people will challenge her findings by claiming she sampled only a “fringe group” of women. In response,

Crowley said, “You could very well be right. I think because of the way I collected the sample, I got people who have been more severely abused.

“But for a long time, using random community samples, we might also have been sampling just a part of the picture,” she added.

Studies that compare women who were not sexually abused as children to those who were do nothing to help us understand why 75 percent of women who were abused seem to go on to experience long-term problems while 25 percent do not, she said. Insight into that question is most likely to be found in studies like hers, where meaningful comparisons may be

drawn between those who were severely abused and those who were less severely abused, she said.

In addition, Crowley said the small percentage of reports of stranger abuse in her study is consistent with other samples, regardless of their source.

“The fact is,” Crowley said, “children are seldom sexually abused by strangers. We love things like Megan’s Law, where we think of that evil stranger stalking our children. But the ugly truth is that consistently, and across all samples, sexual abuse is a family affair.”

In the qualitative phase of her study, Crowley said that among other things, she

found a need to own up to and let go of her preconceived notions and stereotypes about the women she interviewed.

“I went in thinking I was going to talk to victims,” she said, “and I discovered remarkable courage. I discovered women who, while they still had many serious problems as evidenced by the trauma checklist, lived with those problems in lives that were loving, productive and important in their communities. I found women who were teachers and bankers and nurses and therapists and homemakers — women who, I want to say, are contributors in fundamental but not flashy ways — women who are all a lot more than that history of abuse.”

Research targets “flashback” abuse experiences

M. Sue Crowley hopes the data she collected in a recent study of childhood sexual abuse survivors will shed light on how women make meaning of traumatic childhood experiences.

Additionally, she hopes to learn more about how women come to believe they were sexually abused as children after adult experiences including anxiety attacks, flash images, and sensations like sounds and smells that tend to accompany flashbacks in “bits and pieces,” she said.

“Bits and pieces’ was a phrase used by many of the women I interviewed as they offered up very rich descriptions of the phenomena that they call ‘flashbacks,’” she said.

Crowley said she chose the approach to side-step the controversy of “recovered memories” and instead respect the importance, the power and the defining nature of individual life narratives.

“I’m not interested in verifying recovered memories, because I consider it a virtual impossibility,” Crowley acknowledged. “As it stands, we know two things about recovered memories: One, that some of them are false, and two, that some of them are true. Actually, the third thing we know, and perhaps the most important thing, is that at this point, no matter what side the competing experts are on, nobody knows how to distinguish one from the other.”

In her study of 88 women who reported being sexually abused as children, 27 said they had always remembered the abuse, 20 reported that they had always remembered but recovered more memories in later life, and 41 said they had only recovered memories.

Rather than getting involved in the controversy over recovered memories that has “whipped up rabid debate and name calling” among researchers, Crowley said the key question for her was, “What

do people mean when they say they have ‘recovered memories’ of sexual abuse?”

To get at that issue, she changed her approach.

“I began by not referring to them as memories,” she said. “I began by using the word experiences. ‘When did you start having these experiences that you came to believe were memories of abuse?’”

Crowley collected her data by means of questionnaires completed by all the women and personal interviews with a subset of 30 women.

“What’s interesting is that how people in the sample define ‘recovered memories’ is very different from [how] either the clinical or the scientific research community defines it,” she said.

The recovered-memory debate tends to focus on psychoanalytic concepts of repression, trauma and recovery, she said.

“Some of these folks talk in ways that would support that conceptualization, but others talk in terms of ‘I didn’t know it was called sexual abuse until I became a teenager.’ Or ‘I didn’t call it sexual abuse,’” she added.

In other words, many women are not “recovering” memories, but reframing and relabeling previous memories.

“When people reframe what they call it, they start remembering other things. Their whole story, the whole narrative history of their childhood begins to change.”

The qualitative portion of Crowley’s study, then, is really about narrative history, which is often contested history, she said.

“I don’t think we can afford to dismiss women who have these experiences as fools or as crazy,” she said. “One of the very interesting things to me during the interviews was how remarkably functional these women are and the kinds of lives they have made for themselves.”

As far as the recovered-memory debate itself goes, Crowley said she thinks it’s time both sides stepped back and accepted with greater humility what is not known.

“I think, especially when you start asking questions of history and memory, that these can’t be adequately addressed in a laboratory setting because of the methodological constraints,” she said.

Yet without the methodological constraints, many researchers are ready to throw out results from studies that include participants reporting controversial “recovered memories,” she added.

“When this debate first started, I was a little confused,” Crowley noted. “Nobody ever asks a Vietnam veteran if his recovered memories are true, if they are ‘real’ memories. If we think that recovered memory as a phenomenon can exist as a result of trauma, how can we disbelieve its existence only in the case of sexual abuse?”

