



S&T

A quarterly newsletter on research, teaching, management, policy-making and leadership in **Science and Technology.**

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Jennifer Fisher Wilson is the science writer for the Annals of Internal Medicine.

Looking In

By Jennifer Fisher Wilson

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Joan Carey, Ph.D. '81



Kyrin (Feagans) Dunston '86

Addressing Infertility

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Making Distant **Voices** Heard

By Dorothy Wright



“Bryn Mawr’s rigorous education and the assumption that we were citizens of the world provided a very strong basis for what I do today. We had to think and write very clearly. We had to read vast amounts of information, process it, understand it and explain it — and that is what my job requires.”

Stephanie Fried '82

STEPHANIE FRIED '82 LIVED IN a remote forest village in East Kalimantan (Indonesian Borneo) as a Fulbright fellow in 1990–91. She designed her doctoral dissertation to help the indigenous Bentian people prove ownership of their ancestral lands, documenting their 23-generation oral history of sustainable forestry practices. The Bentian had been struggling to protect their territory for a decade after Georgia-Pacific, the Atlanta-based multinational paper products corporation, began building roads and logging camps and damming streams in the region. In 1993, an Indonesian timber tycoon with close ties to then-President Suharto sent in armed chainsaw and bulldozer crews to clear-cut the forest.

“That’s how I became involved in environmental work,” Fried recalls. “I was on an academic track when my Bentian family asked for help. So I returned to the United States and, with a student from Kalimantan, visited human rights and environmental groups in New York and Washington, D.C. At Environmental Defense, Bruce Rich offered to try to help the Bentian people and, a year later, ended up hiring me.”

With degrees from Bryn Mawr (A.B., biology) and Cornell (M.S., agronomy; Ph.D., rural sociology), today Fried is a senior scientist and policy analyst for Environmental Defense, a nonprofit organization representing more than 300,000 members, operating the Asia/Pacific Islands Field Office in Kailua, Hawaii.

Putting the Pieces Together

Through Environmental Defense’s International Program, Fried traces and analyzes the environmental and human rights impacts of public funds that flow through international financial institutions, such as the World Bank, the Asian Development Bank (ADB) and export credit agencies. “We respond to requests

by communities in the Asia-Pacific region that have been negatively impacted by these projects,” Fried explains. “We try to put the pieces together to see whether taxpayer dollars are supporting projects that, for example, displace indigenous communities or lead to the destruction of forest, river or ocean ecosystems.”

Recently, Fried and her colleagues published a report analyzing 22 projects funded by ADB over 30 years, which can be accessed on the Web at www.environmentaldefense.org/go/adb. “The shocking conclusion is that at least 70 percent of ADB’s projects, according to its own audit documents, will fail to bring any kind of lasting economic or social benefits to these countries,” she says. “This is a disaster for heavily indebted countries such as Indonesia, which has over \$18 billion in loans from ADB.”

Environmental Defense hopes the report will prompt countries that contribute to ADB to consider suspending funding until the bank meets the demands of local communities impacted by its projects and changes its operations. “We try to make the voices of impoverished, isolated, resource-dependent communities heard in the corridors of power,” Fried explains.

For example, “In the late 1990s the World Bank was planning to fund an expansion of palm oil plantations in Indonesia, which are often established by clear-cutting, bulldozing and burning forested areas owned by indigenous people,” Fried continues. “Working with activists from East Kalimantan, we brought this plan to the public eye, resulting in the cancellation of plans for the loan. There are many other examples where tremendous potential damage has been prevented.”

Struggles and Breakthroughs

Over the past few years, Fried’s work for the Oceans Program has focused on helping to protect the Northwestern Hawaiian Islands (NWHI). “In 2000 we convinced the White House to listen to indigenous Hawaiian cultural practitioners, fishers, scientists and ordinary citizens and to create the nation’s largest protected area, the 84-million-acre NWHI Coral Reef Ecosystem Reserve. This vast, fragile, uninhabited

region is home to the earth’s remaining 1,400 Hawaiian monk seals, green sea turtles, millions of sea birds and reef species that are in deep decline in the heavily populated main Hawaiian Islands,” she explains.

Fried also worked to convince Bush administration officials to support the executive orders that established the reserve. “It is astonishing that we have succeeded this far. Things like that keep me going. Unfortunately, the reserve appears to be under an all-out attack by the U.S. Department of Commerce and the Western Pacific Regional Fishery Management Council.”

Citizens of the World

Fried says her Bryn Mawr education prepared her well for her work. “Bryn Mawr’s rigorous education and the assumption that we were citizens of the world provided a very strong basis for what I do today,” she says. “We had to think and write very clearly. We had to read vast amounts of information, process it, understand it and explain it — and that is what my job requires.”

activism

“You never entirely win battles against environmental and human rights abuses,” she says. “A decade ago we ensured a lot of publicity so that the Indonesian government was not able to threaten the freedom or lives of the main proponents of Bentian rights and forest protection. We were able to help prevent plans for 100,000 hectares to be clear-cut for a paper and pulp mill.

“Since the Suharto government has fallen, however, a regional decentralization program has led to local strongmen pillaging forest resources,” Fried continues. “But a few months ago, the local people impounded logs that had been illegally harvested from their land. It sent a strong message.

“So where there is life, there is hope.” ■

Dorothy Wright contributes news and feature articles on science, technology, engineering and general interest topics to a variety of publications, including Civil Engineering and Engineering News Record.

