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MBL Annual Report 2004

MBL Around the Globe



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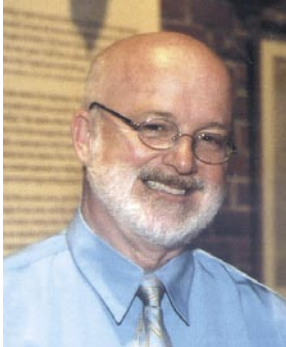
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REPORT OF THE DIRECTOR & CEO



The year 2004 was one of great excitement for the Marine Biological Laboratory. MBL alumni, faculty, corporation members, and friends from around the world were delighted to learn that the Royal Swedish Academy of Sciences had awarded summer investigator Avram Hershko the 2004 Nobel Prize in Chemistry for his discovery of ubiquitin-mediated protein degradation. The first Israeli (along with his Technion colleague Aaron Ciechanover) to ever win a Nobel Prize, Avram has been a valued member of the MBL summer research community since 1991. I know I speak for all my MBL colleagues when I say how proud we are of Avram's accomplishments. We look forward to welcoming him and his wife Judy back for another exciting summer of research.

Avram is one of scores of summer investigators, students, and faculty members who travel from around the globe every year to conduct research or participate in courses at the laboratory. In addition, research collaborations take our resident researchers to field sites abroad as well, making the MBL a truly international hub for basic biological, biomedical, and environmental research. I invite you to learn more about the global reach and impact of the MBL's research and educational programs in subsequent pages of this report.

Strategic Planning Update

Considerable progress has been made over the past year towards meeting the goals of the MBL's 2003 Strategic Plan (background information about the plan is available on the MBL's web site at www.mbl.edu/inside/what/planning/index.html).

Chief Academic and Scientific Officer Recruited

An initial strategic planning initiative was the recruitment of a Chief Academic and Scientific Officer who would be responsible for the leadership, planning, and oversight of all academic programs—equivalent to a Provost in a university setting—and the development and oversight of policies relating to scientific research and commercial relations with private enterprise, including intellectual property and technology transfer.

I am pleased to report that William Beers was appointed Chief Academic and Scientific Officer in the Spring of 2004. Bill has more than 25 years of experience working with Boards of Trustees, CEOs, senior administrative staff, and faculty of non-profit research institutions, and comes to us most recently from The Torrey Pines Institute for Molecular Studies in San Diego where he served as vice president of operations and still is a member of the Board of Trustees.

MBL-Brown University Relationship Flourishing

One of Bill's earliest tasks was overseeing the MBL's fledgling partnership in graduate education with Brown University. This relationship unites MBL and Brown University's combined research and education expertise in biology, biomedicine, and environmental sciences and offers talented graduate students the chance to work with scientists at both institutions. It is also enabling MBL investigators and Brown faculty to pursue joint appointments at the two institutions, thereby providing a rich environment for faculty exchanges and research collaborations between the two institutions. The joint graduate program continues to grow and flourish and has already proven quite popular

among potential students. We welcomed three new graduate students in the fall of 2004, bringing the total number of students enrolled in the nascent program to five. We expect another five students to enter the

graduate program in the fall of 2005 as we work toward a fully subscribed program of approximately 25 students over the next four years.

In addition, scientists in the MBL's Ecosystems Center and their colleagues at Brown University are developing two new graduate-level courses for 2006. Senior scientist Ed Rastetter will teach an ecosystems modeling course at the MBL during the Brown intersession next January, and Ecosystems Center

scientists, in cooperation with colleagues at Brown, are developing an additional course for advanced undergraduate and graduate students that will focus on human impacts on ecosystem functioning.

Campus Master Site Plan Developed

Another recommendation that emerged from the strategic planning effort was that the MBL must address the need for more and improved facilities to fulfill the strategic objectives that are central to the MBL's mission. The strategic plan identified the need for new and renovated research laboratory space to support new initiatives in research; expanded and updated classroom facilities to address the anticipated growth in our educational programs; new and renovated

housing, conferencing, and support space to accommodate an increased volume of scientists, students, and staff on a year-round basis; relief from deferred maintenance and sub-optimal conditions in the Whitman, Lillie, Loeb, and Swope buildings; and additional remote parking and more transportation to mitigate traffic congestion in the village, particularly during the busy summer months.

The architectural firm of Tsoi/Kobus and Associates was hired to develop a comprehensive vision that addresses the needs outlined above. The resulting plan (which can be found on the MBL's strategic planning web site) calls for an overall "greening" of the Woods Hole village campus; additions and renovations to improve efficiency and the Lillie and Loeb buildings; a renovation and possible expansion of the Whitman building; the addition of new classrooms and computer laboratory space in Loeb; additions and renovations to the Swope building to provide new dormitory housing, conference, dining, and support space; and the creation of a park-like area adjacent to the Eel Pond side of the Lillie building for functions and gatherings.

To accommodate the need for additional housing over the next 10 years, the plan calls for the renovation of the cottages at Devil's Lane and Memorial Circle for use by the summer scientist community and the construction of three groups of townhouse units on the Oyster Pond Road campus for year-round, transitional housing. The plan also includes the addition of approximately 200 parking spaces to the Oyster Pond Road parking facility.