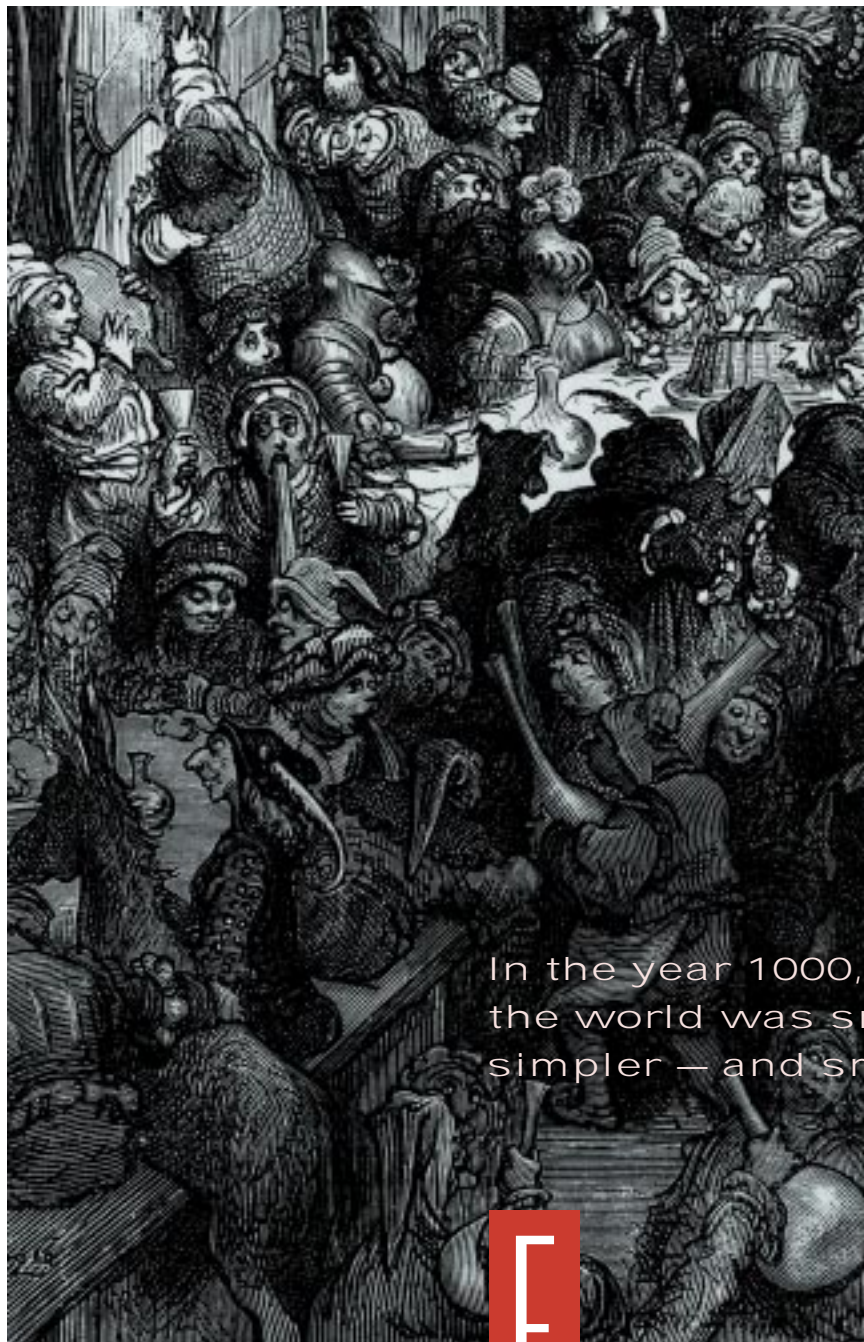
On the other hand, Crowley acknowledges that issues of sexual abuse tend to touch on very profound fears that can “take fire in unpredictable ways,” undoubtedly including some false claims of child sexual abuse.

The rash of day-care cases that swept the country in the 1980s could be an example of that, she suggested.

“I think that had much to do with our fears of what was happening with women going back to work, and trusting our children to agencies, rather than to families, and our fears about what that could mean,” she said.

“There was almost a hysteria that surrounded those cases, and I think innocent people were sent to prison. I also think a lot of people would be surprised to hear me say that.”

The first millennium



In the year 1000, the world was smaller, simpler — and smellier



MEDIEVALIST ROBIN OGGINS LOOKS OVER EXAMPLES OF ART AND MANUSCRIPTS FROM THE MIDDLE AGES, WHICH PROVIDE CLUES TO WHAT LIFE WAS LIKE IN THE YEAR 1000.