Practicing

at the Intersection of Law,
Policy and Technology **By Barbara Spector**

IN

2001 THE COALITION TO Support and Expand the Freedom of Information Act, a federation of some 40 organizations, inducted Beryl A. Howell '78 into the Freedom of Information Hall of Fame. The honor recognized her work to ensure access to government information. Howell's varied career has taken her from the courtroom, prosecuting gangsters and corrupt public officials, to the U.S. Capitol, where she served as general counsel for Sen. Patrick J. Leahy (D-Vt.), the senior Democrat on the Senate Committee on the Judiciary.

For a decade, until earlier this year, Howell made policy recommendations and drafted legislation on cybersecurity, electronic surveillance, online privacy, speech and intellectual property rights, and other issues. Howell helped craft the 1996 Leahy Electronic Freedom of Information Act amendments, which expanded the range of government records accessible in electronic format under the Freedom of Information Act (FOIA). "These amendments updated the FOIA to make the information available in a more consumer-friendly way," Howell says. She also helped Sen. Leahy fend off proposals to impose new limits on the FOIA. "On [Capitol] Hill, you often count your successes, not just by the bills that pass, but also by the bills that are stopped — the bad ideas that should not become the law of the land," she notes.

Crisis Management

After the terrorist attacks of Sept. 11, 2001, Howell led staff negotiations for the Judiciary Committee on the USA Patriot Act. "The Capitol building had been a near-miss target of the terrorists and, at the same time, we had to respond in a time of crisis," she says.

Shortly after the attacks, during intense negotiations with the administration over the terms of the new anti-terrorism law, anthrax was found in the Senate office buildings. Howell and colleagues underwent nose swabs to test for anthrax and evacuated their offices, moving to "little cubbyholes in the Capitol," she recalls. Before they moved, "My assistant frantically copied our working files off the computer onto a laptop," Howell says. "We certainly could not afford to lose any time recreating our files."

From 1987 to 1993, Howell was an assistant U.S. attorney in the U.S. Attorney's Office for the Eastern District of New York and deputy chief of the narcotics section. Her law-enforcement experience, she says, enables her to assess the controversies over the USA Patriot Act from a real-world perspective.

For example, Howell says, "Some of the concerns that have been raised about expansions of surveillance power focus on provisions that actually only codified investigative practices that were long-standing."

In July 2003, Howell notes, the House of Representatives voted to roll back a provision of the act authorizing the government, when necessary, to conduct "sneak and peek" searches of suspects' property without notifying them immediately. But Howell notes that "sneak and peek" searches were conducted before this provision was enacted and were judicially sanctioned — for example, to allow secret searches of a location for a kidnap victim without alerting the kidnapper and endangering the victim.

Digital Forensics

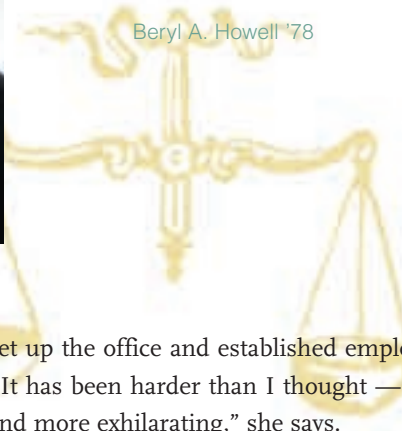
As a prosecutor, Howell supervised wiretap investigations and conducted grand jury investigations. She received the Attorney General's Director's Award for her prosecution of a Colombian money-laundering operation. In another high-profile case she led, 29

Barbara Spector writes on science and technology as well as business topics. She is the executive editor of Family Business magazine and former editor of The Scientist.



“I have been dealing with a host of issues, ranging from the mundane to the significant. It has been harder than I thought — and more fun and more exhilarating. Bryn Mawr gives women confidence in their brainpower and the skills to learn any subject matter.”

Beryl A. Howell '78



New York City building inspectors were convicted of extortion.

Howell earned her law degree from Columbia University, where she was a Harlan Fiske Stone Scholar. She served as a law clerk to U.S. District Judge Dickinson R. Debevoise, District of New Jersey, and was an associate at a New York firm early in her career.

Since February 2003, Howell has been executive vice president of Stroz Friedberg LLC and managing director and general counsel of the firm's new Washington, D.C., office. The firm provides consulting and technical services in computer forensics and

law

computer abuse investigations for private- and public-sector clients. Howell describes her work as “cyber sleuths doing information age investigations” for use in litigation or internal corporate management.

These can be classic “whodunits”: who is hacking a computer system or sending harassing e-mails? The firm also helps clients respond to demands for electronic data in civil or criminal cases.

As managing director, “I’ve been dealing with a host of issues, ranging from the mundane to the significant,” Howell notes. In addition to addressing clients’ concerns and developing new business, she

has set up the office and established employee benefits. “It has been harder than I thought — and more fun and more exhilarating,” she says.

Brainpower

Howell’s mother, Ruth Bronsweig Howell ’53, and sister, Debra Howell ’79, are also Bryn Mawr College graduates. “Bryn Mawr gives women confidence in their brainpower and the skills to learn any subject matter,” says Beryl Howell, who majored in philosophy. These strengths have served her well as she begins a new phase in her career, she notes. “I have to focus my skills in a different way.”

