MBL

Catalyst

Biological Discovery in Woods Hole

Founded in 1888 as the Marine Biological Laboratory

Fall 2006
Volume 1, Number 1

IN THIS ISSUE

Catalyst for Discovery

By providing a charged scientific environment and attracting top researchers and students from around the globe, the MBL sparks biological discovery

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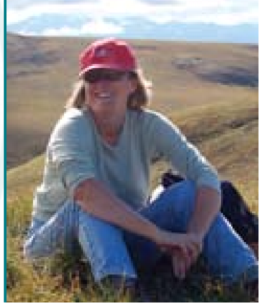

From the Editor

Dear Friends,

When the MBL decided to launch a new magazine, we knew it had to capture vividly the excitement, the energy, the magic that is the MBL. It also had to have a strong yet simple name that would stand the test of time, recognize the MBL's remarkable history, and convey the institution's aspirations for the future.

But finding the perfect name for a new magazine isn't easy. Over the past few months we've brainstormed. We've asked members of the MBL family for suggestions. We've debated and tried various options on for size. In the end we chose "Catalyst," a noun we believe speaks to the heart of what the MBL is all about.

The MBL is—and always has been—a catalyst… for biological discovery, for shaping careers, for sparking collaborations, for fomenting ideas. It's a place where the leaders of today work with the leaders of tomorrow to do remarkable things, often changing the face of biology in the process.

The stories you'll find in this and future issues illustrate the MBL as catalyst. In our inaugural issue you'll meet MBL's new director and CEO, Gary Borisy, and learn more about his exciting vision for the institution's future. You'll find the latest news from our laboratories, get to know some of our scientists, and learn more about our plans to transform the science that's being done here.

Every issue will contain a "Scientist's Eye View" commentary from our guest science editor, who will share his or her thoughts about important issues in science. We owe a great debt of gratitude to Catalyst's *first guest editor Thoru Pederson for his good humor, gentle guidance, and deft editing. Editor and writer Andrea Early also earns our hearty thanks for all she's done to make* Catalyst *a reality.*

Catalyst *will be published by the MBL twice a year. And while we know scientists and MBL Corporation Members will enjoy the magazine,* Catalyst *is primarily designed for the non-scientist, for people who'd like to get to know the MBL better.*

So, welcome to Catalyst. *Read and enjoy. We look forward to sharing the magic of the MBL with you and welcome your comments and suggestions.*

Pam Hinkle

Pamela Clapp Hinkle
Editor-in-Chief
Director of Communications

MBL Catalyst

Fall 2006 — Volume 1, Number 1

Catalyst is published twice yearly by the Office of Communications at the MBL in Woods Hole, Massachusetts. The MBL is an international, independent, nonprofit institution dedicated to discovery and to improving the human condition through creative research and education in the biological, biomedical and environmental sciences. Founded in 1888 as the Marine Biological Laboratory, the MBL is the oldest private marine laboratory in the Western Hemisphere.

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About the cover:
The MBL campus and Eel Pond as seen from the Redfield building in Woods Hole. Photo by Tom Kleindinst.

Online extras:
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Catalyst

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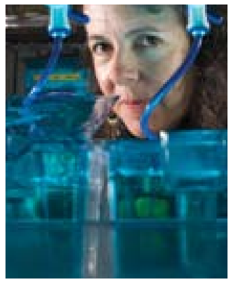
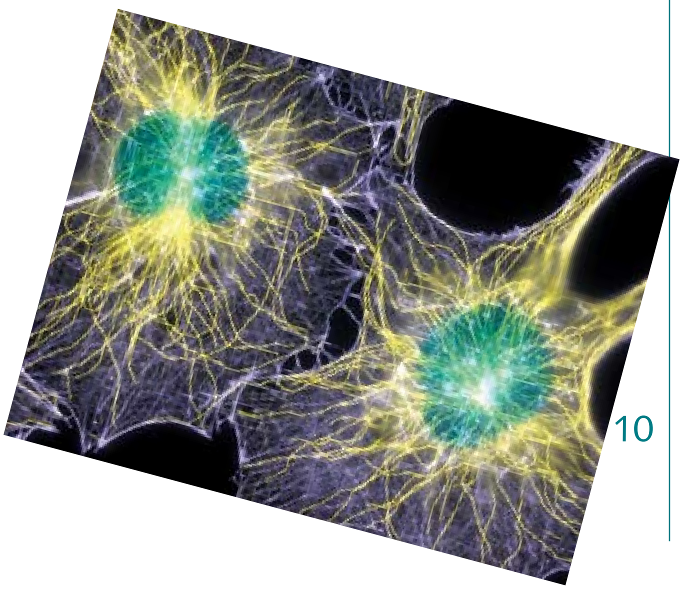




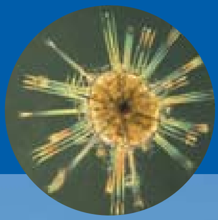
Departments

Catalyst for Discovery

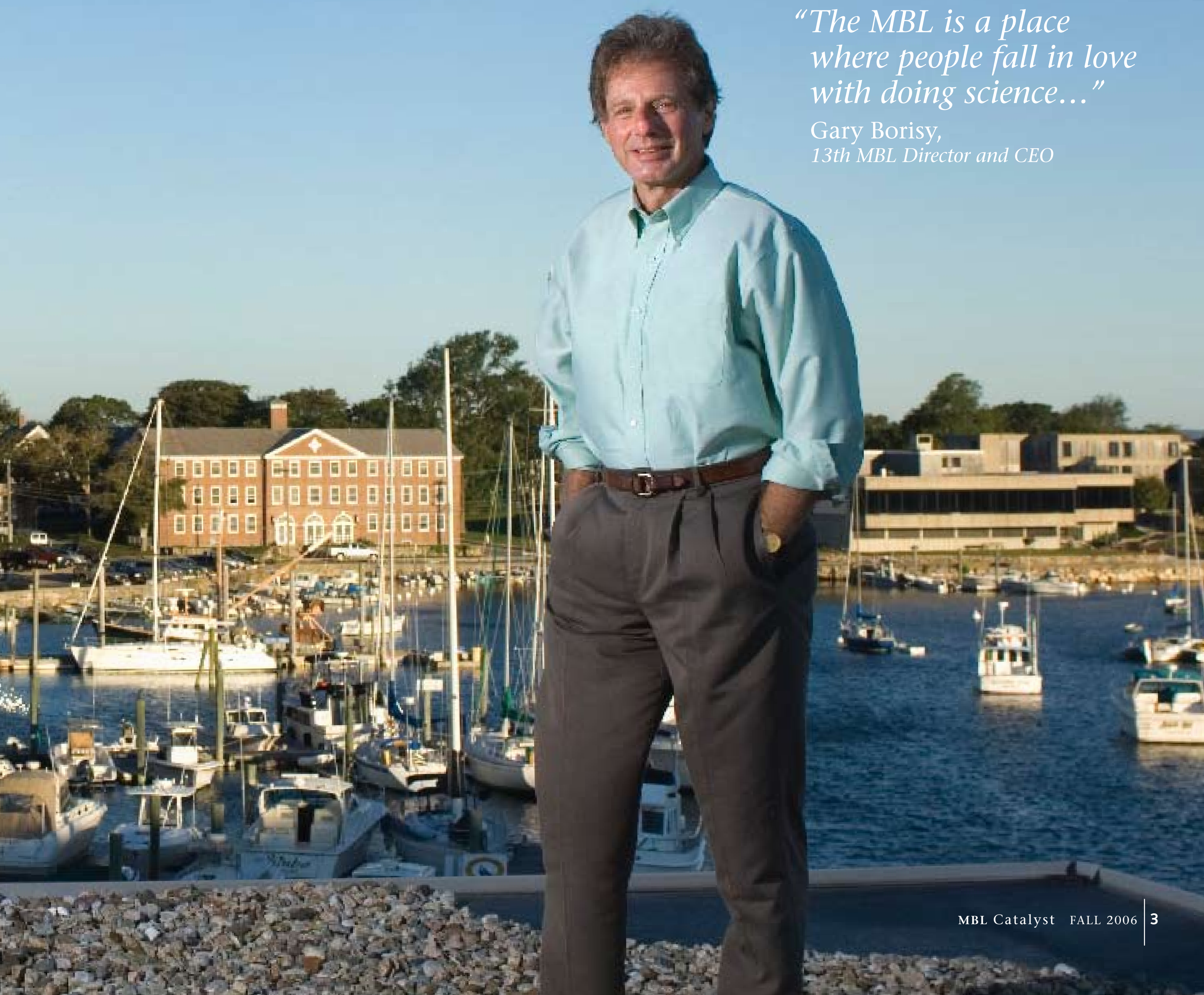
By providing a charged scientific environment and attracting leading researchers and students from around the globe, the MBL sparks biological discovery.