Fill in the blank: “What a difference a _____ makes.” ✦ If the word you supplied was “day,” that’s understandable. It’s not only a familiar cliché, but a well-known song title. ✦ But when you get right down to it, “millennium” is the word that probably best completes the phrase, according to Robin Oggins, professor of medieval and English history.

As we start the third millennium, life in the Western world looks very, very different than it did 1,000 years earlier at the end of the first millennium, Oggins said. And that's something for which we can apparently all feel grateful.

In the year 1000, life was simple, Oggins said, not to mention short. The concept of personal happiness was not one to which most people gave much thought to, he said.

"My guess is that most people probably didn't think too seriously about the whole thing," he said. "At the time, the underlying justification for everything was that you lead a good life and go to heaven. You're here, you live and die, and you move on."

"Moving on" was definitely not something most people did while alive, Oggins said.

Most people — perhaps 90 percent of the population, even two and three centuries after the millennium — lived and died never having traveled more than seven miles from their place of birth. Transportation wasn't an issue.

"If you were a peasant, you walked. If you were a knight, you got to ride," he said.

Longevity wasn't much of an issue either, Oggins added. Life expectancy in the year 1000 probably averaged no more than 30 years, and because nothing was known about dental hygiene or vision care, people who managed to survive into their 40s or beyond probably did so with few teeth in their heads or the ability to see very well.

Of course, even if reading glasses had been available, they almost certainly would not have been *called* "reading" glasses.

"Well over 90 percent of the population was illiterate," he said. "And this included in the 10th century most of the kings and nobles, who simply couldn't read."

The class system was quite strong, Oggins said, and about the only people who had any hope of moving up in society from their station of birth were men who were fortunate enough either to have exceptional military skills during times of unrest or who became connected with the church.

Although Christianity was the predomi-



nant religion, there were small Jewish groups and patches of paganism, as well as belief in superstitions and myths, throughout Europe, Oggins said.

For most, going to church wasn't an occasion to dig out their "Sunday finest," because most people wore the same clothes all year 'round, day and night, Oggins said.

In fact, life wasn't just short for most people, Oggins said; it was also very smelly.

King John, who is known to have taken 24 baths in an 18-month period (his payments for these baths were recorded), was considered effeminate by his contemporaries because he took too many baths, Oggins said.

"It's been said that the typical knight took three baths in his lifetime: one when he was born, one when he was knighted and one when he was married. A fourth was given to him after he died," Oggins noted.

Meanwhile, peasants, who lived and slept alongside their animals, probably didn't notice their own stink because everybody and everything smelled rank, he added. Spices were first used in cooking about this time to cover up the rot in the food, Oggins said.

Bad diet and vitamin deficiencies were common, and though women routinely died in childbirth, men often remarried and had large families, such as the later medieval man who had three wives — one at a time — and fathered 30 children.

"It has been said that when doctors finally started washing their hands before attending a childbirth, the death rate of mothers in childbirth dropped by two-thirds," Oggins said. "That's not until the 18th century. And the

germ concept of disease didn't develop until the 19th century."

When they weren't having children, peasant women generally worked alongside men in the fields, gathering crops, carrying wood or hauling water.

Education was in most cases available only to the sons of kings and important nobles and seldom available to women, regardless of their station.

Marriages, which usually involved little more than taking an oath or a couple "plighting their troth" before God, often nowhere near a church, could be just as easily ended — by husbands, that is.

"For women, a husband's impotence was the only valid cause for divorce," Oggins said. "But there was a lot of repudiation of wives that went on well beyond this period for upper-class men. You get the impression that it didn't matter what the theory of marriage was; when men grew tired, they found a way out."

Overall, if someone from the first millennium could visit us in the year 2000, the biggest surprise to that visitor would probably be our standard and means of living.

"In the year 1000, if you couldn't make it or grow it, you went without it," he said. "Ninety-eight percent of the people lived on the land, and muscle power — human or animal — was the height of technology.

"In the year 1000, Binghamton as it exists today would have been one of the great cities of the Western world," Oggins added.

"And our visitor from the year 1000 would be totally amazed that so many people could live together with no one growing any food," he said.

Talking to people who aren't there by using the telephone or a computer and seeing things from a distance by means of television would certainly be a surprise, Oggins conjectured.

But none of that would be any more surprising to a time traveler from the 10th century than the fact that in this century, people in their 50s, 60s, 70s and even 80s remain vigorous.

"They would be amazed at how good we look," Oggins said, "and how nice we smell."

LINDA SPEAR

Getting to the core of substance abuse

Psychologist seeks adolescent addiction links

After spending years looking at the prenatal effects of cocaine and alcohol, psychologist Linda Spear's research is taking a dramatic turn that could uncover a link between adolescent brain development and alcohol and drug use.