Howell’s husband, Michael Rosenfeld (Haverford ’78), is an executive producer at National Geographic Television & Film. They have three children: Jared, 13; Alina, 10; and Calla, 5.

Howell discusses her work with her children “so they understand that what I’m doing is important,” she says. “As a consequence, they feel a part of it.” After the Sept. 11 attacks, “It was comforting to them to know that I was working and doing my part to make sure the country was safe.

“They’re all incredibly proud of me,” Howell says. “That’s something I’m really thankful for.” ■

A Physician for All Ages

By Karen Young Kreeger

IN HIGH SCHOOL, a friend of Karen Barnes Mitchell '83 came across a brochure describing the educational programs at Bryn Mawr and sent in the request-for-information postcard with Mitchell's name on it. "The first time I heard about Bryn Mawr was when I opened up a packet that read, 'Here's the information you requested,'" recalls Mitchell. "My friend hit it right on. Bryn Mawr had what I was really interested in — science and music."

At first, says Mitchell, it was the strength of the science program that attracted her to Bryn Mawr — not that it was women's college, an advantage that she later came to appreciate. Although Mitchell was raised in a family "where gender didn't really matter," the atmosphere at Bryn Mawr did help her later on in her career, she realizes now.

Strong Foundation

Mitchell, who lives and works in her hometown outside Detroit, has used the strong foundation that Bryn Mawr gave her to successfully blend an active professional and home life. Whether seeing patients in her family physician practice, directing the handbell choir at church, juggling her sons' after-school schedules with her pediatrician husband, or explaining the importance of childhood immunizations to a politician, Mitchell credits her certainty to tackle whatever "I felt that I wanted to do" in part to her years at Bryn Mawr as well as to a supportive family.

After medical school at Wayne State University, Mitchell completed three years of family practice residency at Providence Hospital in Southfield, Mich. She stayed on at Providence's family practice and, in 2002, was promoted to associate residency director. In this role, Mitchell designs new family-practice curricula and comes up with ways to reduce residents' stress and working hours, a topic of current national concern.

"We've had to make sure that when residents are done with their shift, they get at least 10 hours of rest time," Mitchell explains. But this also meant juggling the schedule of more experienced residents to ensure that a senior resident was always available in the hospital.

Caring and Volunteering

For Mitchell, placing importance on the whole person figures prominently throughout her education and medical career. Her choice of family medicine as a specialty speaks to this. "In family medicine we care for all ages, with an emphasis on disease prevention and health promotion," Mitchell says. "What attracted me to family medicine is that I feel this path is how I can be the most effective in my patients' lives."

family

Professional and community volunteering is also part of Mitchell's integrative approach to her career. She holds several state and national level advisory positions, "because that's part of the balance, too," Mitchell says.

Mitchell is in the second year of a five-year term on the American Board of Family Practice, a national certifying body for family physicians that comprises family physicians and physicians from other specialties. One of the board's main tasks is to institute a maintenance certification program for family physicians, which promotes physician involvement in continuing education and improvement of quality health care.

Mitchell derives much satisfaction from the role that her volunteer positions afford her in promoting preventive medicine. She chairs the Michigan Advisory Committee on Immunizations, which works

Karen Young Kreeger is a science journalist who writes on biomedical and women's health topics, as well as careers in science. Her most recent work has appeared in Bioscience, Genome Technology, Muse and The Scientist.

directly with the Michigan Department of Community Health, and has been a committee member since its start in 1992.

“Immunizations are one of my areas of expertise, so this fits right in with my goals,” Mitchell says. “Michigan is facing challenges similar to other states in trying to increase immunization rates in the face of huge state deficits and federal funding cutbacks.” In 1994, Michigan was last of all 50 states in the nation for immunization rates. Working on a number of fronts and taking direction from the advisory committee since then, Michigan now ranks sixth in the nation in immunization rates for children.

The most significant factor contributing to the huge improvement that the state and advisory committee could identify is a new computerized statewide Immunization Registry. “The registry has greatly increased the ability for physicians to know what shots kids have and have not gotten,” Mitchell explains. “That’s been a wonderful effort.” One-on-one meetings with physicians and nurses and a statewide peer education program have also contributed.

Political Advocacy

Mitchell is also a political advocate. As past president of the Michigan Academy of Family Physicians and a representative from Michigan to the American Academy of Family Physicians, Mitchell spends a fair amount of time communicating with state and national legislators about preventive-medicine issues, such as promoting health care for disadvantaged people, and the health needs of different communities.

“My years at Bryn Mawr boosted my self esteem, and that is what really has paid off for me to be able to make a difference in the year that followed,” Mitchell concludes. “Volunteering and political advocacy is what’s important.”

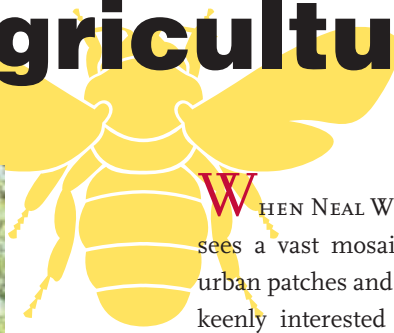
Mitchell’s Bryn Mawr experience has given her the insight to see that what happens in society as a whole is connected. “I think that’s part of the beauty of a liberal arts education,” she says. ■



“In family medicine we care for all ages, with an emphasis on disease prevention and health promotion. What attracted me to family medicine is that I feel this path is how I can be the most effective in my patients’ lives.”