Scientific breakthroughs begin with a hunch, an intuitive spark, a basic question that no one has answered, or maybe even thought to ask. False starts are followed by Eureka! moments. Then, more false starts. New lab instruments are designed because the existing tools do not meet the needs of the experiment. And after months or years of painstaking work and developing and tearing apart ideas with colleagues, it happens—the researcher discovers a protein that leads to potential new treatments for cancer, probes a mechanism in a squid nerve cell that points to fresh insights into Alzheimer's disease, or pieces together an environmental puzzle that may help protect our planet. Often the discovery has little to do with the researcher's initial line of inquiry, but serendipity only heightens the thrill—and the impact—of discovery.

For more than a century, the MBL has provided a uniquely productive place for this kind of research, attracting a high concentration of scientists and students from around the globe. They interact intensively, catalyzing the rate of development and discovery, their breakthroughs dramatically altering our understanding of biology and offering bright new possibilities for improving human health and the environment.



Now the MBL is evolving into an even more dynamic center for biological discovery. "We are poised for a jump to a higher level of impact on biological science," says new director and CEO, Gary Borisy (below). With Borisy at the helm; an unprecedented $5 million gift from the family of new chairman of the board John W. Rowe and his wife Valerie; and major upgrades underway in the MBL's Whitman building, the MBLWHOI Library, and other facilities, the MBL has initiated a sea change intended to keep it at the frontier of biological science, where there is still a great deal to discover.



"The MBL is a place where people fall in love with doing science..."

Gary Borisy,
13th MBL Director and CEO

MBL: Catalyst for Discovery

A Leader in Biology Since 1888

The history of the MBL is the history of modern biology. Scientists here have made, and continue to make, fundamental discoveries about how organisms—including humans—reproduce and develop, how the immune system works, how sensory organs gather information, and how brains process it. Sea urchin research has taught us about fertility. Studies of sea slugs have shed light on learning and memory. Experiments with sponges have revealed secrets about disease immunity. Research using the nerve cells of the squid has provided insights about neurodegenerative disorders. Horseshoe crabs have helped MBL scientists lay the foundations for modern vision physiology.

MBL Research Today

MBL scientists are currently working on the next big discoveries. In the Whitman Center for Collaborative Research, investigators are pushing the limits of cell biology and neuroscience, reproductive research and tissue engineering, and immunology and vision research to gain essential information needed to solve such medical mysteries as diabetes, hearing loss, epilepsy, infertility, cancer, macular degeneration, and Parkinson's disease.

One Whitman Investigator, for example, is studying the molecules in the horseshoe crab's immune system, which is leading to a better understanding of how humans fight disease. Another MBL scientist, Nobel Laureate Avram Hershko of the Technion-Israel Institute of Technology, studies ubiquitin—a protein implicated in cancer. And MBL neuroscientists are using the latest optical imaging tools to observe cellular processes related to learning and memory.

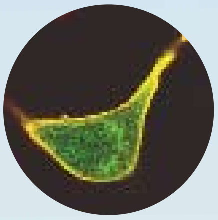
In the MBL's Josephine Bay Paul Center for Comparative Molecular Biology and Evolution, scientists using advanced genome analysis recently showed the world just how diverse bacteria are in the deep ocean. Other Bay Paul Center scientists are exploring disease-causing microorganisms that affect humans and other species. Bay Paul Center researchers are also analyzing the composition and distribution of water-borne human pathogens, such as those that flourished after Hurricane Katrina.

Across campus, MBL Ecosystems Center scientists use stable isotope analysis, GIS mapping, and mathematical modeling tools to examine life on a larger scale. Center researchers gather data from simple ecosystems and build computer models for the same reason some MBL biologists study squid cells or sea urchin eggs: learning how normal healthy systems work is a critical part of understanding—and one day potentially fixing—systems that are diseased or malfunctioning. Ecosystems Center scientists study environmental systems around the globe, including forests, salt marshes, Amazon basin streams, and Arctic tundra ecosystems. They are also tracking a freshening trend in the Arctic Ocean that could have serious climate implications.

Training Tomorrow's Scientific Leaders

Biological discovery isn't just for MBL researchers. It's also a signature part of our unparalleled educational program. By offering intensive, hands-on laboratory and field courses taught by the top researchers in areas ranging from ecosystems science to embryology, reproductive technology, microbiology, neurobiology, parasitology, cell physiology, and even biomedical information technology, the MBL is a premier training ground for tomorrow's scientific leaders.

"Our courses are oriented toward discovery, not pedagogy," says Borisy of the educational approach that draws students from nearly every continent. MBL's courses also incorporate the latest research tools, such as computational biology, genomics, and high-powered microscopes. Our recently established joint Ph.D. program with Brown University is evidence that the MBL's educational reach is still growing.



Building for the Future

These are exciting times at the MBL. Signs of growth and progress are everywhere. While Gary Borisy and the Board of Trustees work to widen the MBL's scientific, educational, and financial horizons, construction workers with buzz saws and cranes are transforming the Whitman building and facilities within the Lillie building to better serve the MBL community.

"Our goal is to make the MBL an even greater research and education center," says Borisy. "The plan is to integrate discovery-based education and the MBL's signature research programs by identifying synergies between these disciplines and seeking ways to expand or enhance them," he explains. "We intend to protect and nurture all that makes the MBL special, while keeping the institution focused on first-rate science that can be done uniquely or to special advantage at the MBL." •

Gary Borisy
13th MBL Director and CEO

Previous Appointments:

2003-2006: Associate vice president for research, Northwestern University

2002: President, American Society for Cell Biology

2000-2006: Leslie B. Arey professor of cellular and molecular biology, Northwestern University Feinberg School of Medicine

1968-2000: Professor of molecular biology and zoology, University of Wisconsin, Madison

Discoveries:

Borisy is one of the cell pioneers of our time. In 1965, he discovered the protein tubulin, which comprises a key part of the cell's cytoskeleton. He has also provided important insights into chromosome movement; the role of the protein actin, a major component of cell motility; and the dynamics of microtubules, filaments that help direct cell division.

MBL Affiliations:

"The MBL is a place where people fall in love with doing science," says Borisy. He himself fell in love with science at the MBL in 1965, as a student in the Fertilization and Gamete Physiology course. He returned in 1972 to establish a summer laboratory, where he conducted research for five years on cytoskeleton formation. He also served as a Physiology course consultant in 1982 and 1983.

Education:

B.S. in biochemistry, University of Chicago

Ph.D. in biophysics, University of Chicago

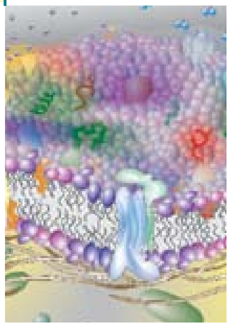
Postdoctoral Fellow, Medical Research Council, Cambridge, England

Family:

Married to Sally Casper, a development professional. Three grown children; five grandchildren.