"I think one of the huge remaining research issues is 'What is it that predisposes the initiation of drug and alcohol use?'— virtually all of which is initiated in adolescence," Spear said.

Ironically, after more than 23 years of drug and alcohol research, Spear finds herself coming full circle, back to a research question that first intrigued her much earlier in her career.

"I did my first adolescent review back in 1983," she said. "I think I knew the question even then. I just didn't have enough pieces of the puzzle to even begin putting it together. It was like a 2,000-piece puzzle, and at the time I had maybe 30 pieces. So I wandered off into other areas, most notably prenatal research."

But resolving questions about the links between adolescence and drug and alcohol use is a challenge that has continued to call to Spear throughout her career. Now, she hopes to look at those questions and to more broadly examine risk-seeking and novelty-seeking behaviors that tend, like experimental drinking and drug use, to accompany the onset of adolescence.

Like the rest of the body, the brain undergoes major changes during adolescence. And while some of those changes involve adolescent hormones, even more significant is a sweeping neurochemical and anatomical restructuring of certain brain regions during this stage of development, she said.

"I think what we really need to do is focus in on these brain changes as predisposing factors for the behavioral changes associated with adolescence, which include the initiation of drug use," she added.

Spear will do that by working with rats between 28 and 42 days of age, who are developmentally equivalent to human adolescents between the ages of 12 to 18, she said.

When Spear talks about exploring factors related to alcohol and drug use, one thing is

certain: Funding agencies listen.

A distinguished professor of psychology and a winner of this year's University Award for Excellence in Research, Spear has attracted about \$6 million to the University since coming to Binghamton from the University of Florida in 1976. The funding for her cocaine work has come from the National Institute of Drug Abuse, while her alcohol research has been regularly funded by the National Institute of Alcohol and Alcohol Abuse.

She recently received approval of two alcohol grants that propose separate five-year studies on alcohol tolerance and stress, and adolescence and stress. These grants account for \$2.3 million of Spear's career research funding total.

To the extent that there are connections between alcohol and stress, "the story is the clearest during adolescence," according to Spear.

"We always assumed that raging hormones were causing all the problems," she said. "But clinical studies show that hormones really don't relate very well at all to the behavioral changes seen during adolescence."

Spear instead hypothesizes that the most important changes going on during adolescence may be the critical shifts taking place in the brain.

"When adolescence starts to come on, there's a huge decline in certain kinds of synapses and significant increases in others," she said.

Much of the brain restructuring common to adolescence takes place in the prefrontal cortex and mesolimbic brain regions, the very brain regions that support and are subject to the reinforcing effects associated with drug and alcohol use.

Understanding why adolescents initiate drug and alcohol use is important for a number of reasons, not the least of which is that those who don't start using drugs or alcohol until they are 20 or 21 years old are "very unlikely to become an alcoholic or a drug addict in adulthood," Spear said.

"When we're talking age of first initiation today, we're usually talking 12- and 13-year-olds," she added. "One of the strongest pre-

dictors of alcoholism in adulthood is the age of first initiation. The younger you start, the more likely you are to become an alcoholic. And that goes for other drugs as well."

That doesn't mean that all adolescents who initiate drug or alcohol use at an early age will become alcoholics or addicts, Spear emphasized. A predictor is only a flag or marker, and causation really can't and shouldn't be assumed, she noted.

"Nevertheless, the best predictor of whether a person is going to become an alcoholic is not family history," Spear said. "It's not current stressors. It's not gender. You can look at all the various factors, and the best predictor of whether you're going to be an alcoholic in adulthood is the age of initiation of use. So there may be something about early use that itself is changing the propensity to become addicted to alcohol or anything else."

Spear has become one of the nation's and perhaps one of the world's leading experts on the relationship between neurotransmitters and behavior during development, as affected by drug abuse.

Using rats, she has tested the consequences of prenatal cocaine in the subsequent development of brain and behavior in infancy, and has expanded her research into the use and abuse of alcohol. While Spear's research shows that early exposure to cocaine alters the line between vulnerability and resiliency in regard to stress, she says that as a drug, alcohol is far more complicated than cocaine, as evidenced by its impact on the brain.

"When you're talking cocaine, at least you're talking mainly dopamine systems," Spear said.

Dopamine is an important neurotransmitter in the brain. Though changes in its levels in the brain and subsequent alteration in its various receptors are implicated in a variety of commonly occurring neurological disorders, including schizophrenia, Parkinson's disease, Huntington's disease, tardive dyskinesia, cocaine addiction, hypertension and stress, dopamine systems are located only in specific brain regions.

Cocaine, therefore, affects the brain like a probe, Spear said. Alcohol, on the other hand,



Effects of cocaine abuse on fetus less than originally thought

One of the more surprising findings in Linda Spear's 23 years of research at Binghamton University is that the effects of prenatal cocaine exposure are not nearly as dramatic as psychologists had originally presumed they would be.