Of course, the MBL's Campus Master Plan is a snapshot in time based on current and projected needs. It is a work in progress and entirely contingent on successful fundraising for the various projects it recommends.



Whitman Renovation Project Underway

One of the jewels in the MBL crown is the summer and visiting research program that largely takes place in the Whitman building. Some of the most important basic biological and biomedical research in the world has been conducted here during the summer months, as evidenced by Avram Hershko's recent Nobel. Unfortunately, our facility for visiting research—the Whitman building—isn't as modern as the science being conducted there. In fact, as the report of the strategic planning effort noted, the building is woefully inadequate. Renovating Whitman to accommodate 21st century biology was a key recommendation of the strategic plan and has been one of the top priorities of my administration. In 2004 we announced the launch of a campaign to raise \$20 million to support the modernization of Whitman.

With \$3.8 million in gifts and pledges currently in hand for the Whitman project, we have already been able to complete much of the initial project enabling work: the redistribution and "clean-up" of electrical power on campus, which is also allowing us to upgrade the MBL's computer network infrastructure and provide wireless access to the internet from most labs, classrooms, housing units and even the Associates Quadrangle this summer. We expect to begin construction on the Whitman renovation in the fall of 2006. Summer investigators can expect to find a substantially upgraded and modernized research facility when they return to Woods Hole in the summer of 2007.

Image and Identity Effort Underway

One of the shared beliefs that emerged early in the strategic planning process was that the MBL needed to expand its external reputation to meet its strategic goals and objectives. To that end, we conducted, in 2003, an audit of the MBL's existing communications efforts to assess strengths and weaknesses and

help determine next steps towards raising awareness of the institution. The audit strongly recommended that the MBL embark on a image and identity effort that would include evaluating the laboratory's current "brand equity," developing an overarching communications and marketing plan for the institution; developing strategic positioning messages designed for key constituencies; and developing a new visual identity system for the institution that includes a new, contemporary institutional mark, tagline,



and consistent "look and feel" for all MBL publications. Thanks to a generous gift from Rodolfo Llinás during the MBL's last campaign (targeted specifically for institutional communications efforts), we have engaged the firms of D. R. Giller and Associates and Lasater/Sumpter Design to assist us in this effort, which began in earnest in the late fall of 2004. We expect to begin introducing ideas for our "new look" to the community sometime this summer.

Research

In addition to our outstanding education and summer research programs, the MBL's resident research programs continue to thrive. Competitive, peer-review funding for these programs was at an all-time high in 2004 with awards totaling \$28,730,470 from the federal government. Federal funding of MBL research has risen steadily over the past five years. We hope that this trend can continue, but have

some concerns given the long-term outlook for the budget of the National Institutes of Health, which is projected to increase only 0.7% in fiscal year 2006. The outlook for the National Science Foundation—our largest source of federal funding—is even more dire. Because the MBL receives more than 74% of its government grant support from these agencies, we must keep a close eye on these trends as we continue to plan and build for our future.



I am happy to report that private support for our research programs was robust in 2004. Mitch Sogin and the Bay Paul Center received a \$900,000 grant from the New York-based Alfred P. Sloan Foundation, for example. This seed grant launched the International Census of Marine Microbes, the first global effort to focus on the biodiversity of single-celled organisms in the world's oceans. This unprecedented effort to catalog the Earth's known marine microbes, and explore the

ocean's yet untold microbial diversity, is part of the 10-year, \$1 billion Census of Marine Life, a massive collaboration to catalog and map marine species worldwide involving hundreds of scientists in more than 70 countries.

Funding for summer fellowships also increased sharply in 2004. Thanks to gifts from a variety of sources including the Dart Neuroscience Limited Partnership and the Grass Foundation, we awarded 22 fellowships to conduct research at the MBL this past summer.

We were delighted to learn that Bay Paul Center adjunct scientist and corporation member Matthew Meselson was awarded the 2004 Lasker Award for Special Achievement in Medical Science. Matt was recognized "for a lifetime career that combines penetrating discovery in molecular biology with creative leadership in public policy aimed at eliminating chemical and biological weapons," according to a statement released by the Lasker Foundation. A Harvard professor, Matt maintains a year-round laboratory at the MBL.

On a sadder note, we were disappointed when we were informed that Boston University (BU) had decided not to renew its contract with the MBL to lease space for the Boston University Marine Program (BUMP). Given our 35-year, mutually beneficial relationship with the BUMP program and its faculty members, this is unfortunate news indeed. The MBL has valued its association with BUMP over these many years and looks forward to the program's continued success. We hope that BUMP faculty will continue to collaborate with the MBL on research and educational efforts and are currently working with BU to accommodate those faculty members who wish to continue to conduct their research at the MBL. The BUMP program will leave the MBL by June of 2006.

Education

As you'll read later in this report, 2004 was another great year for the MBL's education program. Once again, hundreds of outstanding students and top faculty came from around the globe to participate in our many courses. Both the revamped Physiology course and the Zebrafish course attracted record numbers of applicants, and funds available for scholarships—and the number of scholarships awarded—were also at an all-time high.