Other Talents:

A baritone, Borisy once sang in the Madison Civic Opera Chorus, in operas including *Tosca, Pagliacci,* and *Cavelleria Rusticana*. He has also been known to build the occasional stone wall, and is a lapsed vegetable gardener.



Diabetes Meets Microtechnology

Now that diabetes has reached epidemic proportions in the U.S., the development of new treatments and ways to test them is an urgent matter. That's where Peter J.S. Smith, director of the MBL's BioCurrents Research Center, and MBL Bell Tissue Engineering Fellow Ronald Pethig, of the University of Wales, Bangor, come in. They are attempting to engineer artificial assemblies of insulin-secreting cells to mimic pancreatic cell groupings called islets of Langerhans. Malfunctions in these important tissues often result in diabetes. The scientists, who are using electrical fields and other microtechnologies to create the artificial islets, have the long-term goal of someday offering transplant options for Type 1 diabetics. The engineered tissues may also provide a valuable testing ground for therapies being developed to fight certain diabetic conditions. •

Itchy Consequence of Carbon Dioxide

Carbon dioxide (CO_2) is getting a bad rap lately for all that it contributes to global warming. Now rising CO_2 levels may exacerbate another problem: poison ivy. Jacqueline Mohan of the MBL's Ecosystems Center recently reported that when poison ivy is exposed to the levels of CO_2 expected in the atmosphere by the middle of the century, it is twice as prolific. Not only that, the version of urushiol, the compound that causes the dreaded itchy rash, was more allergenic in the CO_2-enhanced plots. Mohan's study, published this year in the *Proceedings of the National Academy of Sciences*, was part of a CO_2 enrichment experiment at Duke University, where extra carbon dioxide was pumped into 100-foot diameter circular plots of forest. Her results are significant beyond our desire to avoid blistering rashes. Poison ivy is a type of woody vine that smothers saplings in forests around the world. If carbon dioxide increases woody vine growth, and woody vines strangle baby trees, the effect on future forests could be considerable. •

Unfathomable Microbial Diversity in the Deep Ocean

The MBL's Mitchell Sogin and his colleagues recently made waves with the publication of a groundbreaking study revealing that marine microbial diversity in the deep ocean may be some 10 to 100 times greater than expected. In a paper published by the *Proceedings of the National Academy of Sciences* (PNAS), Sogin and his co-authors reported that the vast majority of these microbes are previously unknown, low-abundance organisms theorized to play an important role in the marine environment as part of a "rare biosphere." "These observations blow away all previous estimates of bacterial diversity in the ocean," says Sogin, director of the MBL's Josephine Bay Paul Center for Comparative Molecular Biology and Evolution. As part of the International Census of Marine Microbes, the scientists collected water samples from eight deep-sea locations, including on the Axial Seamount in the Pacific Ocean and at several Atlantic Ocean sites between Greenland and Ireland, and discovered the new kinds of bacteria using an innovative DNA analysis technique known as "454 tag sequencing." The resulting paper was one of August's most-read papers at PNAS Online and was recently listed as "the Number 1 paper in all biology" by Faculty of 1000, an online research tool that highlights the most interesting papers in biology based on the recommendations of more than 1000 leading scientists. •

How Our Seas Became Less Salty

Scientists have known for some time now that fresh water from various sources was somehow contributing to a 50-year freshening trend in the Arctic and North Atlantic Oceans, but didn't know how the puzzle pieces fit together. This year MBL Ecosystems Center senior scientist Bruce Peterson and his colleagues changed all that by providing the first-ever, big-picture analysis of this trend. Their findings, published recently in the journal *Science*, revealed that fresh water increases from Arctic Ocean sources appear to be highly linked to a fresher North Atlantic. The study also showed that increasing precipitation and river discharge contributed the most fresh water (~20,000 cubic kilometers) to the Arctic Ocean and high-latitude North Atlantic. Sea ice reduction provided another ~15,000 cubic kilometers of fresh water, followed by ~2,000 cubic kilometers from melting glaciers. Fresher northern ocean waters could potentially cause a cooling of northern Europe within this century, because they may disrupt the gigantic ocean conveyor belt known as the Thermohaline Circulation. Normally, cold northern water sinks and flows south, while warm southern waters flow north on the surface. But fresh water is less dense than salt water and floats on top. If northern ocean water becomes too fresh, it will float instead of sink, interrupting the normal flow of warm water that usually keeps northern climates temperate. The *Science* study provides climate and ocean circulation researchers with new information that could greatly aid their work. •

New Method to Measure Nitrogen Transfer by Fungi

An MBL Ecosystems Center scientist recently helped change the world's understanding of the importance of fungi in the Arctic nitrogen cycle. Previous studies have shown that a type of mushroom lives symbiotically with trees and shrubs. When nitrogen is scarce in the soil, the fungi pass nitrogen from the soil to the roots of the plants; in return, the plants provide sugars to the fungi. But until recently, the amount of nitrogen transferred had never been measured. John Hobbie, MBL distinguished scientist and former co-director of the Ecosystems Center, and his son, Erik Hobbie of the University of New Hampshire, developed a technique for calculating this transfer by measuring minute changes in the amount of a stable form of nitrogen in the soil, fungi, and plant leaves. The study, published this year in the journal *Ecology*, proves that fungi provide up to 90% of the nitrogen that Arctic trees and shrubs need to grow. That same dependence on fungi is likely to be true in nitrogen-limited forests worldwide. •

The Quest for Synthetic Blood

Transfuse the wrong blood type and the patient's immune system may destroy the new blood cells, in some cases leading to death. John Harrington, professor and dean of the School of Science and Engineering at SUNY-New Paltz, hopes to one day develop a red blood cell substitute that would make matching blood types for transfusions irrelevant. Harrington is especially interested in a primary component in red blood cells called hemoglobin, the chemical that carries oxygen from the lungs to the tissues where it is needed. He is researching the possibility of synthetic substitutes for hemoglobin, which would not have the molecules that cause blood type rejections in natural blood. At the MBL, Harrington studies the chemical properties of hemoglobin from the lugworm, a marine organism, to understand why it has a more stable structure than mammalian hemoglobin. Understanding what properties make it more stable could lead to developing safe substitutes, reducing the problems that result from blood shortages and mismatched blood types. •

Nerve Center for Neuroscience

Neuroscience research—like Maria Gomez's quest to understand how nerve cells transport the neurotransmitter dopamine—is thriving at the MBL.

The tiny zebrafish is an important experimental model for scientists studying vertebrate development and disease because, on the simplest level, the life processes of these fish are similar to those of humans. The fish are also easy to breed and genetically alter, so scientists can observe specific genes and molecules.

At first glance, Maria del Pilar Gomez's MBL summer laboratory would hardly make one think of a three-ring circus. It is a more orderly place than many labs, and the lone zebrafish swimming in a small aquarium on a lab bench gives it the calm feel of a doctor's office.

But when Gomez, a neuroscientist from Boston University (BU), does her research she literally becomes a juggler using several tools at once, including electrical recording, optical monitoring, and the use of electrochemistry to detect molecules. She studies minute brain cells, including those of rats, and has recently added the zebrafish to her list of chosen model organisms. Such simple experimental systems often help scientists unravel human medical mysteries.