"Our work has shown that kids who are prenatally exposed to cocaine aren't necessarily doomed," she said. "The effects are there, however, and they tend to be brought out when you challenge the system."

Spear's research showed that under minimal-stress circumstances that demanded little from rats prenatally exposed to cocaine, the rats did well and were not significantly distinguishable from normal rats.

They did, however, show subtle deficits characterized by increased vulnerability to environmental stressors, and similar patterns are beginning to show up in more recent clinical studies of human offspring exposed *in utero* to cocaine, she said.

"When you challenge the prenatally exposed rats with either a complex cognitive task or a stressor, that's when you start to see differences show up. They do not respond to stressors like normal animals. They behave differently," Spear said.

Normally when they find themselves in a stressful situation with no hope of escape, rats become immobile and conserve their energy.

"Cocaine animals show less of this immobility response and are more inclined to continue to try over and over again to escape the situation," she said.

Using this and other measures, Spear's research has shown that the cocaine-exposed offspring may show beneficial effects from early experiences, and that under some circumstances they may be more sensitive to the beneficial effects of enriching experiences early in life than control offspring who were not exposed prenatally to cocaine.

What this could mean for humans, Spear said, is that the outcome for cocaine-exposed children is not strictly determined by their gestational drug exposure: enriching early life experiences could benefit them considerably.

PSYCHOLOGIST LINDA SPEAR, WHO LAST YEAR RECEIVED THE UNIVERSITY'S AWARD FOR EXCELLENCE IN RESEARCH, HAS ATTRACTED ABOUT \$6 MILLION IN FEDERAL FUNDS TO SUPPORT HER RESEARCH ON THE CAUSE AND EFFECTS OF DRUG AND ALCOHOL ABUSE SINCE COMING TO BINGHAMTON IN 1976.

affects lots of different neurotransmitter systems and, in higher concentrations, affects membranes throughout the brain.

"Alcohol is like a sledgehammer on the brain," she said.

Spear earned her bachelor's degree in psychology at Western Illinois University and then went on to the University of Florida, where she earned her master's and PhD degrees in psychology, both with minors in neuroscience.

Reflecting on her motivations for returning to adolescent research this late in her career, Spear said the choice was clear.

"When you're an assistant professor you want to be an associate professor, and when you're an associate professor you want to be a full professor, and when you're a full professor you want to be a distinguished professor," she said. "OK, you're a distinguished professor — and now?"

Now, Spear said, she wants to do something of immediate importance and value to her community and to the country.

"I think that alcohol is the biggest problem with adolescents. And at this point, I really want to do work that makes a difference."

ANTHONY KING

Edifice complex

Divining culture from society's structures

Not many scholars can claim that an airplane is a valuable research tool. But Anthony King has been known to use an airplane's vantage point to ponder aspects of culture that are often overlooked by researchers grounded in more traditional approaches.

King uses aerial photos as one way to evaluate the physical manifestations of cultures and societies. By looking at the way towns and cities are built, King makes inferences about the societies that built them. In centuries past, for example, King said, many cities in the West were organized around the space of the city square. Today, they are increasingly being organized around the airport.

King, a professor of art history and sociology, studies the social and cultural production of the built environment. In this multidisciplinary approach, he uses ideas from history and sociology to relate what exists in the physical and spatial realm to what is happening on the social and cultural level.

"You can read and interpret what is going on socially and culturally by looking at space and the built environment," King said.

The "built environment" includes more than just architecture, King explained. The placement and structure of houses, civic buildings, office parks, prisons and streets provide a more complete picture of society than just the aesthetic design of buildings.

"Two questions you can ask are: What can you find out about the built environment by examining the society in which it exists? and What can you find out about the society by examining the built environment?" King said. "There is an enormous amount you can learn about what is going on, whether it's questions about power in societies, or authority in societies, or oppression in societies that is manifest spatially."

For example, King said, aerial views of American cities show an urban sprawl that seems to bleed into vast suburban developments, while many European cities have more distinct outer borders, as European governments usually have greater control over land use.

"There's a politics of space. You can see how a political commitment to public, rather than private, transportation modes such as rail, bus [or] tramways, holds the space of a city together."

"There's a politics of space," he said. "You can see how a political commitment to public, rather than private, transportation modes such as rail, bus [or] tramways, holds the space of a city together."

The built environment doesn't just act as a mirror reflecting societal norms, King said, but also helps to constitute them. Images can also be internalized and help create the individual's, as well as a nation's, identity.

How important are built environments in creating identity and sense of self?, King asks. "Everybody knows that, especially in terms of the house they live in. How they organize the space in their house, how they construct environments around themselves and make divisions between their space and somebody else's space, and how they put things around them."