Karen Barnes Mitchell '83

Probing the Nexus of **Natural**
and **Agricultural** Habitats
By Dorothy Wright



WHEN NEAL WILLIAMS OBSERVES the landscape, he sees a vast mosaic composed of agricultural areas, urban patches and remnants of natural habitats. He is keenly interested in the connections among these pieces.

Williams, who earned a doctoral degree in ecology and evolution at the State University of New York, Stony Brook, will join the College in January as assistant professor of biology, teaching ecology in a field-based component of a lab ecology course.

Williams' past research includes the ecology and evolution of foraging and feeding specialization in solitary bees, as well as comparative studies of pollen dispersal by various insects and the effect of this dispersal on plant reproduction. "These interests have led to a current research focus exploring the effects of landscape change on communities of native bees and on their pollination of native plants, weeds and crops at the interface of natural and agricultural habitats," he says.

"More than 70 percent of all the plants on earth rely on pollination to reproduce. I am examining how this ecological process is affected by landscape change."

Neal Williams

Global Biodiversity

Currently a D.H. Smith Postdoctoral Fellow with The Nature Conservancy, Williams conducts research with collaborator and mentor Claire Kremen in the department of ecology and evolutionary biology at Princeton University. "A primary focus of the Kremen lab is to study human impacts on biodiversity and ecological functioning at the landscape scale," he explains.

Human populations affect the global landscape in many ways, including fragmentation of natural habitats. "One human activity that is dramatic in the scale of its impact is agriculture," Williams says. "We create vast areas where fields and natural remnants come together, gigantic mosaics made up of remnant natural habitat within vast agricultural landscapes, as well

as small plowed fields nestled in much larger areas of semi-natural or grazed areas. These are dominant landscapes across much of the world.”

A generation of conservationists and ecologists has been interested in understanding how biodiversity is affected by habitat loss and fragmentation. “More recently, there is growing interest in how ecological processes are affected by these changes,” Williams says. “For example, more than 70 percent of all the plants on earth rely on pollination to reproduce. I am examining how this ecological process is affected by landscape change.”

Pollination not only is a key process in natural systems, but also represents a potentially valuable service that is provided by natural systems to humanity, in this case in the form of crop pollination. Take California, where much of the pollination of crops relies on managed honeybees, whose populations have been decimated by disease. “This has led to shortfalls in the availability of honeybees for crop pollination,” Williams explains. “If some of that slack can be picked up by native bees, there would be an economic justification for restoration of natural habitat.”

Williams and collaborators have shown that native bees contribute significantly to crop pollination when there is sufficient natural habitat nearby. “Farmers in those situations already are reaping the benefits of natural habitat and populations of native bees,” he says. “It’s very gratifying to be able to do this work.”

Is Restoration Working?

Although it is advantageous for a conservationist to cite an economic justification for habitat restoration, The Nature Conservancy is interested in the answer to broader questions: Is habitat restoration really working and, if not, what must be done differently? “Often, restoration ecologists restore woody vegetation at a site, but they don’t address many of the other elements in the system; for example, they don’t plant tiny flowers and release bees and butterflies. The tacit assumption is that these sorts of species will return on the coattails of structural restoration,” Williams

explains. “I’ve been examining whether or not that assumption is true.”

In particular, Williams is studying the importance of the interface between the habitats — that is, whether or not native pollinators rely on agricultural areas for some of their resources. “Understanding

connectivity



this connectivity is important for informing the design of management strategies,” Williams says. “People are beginning to ask the same kinds of questions around the world.”

A Role for Undergrads

Williams looks forward to involving Bryn Mawr undergraduates in various aspects of his research, including lab studies, fieldwork and computer analysis. “Working with plants and insects in the lab setting requires interested minds and able hands, but not great amounts of training, so it is approachable for undergrads within the timeframe of a summer or a semester,” he observes.

Inspired by the example of his father, Williams has been interested in pursuing a teaching career since he began college at the University of Wisconsin, where the elder Williams is a plant pathologist and professor. “My dad remains one of the most inspirational scientists and teachers that I know,” he reflects.

Williams is particularly excited about the opportunity to work with Bryn Mawr students. “Bryn Mawr is very special place, a really strong liberal arts college,” he says. “The women of Bryn Mawr are so bright and creative — they are as capable as any starting graduate student. They don’t know as much yet, but the intellect is there. Working with them requires that you be creative in the way you explain things; you just don’t want to hold them back. That’s why I sought this type of teaching position.” ■

Dorothy Wright contributes news and feature articles on science, technology, engineering and general interest topics to a variety of publications, including Civil Engineering and Engineering News Record.

Experiencing **Research** *Firsthand*

By Barbara Spector



(From left) Angelina B. Lucento '05, Laura R. Snyder '04 and Sharon Burgmayer

"The tris-dithiolenes that were discovered in Dr. Burgmayer's lab are paramagnetic, meaning that they possess unpaired electrons. We were attempting to characterize these compounds as extensively as possible to explain this unusual property."

Laura R. Snyder '04

COLLEGE SCIENCE COURSES give students the foundation of knowledge on which to build a successful career in research. But the only way to get a feeling for what life in the lab is actually like is to conduct an investigation oneself. The Bryn Mawr College students who participated in this year's Undergraduate Summer Science Research Program experienced both the highs and lows of scientific experimentation.