Gomez is researching dopamine, the neurotransmitter that helps regulate the brain's motor and reward centers. Released at the ends of certain nerve cells in small packets, dopamine travels across a narrow space, the synapse, and activates the receiving nerve cell. But not all the dopamine is used up, and its timely removal, or reuptake into the sending cell, is essential for properly balanced information processing. She and her long-time scientific partner and husband, Enrico Nasi, also of BU, are especially interested in dopamine transporters, the proteins responsible for this cleanup job. But scientists now believe they may also perform an additional function. The hypothesis, which Gomez hopes their research will support, is that transporters can also release dopamine, and thus mediate a type of chemical signal delivery that differs from the classic mechanisms that operate at the synapse.

Learning how dopamine transporters work—and defining the role they play in cellular communication—may further our understanding of diseases, such as Parkinson's, which feature the malfunction of nerve cells that send and receive dopamine. The research may also have eventual implications for the treatment of addictive behaviors caused by drugs such as ecstasy, cocaine, and amphetamines. These drugs specifically target dopamine transporters and inhibit their reuptake function, leaving too much dopamine in the synapse, and leading to over-stimulation of the receiving cell.

Drawn to the MBL for its world-class neuroscience community, its library, and its advanced seminar offerings, Gomez is one of 117 neuroscientists who pondered the inner workings of the nervous system here this summer.

The MBL has been a magnet for neuroscience since 1930, when J.Z. Young rediscovered the squid giant axon, a nerve fiber that is 20 times larger than the largest human one. This ideal model system caught the attention of Young's MBL colleague K.S. Cole, who used it to make the first measurements of the resistance changes underlying the nervous impulse. This research inspired A.L. Hodgkin and A.F. Huxley (who won the Nobel Prize for this work) to lay the basis for the modern understanding of electrical activity in the nervous system by measuring the flow of charged particles across the axon's membrane.

The MBL continues to be a leader in neuroscience, attracting scientists who study the giant axon, as well as those seeking to understand the mechanisms of vision, learning and memory, recognition and memory storage of odors, and scientists like Gomez who study the transport of neurotransmitters. Courses in neurobiology and computational neurobiology, as well as MBL-funded fellowships and faculty collaborations supported by the

The MBL has a worldwide reputation with biologists for its expertise in rearing organisms, such as zebrafish, for scientific research. Maria Gomez studies these popular aquarium fish to learn about dopamine, a neurotransmitter whose malfunction has been implicated in addictive behavior and Parkinson's disease.

Grass Foundation and Dart Neuroscience LP, draw additional brainpower, as does the MBL's virtual Neuroscience Institute, and the Whitman Center's NeuroImaging Cluster, a grouping of neuroimagers and high-powered equipment that promotes informal collaborations among top experts in the field.

The dopamine transporter study is a recent undertaking for Gomez, and she and Nasi have benefited from the MBL neuroscience community as they've explored this new territory. They had conducted vision research here for 20 years using marine models including squid and scallops, but when their former BU colleague Isabelle Mintz (now of Northwestern University) approached them two years ago about collaborating on the new project, they decided to pursue it.

Gomez and Nasi are proficient at working with isolated cells, a challenging approach they've been using in the dopamine transporter study. But one reason the MBL is crucial to their current research is that it offers expertise on something in which Gomez and Nasi aren't yet well versed: zebrafish. "We're interested in creating a transgenic line of zebrafish that will express a fluorescent marker in dopamine-releasing cells," says Gomez. "And the MBL has expertise in zebrafish rearing and genetic modification." Because the embryos of these tiny aquarium fish are transparent, the markers will enable the scientists to positively identify those cells that express the dopamine transporter, so they can be targeted for physiological measurements.

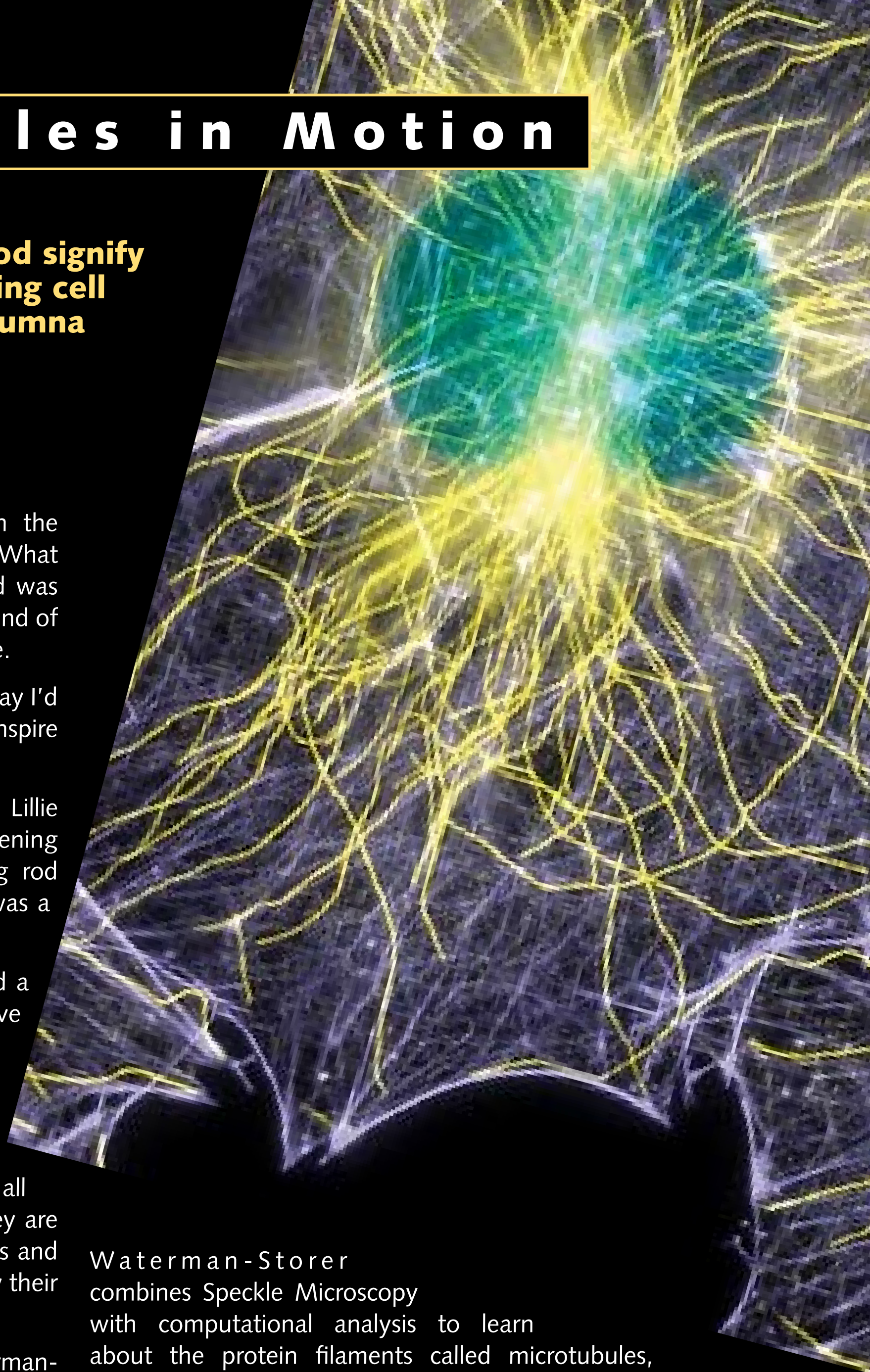
The MBL has been a constant in Gomez's and Nasi's scientific pursuits. "It has been fundamental in all of the experiments we do," she says. "I'd say two thirds of our experimental work has been done at the MBL. It is important not only because of the resources, such as the library and microscopy facilities, but also because of the lively scientific environment and the opportunity to keep up to date through the speakers featured in the various seminars and lecture series."