For example, Americans often place emphasis on individuality, and this is both reflected in and reinforced by the seas of single-family homes that dominate much of the country, a phenomenon that has immense economic and environmental implications.

King says the use of space is similar to dress.

"It's partly how you represent yourself to others and how you use space in relation to others," he said. "So you can think of that on

an individual basis, but you can also think of how space is constructed through ethnicity, through race, through class especially, and through the nation as well as the reverse — how space and the built environment helps to construct these identities."

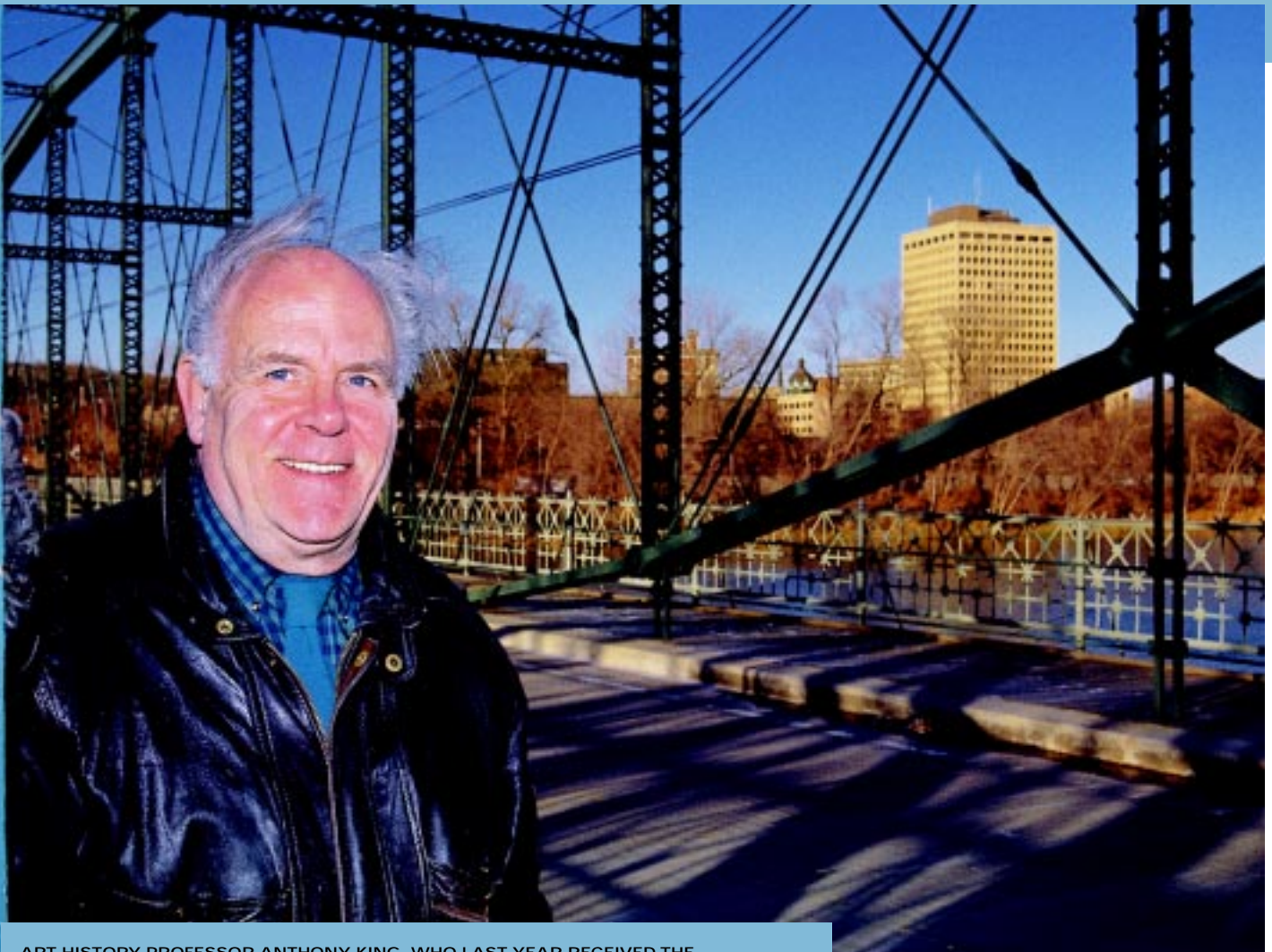
If a constructed environment reflects personality and also contributes to identity, it seems appropriate that the office wall behind King's desk is filled with books. His long list of journal articles, chapters in edited books, sole authorship of books and editor positions is as diverse as his background. He has master's degrees in history and education and a PhD in social sciences from Brunel University in London. He held titles in sociology, history, architecture and development planning departments before coming to the art history department at Binghamton in 1988.