"It's when something *doesn't* work that you really learn the most," says Laura R. Snyder '04, a chemistry major who spent the summer in the lab of Professor of Chemistry Sharon Burgmayer.



Compound Interest

Snyder and Angelina B. Lucento '05 investigated the magnetic properties of molybdenum compounds. In plants, molybdenum is essential in nitrogen assimilation. In humans, molybdenum enzymes are involved in gout and radical damage after heart failure.

Snyder focused on molybdenum tris-dithiolenes, a category of compounds generally characterized as diamagnetic, or having electrons arranged in pairs. "However, the tris-dithiolenes that were discovered in Dr. Burgmayer's lab are paramagnetic, meaning that they possess unpaired electrons," Snyder says. "We were attempting to characterize these compounds as extensively as possible to explain this unusual property."

Snyder and Lucento synthesized the compounds. "Angelina's role was to synthesize the ligand precursors, which I in turn used to create the tris-dithiolenes complex," Snyder says.

"This kind of teamwork has taught me that I must be very careful in every step that I take chemically, because if something goes wrong on my end, it could cause Laura's results to be misleading," notes Lucento, a chemistry major and Russian minor.

"By participating in research, students learn that I don't have all the answers to their research problems," says Burgmayer. "Sometimes they encounter research problems that I cannot solve immediately." In such cases, "We go to the chalkboard together, think through what we know and then plan for the next step," Burgmayer says. "That eliminates some of the hierarchy of the classroom and emphasizes their participation as collaborators in the project."

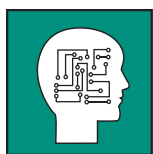
The fact that the paramagnetic compounds defy traditional categorization provides an important lesson for the students, Burgmayer notes. "There are other levels of problems associated with studying them — subtleties that need to be thought about and dealt with."

Lucento plans to attend medical school and possibly pursue a combined M.D./Ph.D. degree. "This summer has allowed me to see how many research opportunities are open to someone with a background in inorganic chemistry research," she says.



Darby Thompson '05 (l.) and Doug Blank

Snyder, a Dorothy Nepper Marshall Fellow, has spent three summers in Burgmayer's lab. She plans to pursue a Ph.D. in inorganic chemistry. "After my first summer doing research, there was no doubt in my mind that I would go to graduate school," she says. This fall, Snyder will present a poster at the American Chemical Society's national meeting in New York.



Auto-Pilot

Darby Thompson '05, a computer science and mathematics major, conducted artificial intelligence research with the goal of teaching a robot to

respond to a command to move from one point to another. In traditional A.I. research, the robot is programmed to take the shortest route. But Thompson tried to teach it to determine its own path, using previous knowledge and predictions.

Thompson was mentored by Assistant Professor of Computer Science Doug Blank and Associate Professor of Computer Science Deepak Kumar. The team also included Ioana Butoi '05 along with one high school student and four Swarthmore College students mentored by Lisa Meeden, an associate professor of computer science at Swarthmore.

"We are working on an approach to artificial intelligence that is very different from anything that anyone has worked on before," Blank explains. "We want the robot to study the problem and figure out how to solve it. Our idea is to raise the robot as one might raise a child. So we start with some basic abilities and, only through interaction, we teach the robot

how to become an increasingly sophisticated thinker. Our methodology lies between learning and evolution: what we call developmental robotics. Darby and Ioana did a wonderful job exploring this unknown territory."

"We wanted to make the artificial intelligence process as human-like as possible," Thompson says, "but a robot is going to think differently in how it connects the dots." The robots were best able to avoid obstacles when their behavior was purely reactive — when they had no memory at all, Thompson notes.

The team's experiments demonstrated that "memory just gets in the way if you don't need it," Blank says. "This shows the tricky nature of the problem: What do we give the robots to start out with? They surely will need memory some day, but if you just give it to them at the beginning, it can be a problem because they don't know what to do with it. What the robots need is an architecture that they can 'grow into.' And that's what we have been working on."

The students from the two colleges met weekly to discuss their progress. "I would think about robots at home," Thompson says. "I couldn't get it out of my head."

Thompson and Butoi first used computer simulation. When they began working with robots, they decided to keep them in a pen. "The two professors, Ioana and I piled into a car and went to Home Depot and bought a lot of wood," Thompson says. "We removed all the furniture from the lab and built a wooden pen for the robots."

"We discovered all kinds of aptitudes that the students had," including their woodworking skills, Kumar says. "We got to see this whole other side of them."

At first, the students were skeptical that the programming techniques would work, Kumar recalls. "By the end of July, they were designing experiments themselves to illustrate how those techniques work."

The students were able to replicate research that is only a few years old, Kumar notes. "Doing robotics at a women's college is not something that traditionally has been thought about. I'd like to see them put together a paper that could be published in a research journal."

(continued on page 12)

"We wanted to make the artificial intelligence process as human-like as possible, but a robot is going to think differently in how it connects the dots."