Fully understanding how dopamine transporters work and how that information might be applied to treating Parkinson's disease or certain drug addictions is likely to take a while, and will require painstaking work, but Gomez thinks it will be worth it. "You have to understand the basic mechanisms before you can attempt to find a cure," she says. •

"You have to understand the basic mechanisms before you can attempt to find a cure."

Catching Molecules in Motion

How does an old fishing rod signify success to an award-winning cell biologist? Just ask MBL alumna Clare Waterman-Storer.



In 1993, when Clare Waterman-Storer was a student in the Physiology course, the laser pointer hadn't been invented. What course instructors and Friday Evening Lecturers used instead was an old fishing rod that immediately became a symbol of the kind of scientific success Waterman-Storer hoped to someday achieve.

"I was obsessed with that pointer, she says. "I thought: One day I'd like to be a good enough scientist to return to the MBL and inspire young scientists, and I want to hold that damned pointer."

This summer Waterman-Storer did just that. On stage in Lillie Auditorium, she delivered the Distinguished Alumni Friday Evening Lecture while pointing to her slides with the same fishing rod pointer she had dreamed of holding for thirteen years. "It was a huge moment for me," she says.

Now an associate professor at Scripps Research Institute and a 2005 recipient of an NIH Pioneer Award grant for her innovative studies of cell movement, hers is a classic MBL story.

"Taking the MBL Physiology course was the deciding factor in my scientific career," she says. "I had read a lot of scientific papers, but there was no human aspect to them. You get to the MBL and you actually meet the people who have written all the papers that influence your thinking and you see that they are human. And you get an opportunity to get inside their heads and see how these different great scientists approach biology, how their brains work, and to be inspired by them."

Since she recently became a Physiology course instructor, Waterman-Storer is now someone whose head students want to explore. And meeting her isn't an experience one easily forgets. "She has remarkable energy," says Physiology course director Ron Vale. She also has a no-nonsense way about her that exudes competence, and her biceps tattoo of the mitotic spindle speaks volumes about her dedication to her science.

"Clare brings the same energy to teaching as she did as a student," says Vale, who was her Physiology course instructor in 1993. "She runs a very well-organized teaching section, brings interesting research projects to the course, works side-by-side with the students past midnight, and enjoys a subsequent beer with them at the Captain Kidd. The students love her."

An expert in cellular biophysics and the owner of no fewer than five high-powered microscopes, Waterman-Storer is well known for her use of specialized fluorescent imaging to observe the dynamics of molecules in living cells during cell migration and division.

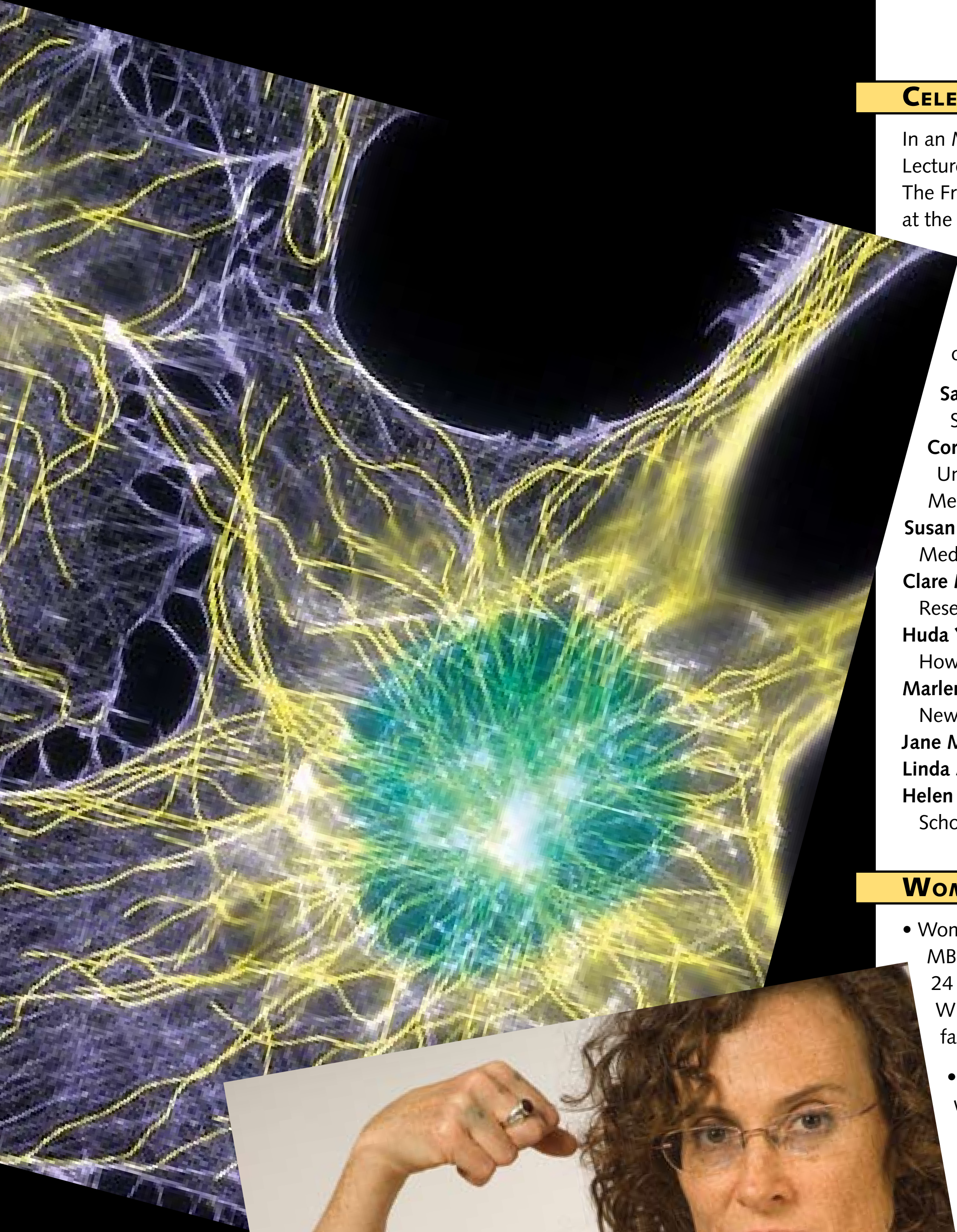
In fact, while serving as a postdoc in Ted Salmon's lab at the University of North Carolina, a mistake in the lab led to her discovery of quantitative Fluorescent Speckle Microscopy, the technique that enables her to track the moving parts of a cell.

Waterman-Storer combines Speckle Microscopy with computational analysis to learn about the protein filaments called microtubules, which make up the cell's internal framework, or cytoskeleton, and help cells divide, move, and transport important materials to where they're needed.

Living things, she says, are in part defined by the ability to move or change. Her primary interest is in how systems of molecules inside a cell work together to make it move. Understanding this process may ultimately have implications for curing diseases of the immune and vascular systems, as well as preventing cancer metastasis, since all involve cell movement.

Since her days as a Physiology course student, Waterman-Storer has established herself as a scientific force. "She has indeed been a pioneer," says Vale. "She has developed novel microscopy techniques for cell biology and she has the ability to think about old problems, such as cell migration, with fresh perspectives."