The latest addition to his *curriculum vita* is as series editor. He and colleague Tom Markus from Strathclyde University in Scotland have spent the past three years soliciting and editing manuscripts for a series published by Routledge, called "Architext." The first three titles in the series have just been published, and another seven books will follow over the next two years.

"The essence of this is to look at architecture and the larger built environment in relation to social and cultural theory," King said. "I guess the first part of the exercise with these books is to bring the theory from both the social sciences and the humanities to the understanding of architecture, which people have done before. The more innovative part of the project is to bring architecture and the study of the built environment more centrally into the social sciences and the humanities through the use of contemporary social and cultural theory."

King said that much of the work in cultural studies, which has blossomed in the last 10 or 15 years and generated many valuable theoretical insights, has somehow bypassed space, the built environment and architecture.

"It is used in relation to every other sphere of human and social practice," he said, "but relatively little of it actually addresses questions of architecture and the built environ-



ART HISTORY PROFESSOR ANTHONY KING, WHO LAST YEAR RECEIVED THE UNIVERSITY'S AWARD FOR EXCELLENCE IN RESEARCH, STUDIES HOW CULTURE AND SOCIETAL VALUES DEFINE THE BUILT ENVIRONMENT OF HOUSES, CIVIC BUILDINGS, OFFICE PARKS, PRISONS AND STREETS FOR A SOCIETY.

ment. So the idea of this series is to remedy this situation and encourage people who write in social and cultural theory to look more specifically at the social meaning of space and the built environment."

King will contribute his own work to this series in a book, *Spaces of Global Cultures*. The subjects of global culture and global cities are topics he has written a lot about in past years and have been a major emphasis of his work. He has also written extensively about colonial and post-colonial architecture and urbanism, topic that have become of increasing interest and significance in recent years. However, he is increasingly uneasy about the widespread use of the term "global." He says other terms such as "transnational" or "neo-imperial" might better represent the contemporary world.

Because King approaches his research with a historical perspective and incorporates ob-

servations of the often-overlooked built environment, he does not see that a global economic system is necessarily leading to a homogenous global environment.

Consciousness of globalization promotes resistance as well as difference, he says. He makes the point that even though there may be an increase in the number of people who are able to travel and take their culture with them, they may continue to interpret the environment through their own cultural lenses.

"I remember visiting Taiwan to give some lectures, and I made some comment that this phenomenon of the monumentally tall building is really a way of expressing identity that has just been absorbed from the West, not least the United States," he recalled. "I was vigorously attacked by two or three Taiwanese in the audience. Basically their criticism had to do with the meaning of this building to them: 'It is our way of demonstrating our entry into

the discourse of modernity. That's what it means to us. It may mean something else to you, but that's what it means to us, the people who live here, who don't travel around and see that there is one of these tall buildings in every country in the world.'"

The concern with cultural homogenization may also stem from what King calls "selective vision," which is based on a cultural appraisal.

"When you travel, what captures your eye is what is familiar to you and what you can understand," he said. "It took me a long time to realize that. When I first went to India many years ago, all I was seeing were these European colonial buildings, and it was because they were familiar to me. And the unfamiliar environment — the Indian, 'Hinduized' environment — I couldn't recognize or identify with, because, initially at least, it didn't have a meaning to me."

What is true with his travels, King said, is also true with his research. He is giving meaning to an area of research that is readily available, but not always recognized for its revealing potential.

A Book of Reasons

Author searches for brother in memoir

As writer John Vernon made his way into the boarded-up, abandoned house in New Hampshire willed to him by his reclusive older brother, Paul, he felt as though he were walking through “a cave, a morgue and a dump — all rolled into one.”

The home had been sitting for years in squalid disrepair. The front steps were gone. The rooms were 5 feet deep in trash, mildewed boxes of bills and correspondence, soda bottles filled with cigarette butts, and a collection of ham radio equipment. The house smelled of urine and cat excrement.

“I did what I suppose most of us would have done, being alone and confronting such a thing: I tried to detach myself from it,” he recalls. “I tried to emotionally insulate myself. But an hour later I went to a gas station and phoned my wife and broke down crying. Even then — when I had no notion of writing a book about my brother — it felt volcanic, a sobbing that came from underground, from centuries of buried history.”

In his recently published memoir, *A Book of Reasons*, Vernon, a professor of English, has attempted to uncover that history by explor-

ing the ordinary forces that shaped the life of a brother he barely knew.

Since its publication in 1999 by Houghton Mifflin, the book has been well received and widely reviewed by such publications as *The New York Times Book Review*, *The Washington Post*, *The Wall Street Journal*, *The Village Voice*, the *New York Observer*, the *Hungry Mind Review* and *Newsday*. *Publishers Weekly* selected it as one of its 50 best books for 1999.