The Semester in Environmental Science (SES), taught by faculty from The Ecosystems Center each fall, enrolled 10 students in 2004, including two undergraduates from Brown. To date, 121 students have participated in the program since its inception, 30% of whom are currently enrolled in or accepted to graduate or professional schools. In addition, eight SES alumni are now employed in scientific or research laboratories, four are employed by environmental consulting firms, and six are working for NGOs or government agencies. Three quarters of SES graduates remain involved in environmental or scientific pursuits.

The Biological Bulletin

The MBL bid a fond farewell to Michael J. Greenberg, who retired as editor-in-chief of *The Biological Bulletin*, the MBL's 100+ year-old general biology journal, after outstanding service for 15 years. I'm pleased to report that the MBL has appointed James L. Olds as the 10th editor-in-chief of the journal. He will serve a five-year, renewable term as editor. Jim is the director of the Krasnow Institute for Advanced Study at George Mason University in Fairfax, Virginia, and has had close MBL ties since 1978. An expert in the role nerve cells play in learning and memory, Jim's research is directed toward understanding and simulating the machinery that permits neurons and neuronal assemblies to store and recall memories, both under normal and



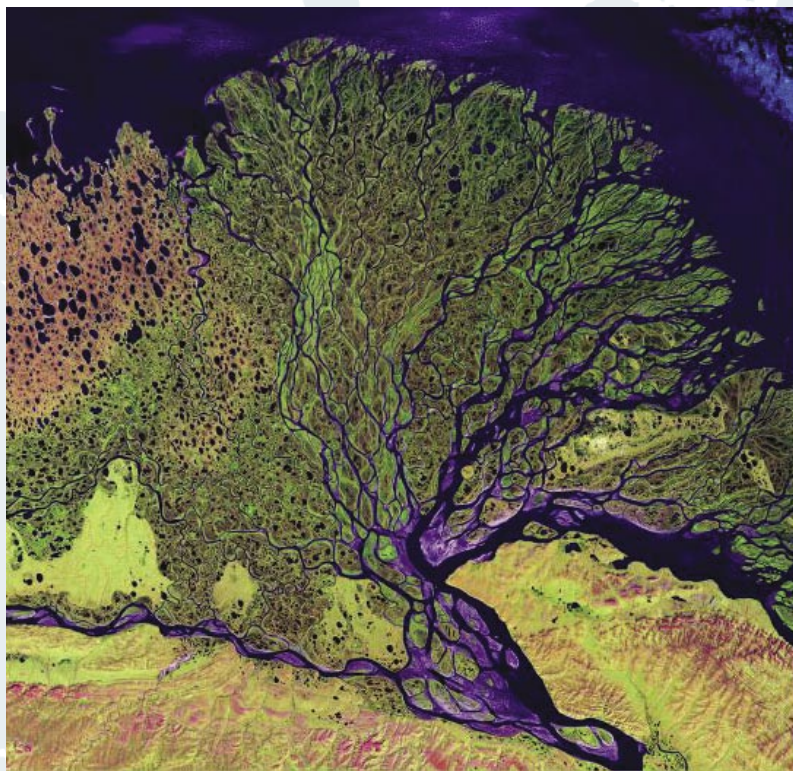
diseased conditions. He uses cutting-edge computerized equipment to image and simulate the cells and aims to eventually develop techniques that will reveal the three-dimensional structure and maps of memory function in both animal and human brains in near real-time.

Final Thoughts

As many of you know, I have decided to retire as director and CEO of the Marine Biological Laboratory when my term ends in July of 2006. A committee led by MBL President John Dowling is in the midst of an active and far-reaching search for my successor.

My decision to leave this very special and important institution was not an easy one, but I find it's time to return to medicine and my professional roots. I hope I have left the MBL a stronger place through our collective efforts at strategic planning, by building an ever more influential and philanthropic Board of Trustees, and enhancing the opportunities the MBL has to have a disproportionate impact on the biological sciences.

— William T. Speck



Russia

It is early June in Siberia. The ice that has engulfed the Lena River all winter has melted and the river flows enthusiastically, unbound again at last. It's a sign of spring to the villagers in the local port of Zhigansk, but

to MBL Ecosystems Center scientists Bruce Peterson, Jim McClelland, and Robert (Max) Holmes, it's an opportunity to examine the potentially serious effects of global warming.



Bruce Peterson and Max Holmes

The ice melt signifies peak flow season on the Lena, a key time to study this 2,800-mile river that winds through the heart of Siberia before emptying into the Arctic Ocean. The scientists and their Russian and Canadian colleagues visit the Lena and five other major Arctic rivers

several times a year to collect water, sediment, nutrient, and other samples. It's part of a National Science Foundation-funded project called PARTNERS (Pan-Arctic River Transport of Nutrients, Organic Matter, and Suspended Sediments), a five-year study of how these rivers are affecting the freshwater levels of the Arctic Ocean.