Returning regularly to the MBL is one way she keeps a fresh perspective. "I keep going back because it invigorates me scientifically, socially, and even spiritually... I've never, ever spent more than four days at the MBL where I didn't come back with some major change in the way I think about what I've been thinking about for 15 years," she says. "Several different summers have produced major changes in the course of my research."•



Celebrating Women in Science

In an MBL first, this year's Friday Evening Lecture Series featured all women speakers. The Friday Evening Lectures feature scientists at the pinnacle of their careers and have been an MBL tradition for more than 100 years. The 2006 series celebrated the MBL's dedication to women in science and highlighted the work of the following scientists:

Sarah W. Bottjer, University of Southern California
Cori I. Bargmann, The Rockefeller University, Howard Hughes Medical Institute
Susan Wente, Vanderbilt University Medical Center
Clare M. Waterman-Storer, The Scripps Research Institute
Huda Y. Zoghbi, Baylor College of Medicine, Howard Hughes Medical Institute
Marlene Belfort, Wadsworth Center, New York State Department of Health
Jane Maienschein, Arizona State University
Linda A. Deegan, MBL Ecosystems Center
Helen M. Blau, Stanford University School of Medicine

Women at the MBL

- Women have been a driving force at the MBL. Today they account for more than 24 of our year-round scientists, over 111 Whitman scientists, 248 of our course faculty, and over half of our students.
- The MBL's early goal was to provide women advanced training to prepare them as high school and college science teachers. The MBL was ahead of its time in enlisting women to enroll in its programs on an equal basis with men, and many our female students went on to earn Ph.D.s in the natural sciences.
- Between 1888 and 1910, about a third of the MBL's students were women, many of them secondary school teachers from throughout the country. In the Botany and Embryology courses, more than half the students were women.
- Although fewer women were admitted between 1910 and 1970, women have been prominent in MBL courses from the seventies to the present.
- In 2005, Mary Mullins and Cecilia Moens became co-directors of the Neural Development & Genetics of Zebrafish course, making it the first MBL course directed exclusively by women.

Vital Statistics

Home Institution: Department of Cell Biology, Scripps Research Institute, La Jolla, California

MBL Affiliations: Physiology course alumna (1993), Physiology course instructor (2004-2006), Distinguished Alumni Friday Evening Lecturer (2006)

Degrees: B.S. in biochemistry, Mount Holyoke College; Ph.D. in cell biology, University of Pennsylvania

Awards: 2005 NIH Pioneer Award; 2002 Women in Cell Biology Career Recognition Award, American Society for Cell Biology

Tattoos: Mitotic spindle (biceps), RNA code for protein "start" and "stop" (knuckles), double X chromosomes (lower abdomen)

MBL Moment

...with

Robert D. Goldman

Director, The Whitman Center for Collaborative Research

Dr. Goldman is the Stephen Walter Ranson Professor and Chair, Department of Cell & Molecular Biology—Northwestern University Feinberg Medical School; 2007 President-Elect of the American Society for Cell Biology.

His study of surf clam eggs is shedding light on the function of proteins known as nuclear lamins in regulating the molecular architecture of the nucleus in healthy and diseased cells. Recently the Goldman lab has focused on the wide range of human diseases caused by mutations in the human nuclear lamin A gene. One of the most remarkable of these diseases is Progeria, which causes premature aging and eventual death from heart attacks and strokes in children.

Transforming MBL Science

The MBL's Whitman building has been a hubbub of scientific pursuit for the past 46 years. With generous contributions and a portion of the proceeds from a recent bond issue, the building is now undergoing a dynamic renovation to keep it, and the science that goes on there, at the forefront of biology. Next summer, the building will be rededicated the John and Valerie Rowe Building in honor of their transformational $5 million gift to the MBL.

We asked Bob Goldman, an MBL leader who has been conducting summer research here since 1977, about the history of the Whitman building and what the renovations mean for the MBL and its scientists.

MBL What contributions have Whitman Investigators made to biology over the years?

RG The Whitman Center is the present day extension of the MBL summer research programs that have been a mainstay of the institution since its founding in 1888. For more than 118 years, MBL research has had a major impact on the life sciences worldwide. Many important discoveries have been made by our investigators. Early on, summer researchers gained critical insights into a host of basic biological phenomena, including the mechanisms of fertilization, the early development of the embryo, and the electrical properties of neurons, using systems such as sea urchin eggs and embryos and squid nerve cells known as giant axons.

In the early 1980s, giant axon studies led to the discovery of the protein kinesin, the founding member of a host of motor molecules that help transport materials along nerve cells. More recently, Whitman Investigator Avram Hershko won the Nobel Prize for the discovery of the biological function of the protein ubiquitin, whose malfunction may play a role in certain cancers. Avram has studied the ubiquitin-regulated degradation of the protein cyclin B in clam eggs for many years. In fact, cyclin B was discovered in sea urchin and clam eggs at the MBL by Nobel Laureate Tim Hunt, a member of the Physiology course faculty at the time, who also worked with Whitman Investigator Joan Ruderman of Harvard.

MBL What will the Whitman building renovation entail, and how will these improvements change the way science is done at the MBL?

RG The building has not been significantly upgraded since it was built in 1960, but thanks to former MBL director Bill Speck, the Board of Trustees, and new director Gary Borisy, the renovation is now a priority. This fall and winter the interior of the building will be gutted, modernized, and upgraded to meet modern safety standards. Asbestos will be removed, sprinkler and alarm systems will be installed, and emergency lighting will be placed throughout the building. The laboratories will be modernized to include new wiring, plumbing, benches and fixtures, and the labs themselves will be constructed such that they

provide flexible space to our investigators over time. Common-use rooms will be available on each floor, housing state-of-the-art imaging equipment, for example. The auditorium will also be gutted, remodeled, and equipped with modern audio-visual amenities. All of these changes will make it possible for Whitman Investigators to enhance their productivity and conduct their research any time of the year.

MBL What's so special about the MBL research experience?

RG It is magical. Almost everyone who experiences it wants to return. I think this is largely because the MBL is a gathering place for scientists from around the world who have an enormous range of expertise.

They work intensely within the same building, bump into colleagues in the hallways and entrances, and have intense conversations without the demands of an academic department environment. In other words, the MBL's summer research program provides a unique opportunity to collaborate and to think about science in an unfettered fashion without being subjected to administrative overloads and the demands of normal teaching/ educational requirements.

MBL What is the value of the basic research being done by Whitman Investigators?

RG The MBL is one of the last bastions of untargeted, curiosity-driven research. It represents a type of paradise where scientists can explore mechanisms underlying fascinating biological phenomena in a wide variety of marine organisms, many of which are notable for their simplicity when compared to other more complex life forms. This provides unprecedented opportunities for obtaining new insights into life processes for the careful observer.

MBL How has being a Whitman Investigator shaped your career and affected your life?

RG My first experience at the MBL was during the summer of 1963. I worked with Dr. Arthur Parpart of Princeton University on the transport properties of the surface of eggs of the local sea urchin, *Arbacia punctulata*. It was a wonderful and exciting summer. I met people from all over the world and fell in love with the place. In 1965, I returned to work with Lionel Rebhun, my thesis advisor at Princeton. I invited my future wife Anne for a visit that summer and she, too, fell in love with Woods Hole. That did it. We got married soon thereafter. Following graduate school and postdoctoral studies, we started coming to the MBL again. Now it is an essential part of our lives, as well as the lives of our two sons, their wives, and our new grandson. •

"The MBL is one of the last bastions of untargeted, curiosity-driven research."

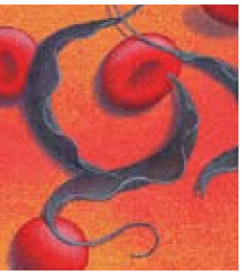
The Whitman Center for Collaborative Research

Each year, some of the top cell biologists, physiologists, parasitologists, microbiologists, neurobiologists, and developmental biologists convene at the MBL in pursuit of scientific discovery, collaboration, and intellectual enrichment. Many of these scientists are part of the Whitman Center for Collaborative Research, which is headquartered in the Whitman building. This year's visiting and summer research included:

Principal Investigators:	115
Additional Researchers:	183
Institutions:	149
Countries:	20

Gifts & Grants

The MBL received a $5 million gift from the family of new MBL chairman of the board **John W. Rowe and wife Valerie**. The gift will be used to develop new, and enhance existing, programs. It is the largest gift from an individual in the MBL's history. Next summer, the newly renovated Whitman building will be renamed the John and Valerie Rowe Building in honor of this capacity-building gift.