Memoir writing is new territory for Vernon, who wrote poetry and three books of criticism before turning to novels 15 years ago. His novels (*La Salle*, *Lindbergh's Son*, *Peter Doyle*, *All for Love: Baby Doe and Silver Dollar*) have drawn on historical themes and settings.

Although the novel is still and will continue to be his primary focus, he said his interest in historical research sparked a desire to write a book that stuck to “brutal fact,” that explored “how history touches lives in unexpected ways, a history of ordinary things and everyday life.”

The death of his brother Paul in 1996 provided the impetus for such an examination.

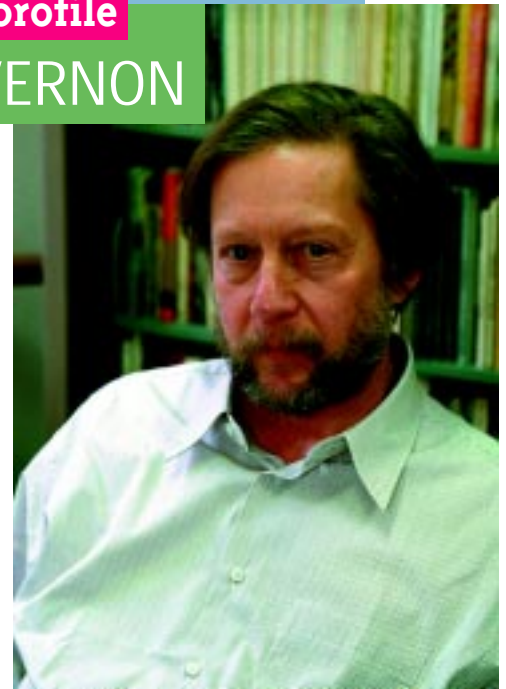
Paul, who was 15 years older than John, was raised by his grandmother, visiting with his parents and younger brother only on weekends. Later, when Vernon was in high school and his grandmother died, Paul moved back in with the family, and although he came to know his brother better, the two were never close.

As an adult, Paul was an assembly worker in the electronics industry and never married. He rarely visited his family and had few acquaintances, except those he made through his ham radio.

Vernon, in contrast, went to Boston College and earned his PhD at the University of California at Davis before taking on a life as a teacher and writer. He married and has two children.

Following Paul's death, as Vernon prepared his brother's dilapidated house for sale, he began searching for “reasons” why the brothers' lives diverged.

With help from an 80-year-old *Encyclopaedia Britannica* and his extensive research, Vernon searches for his reasons with explorations of the history of ordinary things — the thermometer, the evolution of tools, the



ENGLISH PROFESSOR JOHN VERNON'S RECENTLY PUBLISHED MEMOIR, *A BOOK OF REASONS*, ATTEMPTS TO UNDERSTAND HIS BROTHER'S LIFE IN AN EXPLORATION OF ORDINARY THINGS.

history of embalming and burial, the science of human conception and gestation and the central nervous system.

Drawing on the works of thinkers ranging from Galileo, Descartes and Pascal to Abraham Lincoln and Catharine Beecher, the book weaves personal history with the historical and scientific data that Vernon says create the “innumerable strands, invisible but unbreakable” that connect us to the past.

“When we cross a street, when we step off the curb and read the ‘WALK’ sign and walk between the lines and make it to the sidewalk on the other side,” Vernon said, “we are walking through ancient Greek geometrical conceptions of space, through Renaissance ideas about city planning, through the history of cities, the history of dwellings, through the Industrial Revolution and its ready-made materials, through the history of architecture. In other words, if history has any meaning at all, it is local and sweeping. It adheres to the daily minutiae of our lives, to the things we take for granted.”

Although Vernon did not come away from his memoir with all the “reasons” for his brother's behavior, he became reconciled to Paul's life.

“Maybe it sounds belated and convenient, but writing this book has enabled me to love him,” Vernon said. “It's reconciled me to him. My hope is that the book itself will help redeem what seems to have been a wasted life. Maybe it will help others, too.”

EXCERPT FROM *A BOOK OF REASONS* BY JOHN VERNON

“Reasons are not answers. Reasons are recipes for making sense of the world's arrangements and accidents. They are explanations of why things are, how they work, what they mean, where they came from, how they began. We need reasons when we feel dislocated, when ordinary things seem unfamiliar and contingent, when there are no easy answers. Why is that tree there, who invented the nail, how large is the universe, what happens after death . . . Reasons may vary from culture to culture and century to century, sometimes even from decade to decade — still, they are the lifeblood of cultures. They enable us to cross the street, read a newspaper, conduct a ceremony, name a newborn, and perhaps even comprehend our suffering or happiness.”

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