"We're interested in the total amount of freshwater as well as chemicals in the water that can be used to trace the water once it enters the Arctic Ocean," says Peterson, the project's principal investigator. "By sampling at only six sites seven times a year, we can chemically characterize almost two-thirds of the total freshwater inflow from the continents to the Arctic Ocean," he says.

Since no two rivers are alike, the scientists can create a chemical fingerprint for each river by measuring isotopes, chemicals, and organic matter in the samples.

The PARTNERS study is critical because the Arctic Ocean is getting fresher with global warming and, if the trend continues, it could cause big climate changes, including a major cooling in northern Europe. "We're looking at continental-scale processes and oceanographic processes," says Peterson. "The whole point of this is that as humans warm the globe, the hydrologic cycle is changing globally."

To track this hydrological trend, PARTNERS scientists analyzed Russian data collected between 1936 and 1999 and documented that the combined annual discharge from six major

Russian rivers into the Arctic Ocean had increased seven percent, a significant number on the scale of things. The findings, which correlate with a 0.6°C increase in global surface air temperature over the past century, were published in 2002 in *Science*, and support the climate-model based hypothesis that freshwater inputs to the Arctic Ocean and North Atlantic will increase with global warming. The warming increases precipitation and the melting of glaciers in the north, which increases the freshwater discharge of the rivers and, ultimately, affects the salinity and circulation of the Arctic Ocean.

Predictions suggesting the globe could warm an additional 2 to 6°C in the next century are a major concern. Oceanographers know that resulting increases in fresh water in the Arctic could change the regional climate by altering the North Atlantic Deep Water formation, a key process behind the great underwater conveyor belt that controls our climate by circulating salt and thermal energy around the globe. This heat and salt pump is called the Thermohaline Circulation, and Peterson and his colleagues say too much fresh water in the pump might plug it up. And that would mean big climate changes for northern Europe.

If people keep using too much fossil fuel, climate changes could come relatively soon. "If the observed positive relationship between global temperature and river discharge continues into the future, Arctic river discharge may increase to levels that impact Atlantic Ocean circulation and climate within the 21st century," says Peterson. The wild card, he says, is the Greenland ice cap, which scientists say is melting faster than it was 20 years ago. "There is an immense amount of ice and water tied up in that ice," says Peterson. He and other scientists worry about what will happen as parts of the ice cap melt or break up and slide into the ocean.

Although it's hard to quantify the exact effects of increased global warming, Peterson says changes occurring in the Arctic show just how real the phenomenon is. He also says understanding the hydrology and chemical composition of the Lena and other large rivers, which contribute as much as 60 percent of the total discharge into the Arctic Ocean, is essential for predicting future changes and impacts to the Earth's climate.

For his part, Peterson considers storytelling an important part of his job as a scientist. And the global warming story he and other PARTNERS scientists are beginning to tell through the Arctic rivers study is still far from having a definitive ending. "Scientists say this complete stoppage of the Thermohaline Circulation is 'a low probability but high impact event.' I think it could happen but I don't know how likely it is," he says. "It's more likely to happen if we're careless and allow fossil fuel use to increase and continue at a high rate. It's less likely if we develop international agreements to limit greenhouse gas emissions such as the Kyoto Protocol and keep emissions at a relatively lower level."



Meet Anya Suslova, Aspiring Siberian Scientist

One of the most ardent participants in the PARTNERS project is 14-year-old Anya Suslova, an aspiring scientist from the river village of Zhigansk whose favorite subjects in school are geography, chemistry, and biology.

Anya is the daughter of the captain of the *P406*, the 130-foot buoy tender PARTNERS scientists use to collect samples from the Lena River. Ever since she accompanied her father on a two-week PARTNERS sampling cruise in August 2003, Anya has been helping out with the project.

During the cruise, MBL Ecosystems Center scientist Robert (Max) Holmes noticed Anya's interest in the research and decided to encourage her participation by teaching her to collect and analyze water samples. "Anya amazed everyone with her sharp mind, active participation in sample collection and processing, and rapid grasp of the overall goals of the PARTNERS project," says Holmes.

So as a parting gift, he gave Anya a set of water sample bottles and asked her if she'd like to help out after the scientists had gone. Anya agreed, and with her father's help, she has collected samples from the Lena every two weeks since then. These high-frequency samples, which are shipped to the MBL for analysis, provide data that would otherwise be difficult and expensive to collect.

"Though Anya is the youngest member of the PARTNERS team, she is one of its most important members," Holmes says.

Israel



The scent of Mediterranean summer, that faint fragrance of sea salt and lavender, filled the air last July as neurobiologists Simone Engelender and Herman Wolosker, and their 8-month-old son, Gabriel, wound their way toward the airport in Israel's northern city of Haifa.



Simone Engelender

Thanks to Gruss Lipper Family Foundation fellowships that support Israeli scientists, Engelender and Wolosker, M.D.s on the faculty at the Technion-Israel Institute of Technology, were headed toward the MBL and would soon smell seawater and reagents, squid and clams, and the scents of scientific progress that waft through the MBL's Whitman

Center for Summer and Visiting Research during its peak season.