The **W.M. Keck Foundation** awarded a grant of $1,500,000 to enable the MBL to acquire a parallel DNA sequencing system that will provide transformational support to the research efforts aimed at conducting a global census of marine microbes (see story p. 6).

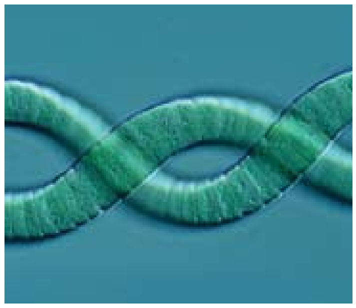
The **Burroughs Wellcome Fund** renewed a grant of $600,000 in support of the **Biology of Parasitism** course from 2007 to 2010.

The MBL also received a grant of $481,950 from the **Burroughs Wellcome Fund** for partial support of the **Frontiers in Reproduction** (FIR) course from 2007 to 2009. Underway for almost a decade, the FIR course mentors and trains young investigators who hold great promise to pursue academic research careers in the reproductive sciences.

The MBL received an unrestricted bequest of $322,347 from the estate of **Octavia C. Clement**. The bequest recognizes Ms. Clement's long-standing affection for the institution that brought her together with her husband and honors his memory and the important work they did together. The bequest was specified to the MBL's general endowment.

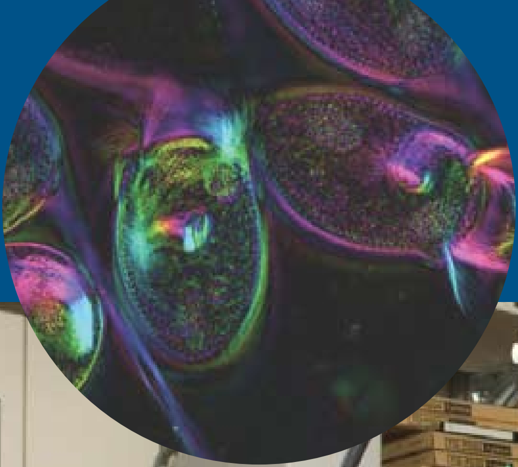
The **George Frederick Jewett Foundation** awarded $100,000 to support the **"Information Commons"** project in the MBLWHOI Library in the Lillie building.

The **Gordon and Betty Moore Foundation** awarded $50,000 in support of the **2006 Microbial Diversity** course. •

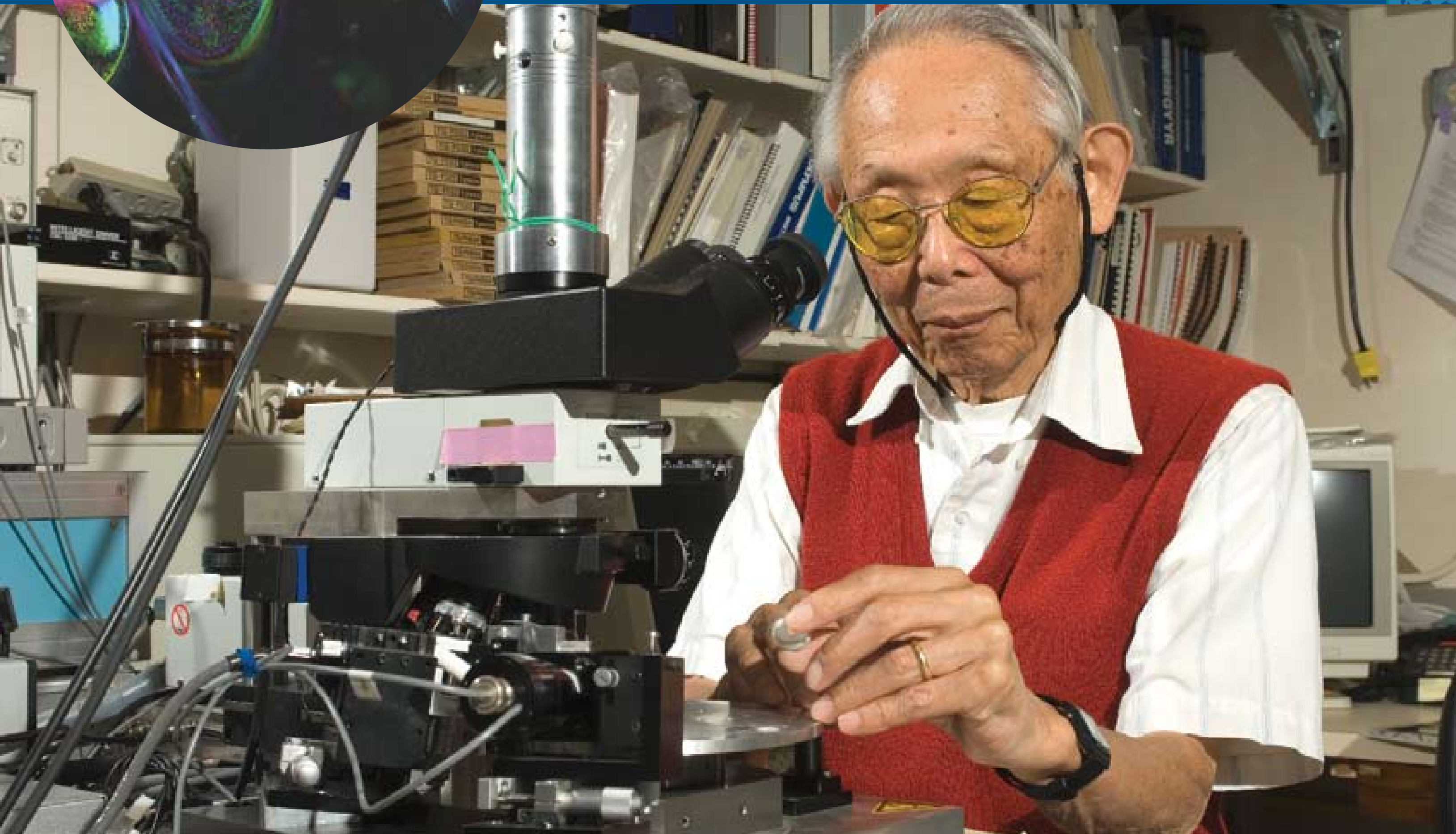


Accolades

- MBL Corporation member and Trustee Emeritus **John Saunders** has been elected to the National Academy of Sciences.
- MBL Corporation member and Nobel Laureate Tim Hunt is now **Sir Timothy Hunt**, having been knighted by Her Majesty the Queen on June 17, 2006, in recognition of his services to science.
- "Composer of the Corporation" **Ezra Laderman**, of New Haven and Woods Hole, was elected president of the American Academy of Arts and Letters in February. He will serve a three-year term with the 108-year-old institution, which awards more than a million dollars annually to artists, musicians, architects, and composers.
- MBLWHOI Library director and Corporation member **Catherine Norton** has been elected to Louis Round Wilson Academy's Knowledge Trust.
- Ecosystems Center scientists **Christopher Neill** and **Linda Deegan** have been selected as Fulbright Scholars to work in Brazil for five months in 2007. Linda will investigate the role of Amazon deforestation in altering the composition and diversity of stream insects and fishes. Chris will work with aquatic chemists at University of São Paulo to use stream chemistry to trace the sources of water to small Amazon streams in forested and deforested regions. The fellowships are co-sponsored by the Council for the International Exchange of Scholars in the U.S. and by the Research Foundation of the State of São Paulo. •



A New Spin on Microscopy



Shinya Inoué is an MBL distinguished scientist, an honor he shares with just one other resident researcher. His discovery of the cell's spindle fibers and his co-invention of video microscopy have revolutionized the field of cell physiology. He is a former Guggenheim Fellow, an elected member of the National Academy of Sciences, and the winner of the 2003 International Prize for Biology from the Japan Society for the Promotion of Science.