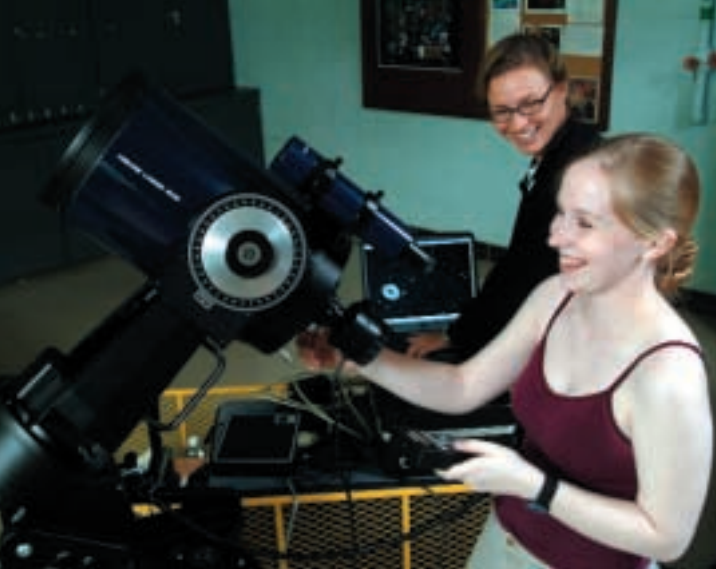
Darby Thompson '05

Barbara Spector writes on science and technology as well as business topics. She is the executive editor of Family Business magazine and former editor of The Scientist.

Photography: Jim Roese

Experiencing Research

(continued from page 11)



Elizabeth McCormack (I.) and Rebecca Pouy '06

"It was so exciting to be able to look at Mars and realize that there was an ice cap that you could clearly see. I had never before seen it with my own eyes through a telescope."

Rebecca Pouy '06

This summer, Butoi, Thompson and Catherine Chiu '04 received a one-year, \$3,000 research award from the Computing Research Association's Collaborative Research Experience for Undergraduate Women in Computer Science & Computer Engineering. The grant will fund their proposal to design a "tour-giving robot" that will offer interactive tours of the science building.



Deep Focus

For her summer research project, Rebecca Pouy '06 focused on astrophotography, using a charge-coupled-device (CCD) camera and a telescope in conjunction with a computer. She was mentored by Elizabeth McCormack, an associate professor of physics.

Pouy, who plans to major in physics and wants to become an astronaut, observed and photographed planets and stars and began compiling a catalog of objects that can be seen from the Bryn Mawr region. She investigated the atmospheric patterns of Jupiter, monitoring the location of its four brightest moons and using those measurements to calculate its mass. She also took images of dust storms and polar ice caps on Mars, which this summer made its closest approach to earth in recorded history.

Jupiter was the first object that Pouy photographed. Before she set the focus, "it would look like a giant floating donut in the sky. Once it got into focus, you could see three of Jupiter's moons. I couldn't wait to go in the next day and play with the photos."

Pouy had read about Mars' dust storms before going out to observe the planet. "It was so exciting to be able to look at Mars and realize that there was an ice cap that you could clearly see. I had never before seen it with my own eyes through a telescope."

Pouy pored through manuals to learn how to use the instrumentation. Despite Pouy's youth, "She is exceptionally prepared to do independent work," McCormack says. "I was impressed with her patience and perseverance. We'll be able to tap into the expertise she's developing for the next three years."

Pouy and McCormack went out to observe a half-dozen times over the summer. Most of the observations took place at dusk, though there were some late-night sessions — one from 3 to 5 a.m. and an all-nighter from 9 p.m. until after 4 a.m. that yielded some 800 CCD images.

Summer research projects involve more than merely investigating the principles of astronomy or physics, McCormack notes. "These projects are a process of developing, of learning how to use the instrumentation and learning the difference between answerable and unanswerable questions."

Extended Community

Summer program participants also learn how to prepare presentations. In the fall 2003 semester, they will present their research to fellow students and science faculty.

Throughout the summer, the undergraduate students also attended brown-bag lunch seminars presented by graduate students, faculty and other researchers. The informal talks enable undergraduates to get to know the College's graduate students and promote cross-disciplinary conversations, McCormack says. "It integrates and reinforces the community. That's something a small college can offer — and it's the way science is going." ■

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“At the beginning of infertility treatment, so that couples know upfront what to expect, I usually discuss what I can do for them and what I can’t, what their expectations should be, and what the overall plan is. I tell them that depending on the results of diagnostic tests and early treatment, I may refer them to an infertility specialist,” Dunston says.

Many possible reasons for infertility exist. IVF was initially designed to assist women with blockages in the fallopian tubes, a common cause of infertility, Dunston notes. Blockages are not evident in a routine pelvic examination, so when one is suspected, she will order a radiology test called hysterosalpingography or perform a laparoscopy in order to look in the abdominopelvic cavity and see where tubal blockages occur. Causes for tubal blockages include sexually transmitted diseases, endometriosis, previous ectopic pregnancy or surgery. Infertility problems in women can also include hormonal imbalance, anovulation and decreasing ovarian functioning related to age. For men they include low sperm count, abnormally shaped sperm or sperm that move too slowly. Sometimes, doctors cannot pinpoint any particular reason for reproduction problems.

Dunston has found that most of her patients are open to IVF if it is needed. “I don’t think there is any stigma attached with IVF. In the general public’s eyes, they consider it an acceptable alternative way to have a baby,” she says. “Their main concerns,” she added, “are the amount of time involved and the amount of money required.”