To scientists familiar with Whitman, such smells evoke what many consider the perfect setting for research advancements that seem unique to the MBL.

Summers here mean uninterrupted research and collaboration in a close-knit community of international scientists—and researchers like Engelender and Wolosker often make it a point to work in Whitman at least once, if not repeatedly, during their careers. Fellowships such as those supported by the Gruss Lipper Foundation often help make visiting research possible.

The work of MBL visiting scientists is vital to the world's understanding of human medical puzzles including cancer, epilepsy, Alzheimer's disease, and Parkinson's disease. Using organisms such as squid, surf clams, and zebrafish, the researchers study cellular processes that are the key to life.

Each year, the Whitman Center draws hundreds of scientists from countries including Canada, Argentina, England, Switzerland, and now, increasingly, from Israel.

Engelender and Wolosker, both senior lecturers and researchers at Technion, learned about the MBL and the Gruss Lipper fellowships for Israeli scientists, from their colleague, Avram Hershko.

Hershko, who won the 2004 Nobel Prize in Chemistry (see story on page 36), is a 13-year veteran of MBL summer research. He is one of the 52 Nobel Laureates with MBL affiliations, and one of more than a dozen scientists supported by the Gruss Lipper Foundation.

The fellowship program was founded in 2001, not long after the foundation's director, Evelyn Gruss Lipper, M.D., met an Israeli scientist while at the MBL. Since then, the foundation has annually underwritten research and education collaborations between the MBL and Israel's most talented scientists.

The need for the fellowships was underscored by a European boycott of Israeli scientists and academics. The boycott was initiated in 2002 in objection to Israel's policies toward Palestinians and made it difficult for Israeli scientists to collaborate beyond Israel's borders.

"I felt it was important for these scientists to be able to study outside of their country," says Gruss Lipper. "All ideas are enhanced by people coming together and communicating with each other. With all of the education and collaboration that happens at the MBL, it seemed like a natural match."

Engelender concurs. "The fellowship was an opportunity to hear great scientists talking about their research," she says. "The U.S. has thousands of excellent scientists, so it is important to be in contact with them."

An expert in the proteins implicated in Parkinson's disease, Engelender spent much of her fellowship in Whitman 404, immersed in the study of a new protein she had discovered called synphilin-1. Using biochemical and cell biology techniques, she studied the protein's relationship with nerve cell junctions called synapses, cellular toxicity, and other proteins. It's research she hopes will eventually lead to the development of drugs to treat Parkinson's patients.

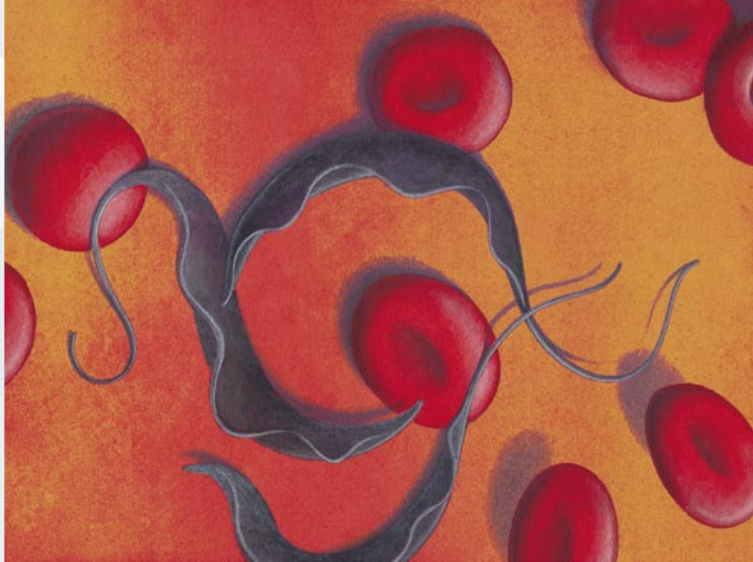
Her lab mate, Wolosker, spent the summer studying D-amino acids, chemicals believed to play a role in excitotoxic cell death that occurs after stroke and neurodegenerative conditions.



Herman Wolosker and Gabriel

With on-site room and board, dedicated lab space, access to the latest equipment, and the MBL Neuroscience Institute of nearly 100 other neurobiologists, the Gruss Lipper fellowships seemed to provide Engelender and Wolosker everything they needed to enhance their scientific ideas.

"At the MBL you are free to do our own research, to try different and interesting projects you wouldn't carry out in your own lab, and to collaborate with senior scientists," Engelender says. "We're really grateful for our fellowships. We had a very productive time."



Sub-Saharan Africa

Before parasitologist Steve Hajduk visited a sweltering makeshift hospital in war-torn South Sudan in the late 1990s, his interest in trypanosomes, the parasites that cause African sleeping sickness, was largely restricted to understanding the basic biology of a highly adaptive organism. But as he walked through room after room filled with patients in varying stages of the disease, he was overwhelmed by the magnitude of the human health problem.



Steve Hajduk

"My brief visit to Sudan in 1999 changed my attitude toward this disease. The suffering caused by sleeping sickness is immense but so is the damage done by the drugs we use to treat the disease," Hajduk says.