Leave it to the MBL's Shinya Inoué to devise a way to combine the gravitational force of a centrifuge with the seeing power of a polarizing microscope. The result, the Centrifugal Polarizing Microscope (CPM), is providing new insights into biology.

MIT biological engineering graduate student, Danielle Cook France, for example, worked with Inoué here at the MBL using the CPM to study the force, speed, and fuel source of a tiny spring that is, gram for gram, the most powerful known engine in biology.

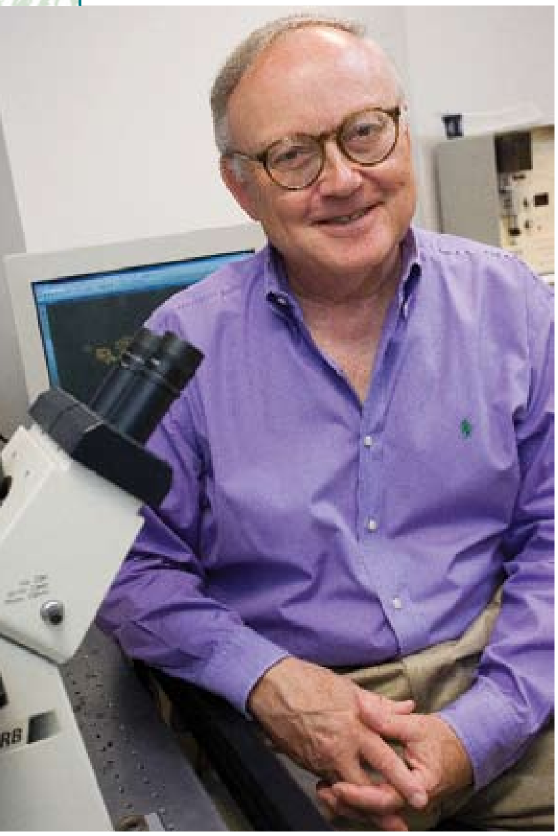
The spring belongs to the microscopic protozoan, *Vorticella*, (above) a bell-shaped aquatic organism that attaches to submerged rocks or floating leaves using a contractile stalk that recoils rapidly when the creature is disturbed.

Scientists have long known that relative to its size, the nanospring that lies inside and powers *Vorticella's* stalk, is extremely forceful. In research that may someday lead to the creation of nano devices, France and her colleagues observed the spring as it pulled against the CPM's centrifugal force and found it more powerful than previously thought. "Weight for weight it is even more powerful than a car engine," says France.

In other CPM-related research, Joseph Hoffman, a red blood cell physiologist at Yale University School of Medicine, and Inoué watched red blood cells being centrifuged, and noted changes in the cells' shapes and the distribution of their hemoglobin. When the force field was increased the magnitude of the changes increased, but the cells reverted to their original shape when brought back to lower speeds. So the investigators concluded that though spinning red blood cells in a centrifuge changes their shape and the distribution of their contents, the alterations are completely reversible. The findings also suggest that centrifuging red blood cells with altered or missing structural elements, such as occurs in various hereditary hemolytic anemias, may help explain what determines cell shape. •

Rediscovering an American Ethos: Discovery

by Thoru Pederson



Thoru Pederson is the Vitold Arnett Professor of Cell Biology and Professor of Biochemistry and Molecular Pharmacology at the University of Massachusetts Medical School, as well as Director of the Worcester Foundation for Biomedical Research. His NIH- and NSF-funded research focuses on RNA-protein complexes and their molecular dynamics in the cell nucleus. He has been associated with the MBL in various capacities since taking the Embryology course in 1965, including serving seven years on the faculty of the Physiology course. He is a member of the MBL Corporation and chairs the MBL Fellowship Review Committee.

To be asked to write an editorial for the inaugural issue of MBL's new magazine is a privilege. I had wanted to pen something rhapsodic about this cherished institution, but it has been suggested that I write on the current federal funding climate for biological and biomedical research. Ouch!

The recent doubling of the NIH budget for extramural research across a five-year span was extraordinary, both historically and in terms of its magnitude; but the success rate for NIH grant applicants did not change much and, as we all know, it has in the past two years plummeted. Paylines in some programs are now hovering around the 10th percentile. Where did the money go? It went, in large part I believe, to well-positioned investigators who wisely submitted more proposals for new projects and—especially—for new collaborations. And, to be sure, many have been successful to the extent that their work is either frankly clinical, or is perceived as unusually medically relevant. This federal agency is not the "National Institute of Curiosity About the Natural World," nor is it even the "National Institute of Biology." It is the National Institutes of Health, and some in Washington (and in Bethesda) believe that its funding patterns are now better capturing the organization's mission. Much of the momentum for this stems from a controversial "Roadmap" developed by the NIH Director. I have expressed my thoughts on this elsewhere (http://www.asm.org/microbe/index.asp?bid=33384).

Is big biological science bad? Of course not. A very large NIH "SPORE" grant to a consortium of investigators in the area of inter- and intracellular signaling did not make the payline upon application for competitive renewal last year, but I suspect that there was potentially more basic discovery to be made with those dollars than in many mega-dollar grants. I just read of a $5 million NIH grant to screen hundreds of compounds, chosen mostly at random, for suppressing symptoms in a rat model of Type 1 diabetes. But the key breakthrough will come when someone finally (probably by accident) unlocks the mystery of autoimmunity (see for example Molecular Immunology *36: 1127-1128, 1999). It may come from a big consortium in Australia or it may come in the MBL Embryology or Physiology course!*

The donors I address at my institution are frankly more excited to hear how the genetic phenomenon called RNA interference was discovered (by accident, and in a soil nematode) than to see our new pediatric wing (even though great medicine is done in the latter). We err if we fail to take advantage of this intense public passion for scientific discovery, and for discoverers. Maybe we almost forgot when we weren't looking, but this deep, abiding respect for discovery is a profoundly important reason why America succeeded. It remains a part of our soul, an ethos that could serve us well in these times, as this still-great nation tries to find itself once again. •

TREASURES FROM THE MBL'S RARE BOOKS ROOM

The Birdman of Woods Hole

MBL founding director Charles Otis Whitman kept pigeons for 18 summers in Woods Hole. He would carry them in the Pullman sleeping cars as he traveled east by rail from Chicago. Whitman used the birds to study variations in genetic traits, including physical appearance and behavior. He also photographed and drew detailed scientific illustrations of the pigeons, sometimes in collaboration with Japanese artists K. Kayashi and Kenji Toda. The wallchart shown here (watercolor, ink, canvas) conveys Whitman's meticulous attention to detail and his fascination with these feathered model systems. It is one of several illustration sets and photographs featured in **Whitman's Pigeons**, an exhibit from the library archive curated by Ann Weissmann and displayed in the Meigs Room of the MBL's Swope Center through May 2007.

KEY TO IMAGES
Rock-Pigeon: *Columba livia* (top)
Passenger Pigeon: *Ectopistes migratorius* (center)
Australian Crested Pigeon: *Ocyphaps lophotes* (right)
Mourning Dove: *Zenaidura carolinensis* (left)
Wing bones and attachment of flight of feathers

In the Next *Catalyst*

Predicting the fate of the world's ecological systems

is a primary goal of the MBL's Ecosystems Center. Our spring issue is dedicated to this crucial research, and highlights long-term studies underway in places like Alaska's Toolik Lake (pictured below). MBL scientists working in this pristine Arctic ecosystem say shifts in Toolik's flora and fauna are forecasters of climate-change effects well beyond this remote location.

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