Expanding Infertility Treatments

If Dunston cannot treat a patient’s infertility problems herself, she refers the patient to an infertility specialist such as Susan Wolf Greene ’80, who runs a private practice in New York City that includes IVF and other assisted reproduction technologies. Greene joined her partner after working as the physician in charge of reproductive endocrinology and infertility at Beth Israel Medical Center, and in doing so joined a rapidly growing number of practices that specialize in treatment for infertility. The number of infertility clinics in the United States grew to 383 in 2000, up 100 since

just 1995, according to the *Assisted Reproductive Technology Success Rates: National Summary and Fertility Clinic Reports* issued by the Centers for Disease Control and Prevention, Atlanta.

Such growth can be attributed to increased acceptance of the procedure as a means to have a baby and also to improved techniques for treating infertility. The armamentarium available to infertility specialists has expanded beyond IVF alone. Using intracytoplasmic sperm injection (ICSI), fertility specialists inject a single sperm into each egg and then return the fertilized eggs to the uterus. This procedure is especially useful for instances of low sperm count. In gamete intrafallopian tube transfer (GIFT), fertility specialists mix eggs and sperm in a narrow tube and then deposit them in the fallopian tube, where fertilization normally takes place. In zygote intrafallopian tube transfer (ZIFT), fertility specialists fertilize eggs in a laboratory dish and the embryos are then placed in the fallopian tube rather than the uterus, as with IVF. An experimental technology called intracytoplasmic transfer, wherein the nucleus from an older woman’s egg replaces the nucleus of a younger woman’s egg, may help older women become pregnant.

Risks and Costs

Greene focuses her efforts on helping patients who want to conceive, but she also has to deal with other issues. For instance, implanting three eggs in a patient’s uterus increases the chances that an IVF cycle will succeed, but it also increases the chances that it will result in multiple births, which put mother and the babies at increased risk. Also, many patients are referred to her because they are experiencing infertility related to declining ovarian functioning. “Pregnancy rates definitely go down the older you are, and so does the success rate with IVF,” Greene says.

Greene’s practice uses a financial counselor who meets with all patients who decide to go through with IVF. Even though New York has recently mandated coverage for infertility, coverage for IVF depends on various qualifications and may not be complete. “The financial issues are hard and sometimes cost does

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Kyrin Dunston ’86



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Susan Wolf Greene ’80



“It’s madness to assume that we can know everything about a biological process as complicated as having a baby. It’s hubris to think we can replicate this process perfectly through an artificial approach.”

Ruth Levy Guyer '67

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change what you do medically,” Greene says. “If I’m working with a patient who can only afford one IVF try, I’ll try to maximize the procedure and will even cancel it and try again later if I think she can make more eggs after another round of ovulatory-inducing drugs.”

Multiple Births

Issues such as cost and safety make Ruth Levy Guyer ’67 uneasy about IVF. “Because IVF is so expensive and so much more expensive than fertility drugs, it further widens the already huge gap between the sorts of medical treatments and opportunities that are available for rich women and those who are poor. IVF certainly helps many people have children who otherwise couldn’t, but the technology, like all technologies, sometimes fails. It’s important to remember that you can’t fully control this technology,” says Guyer, who has written about medical bioethics for 25 years and teaches a bioethics course at Haverford College.

Of particular concern, Guyer notes that IVF increases the likelihood for twins, triplets and higher multiples, and creates great health risks for the mother. Risks for women and fetuses increase with the number of fetuses. Typically, multiple babies are born prematurely with a range of lung, bleeding, bowel and central nervous system problems. Premature babies spend weeks and often months in neonatal intensive care units and require more attention and medical care early on. They also may have lifelong problems as a result of their prematurity.

Of course, multiple births do happen naturally, but IVF and other fertility technologies greatly increase the odds for such pregnancies, Guyer notes. Current U.S. regulations now limit IVF to the implantation of three eggs per cycle, but many clinics have dropped down to two eggs in response to pressure from the medical community and others to act more responsibly. In the past, physicians would use as many as seven eggs per cycle in an effort to improve “success” rates. Even with the lower number of implanted eggs, about 32 percent of pregnancies that result from IVF are twins, and 5 percent are triplets or more.

Designer Babies

Guyer also is concerned about the issue of “control.” Some parents who use IVF come to believe that they can control everything about their babies because they have micromanaged conception and pregnancy. The emerging field of preimplantation genetics screening allows physicians to identify certain genetic defects in either an egg or an embryo. They then implant only those embryos that lack specific genetic abnormalities. This testing can currently be used to identify the genetic defects that are associated with cystic fibrosis, sickle-cell anemia, Tay-Sachs disease, hemophilia and muscular dystrophy — and enable couples and medical personnel to make informed decisions about how to proceed. Should researchers discover single genes for personality or physical traits, parents might try someday to select for traits they consider desirable.

Selecting for a baby who doesn’t have a fatal disease, such as Tay-Sachs, seems to be ethically straightforward, Guyer notes, but selecting for or against genes that might control height or hair color, for example, would be problematic. “What sort of society are we when we think it is acceptable to micromanage a pregnancy or design a baby to this extent?” Guyer asks. As the technology for genetic preselection improves and expands, society is increasingly challenged to address both the correctness and consequences of controlling natural processes. “We have to think about what we’re doing and not do things just because we can,” she says.

Whether parents would actually want to manipulate IVF procedures so that they could control for traits beyond those related to disease is unclear. Greene emphasized that almost all of the patients she treats are not even interested in selecting the sex of their child, let alone selecting for or against other traits. “A basic technique exists for separating the sperm that results in a 75 percent chance of selecting the sex; but sex selection is usually reserved for cases when the mother carries an X-linked genetic disease that would affect a male child, but not a female child,” Greene says.