Most of the patients he saw were undergoing treatment with the arsenic-based drug, melarsoprol, a deadly, antiquated medicine that kills 5 - 10% of the patients treated. "It's a painful and dangerous drug, but left untreated sleeping sickness is inevitably fatal, so there was really no option."

Understanding infectious diseases such as sleeping sickness is more crucial than ever. Twenty-five percent of all deaths worldwide are caused by bacterial, viral, fungal, and parasitic pathogens. And sleeping sickness, a parasitic disease spread by the tsetse fly, has recently reemerged as a major health problem that threatens 60 million Africans in 36 sub-Saharan countries. It is currently estimated that as many as 500,000 people are infected and 60,000 will die this year.

So when he became director of the Josephine Bay Paul Center's new Global Infectious Diseases Program in 2003, one of the first things Hajduk did was to use funding from the Ellison Medical Foundation to create the Ellison Visiting Scholars Program. Each year, the program brings 10 scientists from developed and under-developed countries to the Bay Paul Center for several months of collaborative research. The scholarships are available to graduate students, post-doctoral students, and independent investigators.

"Our goal is to increase the world's understanding of infectious diseases by sharing our cutting-edge research facilities and expertise in using molecular biology, molecular evolution, biochemistry, genetics, and bioinformatics," explains Hajduk. "Our scientists also have a great deal to learn from the visiting scholars, many of whom have important field knowledge of these diseases."

This year two sleeping sickness researchers from Nigeria were among the Ellison Scholars. The scientists joined Hajduk and other Bay Paul Center scientists whose research is focused on the parasites behind this disease. "There was a nice synergy of Nigerians and Americans working together," Hajduk says. "The people of Nigeria are especially aware of the devastating effects of sleeping sickness because it is becoming a public health crisis in several regions of the country."

One of the scholars, Henrietta Awobode, is a young molecular biologist, immunologist, and faculty member at the University of Ibadan. She has studied sleeping sickness since 1998. Awobode and her colleagues have conducted field surveys that suggest that areas of Nigeria previously devoid of sleeping sickness are now reporting an alarming number of new cases, including an acute form of the disease previously thought to be restricted to East Africa. Her work focuses on the important question of whether acute disease in the Delta states of Nigeria is a consequence of a parasite strain variation or a human-host genetic difference.

While working in the Bay Paul Center, Awobode established a molecular basis for examining the genetic composition of the trypanosome. The work enabled her to develop strategies for testing how human genetic differences influence susceptibility to parasite infection, which she hopes will lead to a viable treatment for her county's people. "It was a valuable opportunity to work amongst world-class scientists at the MBL and acquire a lot of experience from them," she says. "It has helped me to more effectively plan and implement my research goals."

Now that she's back home, Awobode says she is optimistic that the collaborative relationships she established at the MBL will be mutually beneficial. "I hope there will be a relationship where MBL scientists can visit

us, especially for field surveys, and where we can visit the MBL to carry out research we would ordinarily not be able to carry out for lack of facilities," she says. "We also hope our graduate students will have opportunities to attend courses organized by the MBL."

The Ellison Scholars Program has helped reinforce the MBL's role as a scientific catalyst not only in the U.S., but also in areas of the world where scientists need better training and facilities. "The best thing about it is the opportunity given to third-world scientists to carry out their work in such a renowned place," says Awobode.



Equally important is what Awobode and the other scholars bring to the program. "Scientists who have witnessed the devastating effects of infectious diseases have a unique first-hand perspective to share," Hajduk says. "The power of seeing people with these diseases can't be overstated. It's an important reminder of how necessary this research is."

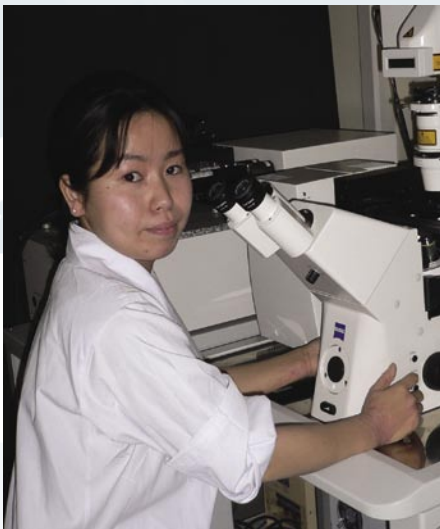
*2004 Ellison Scholars:
Bottom left: Emmanuel
Ogbadoyi
Bottom right: Rudo Kieft
(of the MBL)
Top left: Gustave Simo
Top middle: Henrietta
Awobode
Top right: Raphael Isokpehi*

Japan



When Mio Nonaka began her 18-hour journey from historic Kyoto, Japan, to Woods Hole to take the MBL's summer Physiology course, she left behind the elegant temples and sculpted Zen gardens of one of her favorite cities and had to fly through a typhoon.

Yet she felt compelled to go.