In the long run, it's important that society not accept IVF just because its use is increasing, Guyer says. "It's madness to assume that we can know everything about a biological process as complicated as having a baby. It's hubris to think we can replicate this process perfectly through an artificial approach," she observes, adding that even after 25 years since the first IVF took place, we must still wait to see what the long-term health issues are for IVF-conceived children.

Imprinting Disorders

To date, children conceived by IVF appear to be as healthy as children conceived naturally. Recent research, however, has linked IVF with a slightly increased risk for imprinting disorders, in particular Beckwith-Wiedemann syndrome — a rare disorder that causes babies to be born large, with oversized organs and an increased risk of developing certain childhood cancers. One study found that the incidence of Beckwith-Wiedemann syndrome was six times as high in IVF-conceived children than in naturally conceived children.

Imprinting disorders occur when a gene that is normally "silent" is activated. Scientists do not know the reason for imprinting errors, but they surmise

that, in IVF, the laboratory environment in which the ova and embryos grow before being implanted may somehow activate imprinted genes. In Beckwith-Wiedemann syndrome, for instance, abnormal activation of insulin-like growth factor 2 (IGF2) releases a flood of growth factor that may promote certain cancers to develop.

"The imprinting disorder in Beckwith-Wiedemann syndrome causes two insulin-like growth factor 2 genes to be active rather than just one, and this stimulates abnormalities in insulin-like growth factors that can stimulate cancer growth and other health problems," says Lynne L. Levitsky '62, the chief of the pediatric endocrinology unit at Massachusetts General Hospital and an associate professor of pediatrics at Harvard Medical School. Levitsky treats the symptoms of Beckwith-Wiedemann syndrome, including the associated growth problems, and performs cancer screening. She says that children with this syndrome face a risk as high as 7 percent for kidney or liver malignancy until they reach seven or eight years.

"They need to be constantly screened for these tumors with ultrasounds and blood tests. It's a pretty scary thing having to watch your child get tested every three months for seven years," Levitsky says. A

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"The imprinting disorder in Beckwith-Wiedemann syndrome causes two insulin-like growth factor 2 genes to be active rather than just one, and this ... can stimulate cancer growth and other health problems."

Lynne L. Levitsky '62

About Our Sources

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Susan Wolf Greene '80 has a private practice in New York City specializing in treating people with infertility, where she uses her professional name, Susan A. Wolf. Until recently she was physician-in-charge at the division of reproductive endocrinology and infertility in the department of obstetrics and gynecology at Beth Israel Medical Center. She graduated from Mount Sinai School of Medicine and completed a residency in obstetrics and gynecology at Beth Israel Medical Center. She completed a fellowship in reproductive endocrinology at the University of Medicine and Dentistry of New Jersey.

Ruth Levy Guyer '67 has taught nonfiction and science writing courses in the Johns Hopkins University Master of Arts in Writing program since 1994, and she is a visiting professor at Haverford College teaching bioethics. Previously a writer for *Science* and the NIH, she now writes commentaries, essays and articles about bioethics and medicine for newspapers and journals. Guyer received her Ph.D. in immunology from the University of California, Berkeley.

Lynne L. Levitsky '62 is the chief of the pediatric endocrinology unit at Massachusetts General Hospital and an associate professor of pediatrics at Harvard Medical School, Boston, where her research laboratory focuses on the genetics of human liver development, diabetes mellitus and Prader-Willi syndrome. Levitsky received her M.D. from Yale University.

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preliminary test has also linked an increased risk of another rare imprinting disorder called cloacal-bladder exstrophy-epispadias complex, which causes treatable urological defects among children conceived through IVF.

Cultural Variations

Just as IVF has proliferated throughout the United States, it has also spread throughout the world, not only to highly industrialized countries but also to developing societies, according to Melissa J. Pashigian, an assistant professor of anthropology at Bryn Mawr. In doing so, it has engaged varied societies in a moral dilemma of what is natural and who should have access. Pashigian notes that when a new technology is transferred to other countries, people often use cultural beliefs as a basis for integrating it.

“In a place where sperm donation is unacceptable for religious reasons or because of the belief that children come specifically from the husband’s sperm, traditional IVF creates problems of social acceptability. But with intracytoplasmic sperm injection for cases where a husband has a poor sperm profile, IVF may become culturally acceptable since the need for a donor is eliminated,” Pashigian explains.

Pashigian also notes that cost is a significant issue in many countries where IVF is available. How it is paid for varies from country to country. In the

Netherlands, for instance, the government pays for all of the costs associated with the procedure. In England, a debate continues over whether the National Health Service should offer free IVF rather than current, limited coverage of it. In many countries, the government and individual share the cost of the procedure. In Vietnam, where Pashigian has studied fertility issues, IVF is an expensive procedure compared to annual average income, and the procedure remains beyond the reach of most, she says. Pashigian plans to return to Vietnam to study how people’s perceptions of IVF have changed since the technology arrived there in 1997.

“The idea of natural or unnatural may be a bit different now. Initially, IVF was considered a very experimental procedure not available to many people, but when people seek out infertility treatments today, it’s one in an array of options,” she says. In the past 25 years, IVF has challenged people to examine cultural notions about normalized reproduction, she says. Looking to the future, Pashigian wonders: “Should we anticipate that technology’s role in reproduction will become more prominent in the future?” ■