Mio Nonaka

"I heard about the course's reputation from my supervisor," says Nonaka, who was finishing a biophysics degree at Kyoto University's Graduate School of Science. "I wanted to experience doing research in the best country to do science. And everybody believes the MBL is the magical place to produce good results."

Words like magical and Mecca have been used more than once to describe the MBL summer course experience, and talented

students like Nonaka are flocking here from overseas to get in on the action.

The highly competitive courses, which attract the best and brightest graduate and postdoctoral students, consist of an intensive lecture-laboratory schedule taught at a grueling, yet exciting intellectual pace. Regardless of how far they travel, students at the MBL find themselves immersed in advanced-level science from the moment they arrive to the moment they leave.

The courses are nestled within the MBL's signature summer science community—a place where the MBL's own resident scientific staff converges with more than 1,400 visiting scientists, students, even Nobel laureates, from the best institutions around the world.

Students often spend 60 to 80 hours a week working in their own course with the brightest scientists in the field, but there are also opportunities to interact with other students and scientists through poster sessions, seminars, lectures, and during meals in the MBL's communal dining hall, where mealtime conversations require a scientific vocabulary.

The idea of offering immersive, specialized courses taught by leading scientists isn't new. In fact, it dates back to the MBL's first director, Charles Otis Whitman, who saw science instruction and research as natural partners and believed that "other things being equal, the investigator is always the best instructor." The philosophy was successful from the start, and MBL courses still follow his progressive vision.

In its early years, the MBL offered courses in Invertebrate Zoology, Marine Botany, Physiology, and Embryology. Today's educational offerings include six summer courses: the Biology of Parasitism, Embryology, Microbial Diversity, Neural Systems & Behavior, Neurobiology, and Physiology, as well as 14 courses on special research topics such as Frontiers in Reproduction or Advances in Genome Technology and Bioinformatics.

As the MBL's offerings have grown, so has competition for course placements and the list of countries from which the students come. This year, for example, MBL courses drew 473 students from 37 countries, including Argentina, Austria, the Czech Republic, and Senegal, with some course topics seeming to draw more international interest than others.

"Our largest contingent of foreign students is in our Biology of Parasitism and Frontiers in Reproduction courses, both of which have direct impact on countries in South America and Africa," says MBL education director, Eliezar (Lenny) Dawidowicz.

The Physiology course Nonaka attended also resonated far and wide, luring one-third of its students from foreign countries including the Netherlands, Germany, Israel, and Denmark and one-fourth of the course faculty from abroad.

The all-star faculty for the MBL's courses, all of whom are leading authorities in their field, is surely one reason the courses are so appealing. Another reason may be as simple as word of mouth.

Nonaka, for instance, says she has shared her MBL experiences with her peers and knows two Japanese students who are planning to enroll in future courses. "My friend Kaoru is enrolled in the 2005 Neurobiology course," Nonaka says. "She heard about its good reputation from a U.S. principal investigator who was visiting Japan and told her the course would help broaden her scientific view and get a better view of future research."

Taking the MBL's Physiology course had just such an effect on Nonaka. Not only did the experience encourage her to pursue her Ph.D., it also altered her scientific path. "I recognized the power of cell imaging combined with computational analysis," she says. "I'm still interested in neurobiology, but luckily neurons are challenging but attractive objects for this imaging approach. So now I am more focused on making physiological phenomena visible in the neuroscience field."



Could Nonaka have had a similar experience in Japan or elsewhere? "I don't think I could find a course like this anywhere else in the world," she says, adding that she hopes to return for another course or as a research fellow. "Every summer, excellent researchers and students gather in Woods Hole and share enthusiasms in research. The reason why this repeats only at the MBL is its own history and good environment."



Haiti

Forty miles west of the chaos of Port-au-Prince, in the shadow of Haiti's deforested mountains, lies an oasis. It is a courtyard filled with pipes, pumps and filters, and tanks whose water is alive with the swirl of hundreds of small, colorful fish. The fish, a fast-growing, plant-eating species called tilapia, offer hope with fins to the people of the poorest country in the Western Hemisphere.

The aquaculture initiative aims to stop hunger among poor, malnourished mountain villagers by teaching them to grow and harvest protein-rich tilapia from hand-built ponds. In a country where the devastated land hardly sustains crops or livestock, and where people barely subsist on mangos and rice, fish farming is a welcome alternative. But malnutrition is a problem for the fish, too.

Though L'Acul's villagers built some 60 fish ponds by digging barefooted, hauling water buckets on their heads for miles, and walking long distances through the mountains to the hatchery to obtain their brood stock, the fish weren't being fed properly and they weren't growing. That's why Mebane and Lindell got involved.

"We're trying to teach a technique where people can provide nourishment to themselves by providing nourishment to the fish. But there are a couple of riddles to solve," says Mebane.



MBL aquaculture experts Bill Mebane and Scott Lindell have worked inside this oasis—an aquaculture initiative and fish hatchery run by missionaries—many times. The scientists are sharing their fish-rearing talents with the Comprehensive Development Project (CODEP), which has operated in the L'Acul region of Haiti's northwest coast for the past ten years.

Bill Mebane (top) and Scott Lindell

Those riddles center mainly on fish food. Commercial feed, an aquaculture staple, isn't an option in Haiti. "It's expensive, hard to transport to remote villages, and spoils quickly," Mebane says.

So, after seeing this problem firsthand, he and Lindell returned to their lab in the MBL's Marine Resources Center (MRC) with one goal: to cook up a nutritious fish food the villagers could make cheaply from locally available, non-endangered plants. Eventually, the scientists hope to share the recipe with developing countries, such as those in Central America and Africa, who have similar hunger problems, are on similar latitudes, and have plants similar to those found in Haiti.

Inventing a fish food that might help so many people isn't as easy as it seems. First, Mebane and Lindell had to determine which local plants they could use. "The real challenge was to find a valueless plant crop the Haitians don't use or eat," Mebane says. In their MBL lab, he and Lindell studied dozens of indigenous weeds brought from Haiti. The scientists had many of the plants analyzed to determine their nutritional value, and searched for a plant they could use to bind the fish food together. Because many of L'Acul's villagers don't have electricity or basic appliances, the recipe had to be one that could be made with hand-operated, easy-to-repair machinery.

Eventually Mebane's and Lindell's work paid off. Their labors produced a small green pellet made with a hand grinder from Haiti's *Calliandra*, *Leucaena*, and *Moringa* plants and bound together with cassava root. During MRC feed-trials, the pellet has been a hit with tilapia, which are eating the food and growing. "We're getting about a 6:1 feed conversion ratio," says Mebane. The numbers represent the amount of plant matter fed per pound of flesh that grows.

Before Mebane and Lindell got involved, L'Acul's villagers weren't getting much of a feed conversion ratio at all. "The fish basically weren't growing," Mebane says. "They were staying alive by foraging on the minimal algae that grew in the ponds and any unfortunate bug that flew too close to the water," he says. So the new pellet is a giant step toward better fish farming.

This winter, Mebane and Lindell brought their new recipe to L'Acul and taught the villagers how to use it. The scientists also started searching for any locally available nuts, berries, or plant material that might help fulfill the important amino acid complement of their pellet and increase its nutritional value. "That will help us achieve our targeted feed conversion ratio of one pound of fish for every two pounds of plant matter," says Mebane.

Ultimately, Mebane and Lindell hope to measure the MBL's contributions to the aquaculture initiative not in feed conversions or little green pellets, but in the health of Haiti's people. "Malnutrition is big problem, especially among the children," says Mebane. "You can see it in the reddish tint of their dark hair, which indicates a vitamin deficiency; in their eyes; and in their stomachs," he says. "I'd like to go back there one day and see no red-haired kids, far-away stares, or pot bellies," he says. "That would be a true measure of success."





Brazil

On a cattle ranch overlooking pasture and rolling hills in Rondônia, Brazil, MBL Ecosystems Center scientists Christopher Neill, Linda Deegan, and their Brazilian colleagues wade into a muddy stream. They sample the water; measure its depth and discharge; study algae growth; and seine fish that they count, weigh, and measure before returning them to the water with a *plop*.



Chris Neill and Linda Deegan

Neill and Deegan have been studying how extensive clear-cutting, which has been altering this classic Amazon River Basin locale since the late seventies, is affecting this important ecosystem. One facet of this work is the study of Rondônia's streams, a project that is part of the NASA-funded Large-Scale Biosphere-Atmosphere Experiment in Amazonia.

"Our ultimate goal is to understand how ecosystems work,"

says Neill, explaining that an intact ecosystem like Rondônia's is the perfect natural laboratory for this work. And because it's an area being rapidly converted from rainforest to pasture for agriculture, Rondônia also offers an unprecedented opportunity to see the domino effect of such change firsthand.

Small streams, it turns out, are an important piece of the puzzle, and Rondônia has thousands of miles of them. "The streams start in intimate contact with soils and ground water seepage and therefore link the state's upland and aquatic ecosystems," says Deegan. Rondônia's streams also feed larger rivers, which eventually feed the Amazon itself some 2,000 miles downstream. But these important aquatic bodies have changed dramatically following deforestation, and MBL scientists are attempting to understand the extent, and ultimate impact, of these changes.

Since he first started his research in Rondônia in 1992, Neill has watched the area's rainforest streams literally transform before his eyes.

To illustrate this, he holds up before-and-after photographs. The "before" image depicts a textbook rainforest stream. It is lush with plants and trees that offer just the right amount of shade, and its inviting sandy bottom supports a juicy smorgasbord of small invertebrates that feed the fish.

The “after” image depicts a stream that looks more like it belongs in a New England pasture than in Amazonia. “There is a series of events that happens after deforestation,” says Neill. “You take away the trees and suddenly the streams are in the sun. The grass can now grow in the channel, it starts creeping in, and the stream accumulates sediments and organic material, which is basically dead grass. The grass is prolific so it reaches very high biomass. Under those conditions, that organic material uses up all the oxygen,” he says. “So all of a sudden you’ve gone from a stream with a nice sandy bottom and high oxygen levels to a stream with a mucky bottom that supports a different kind of insect community.”

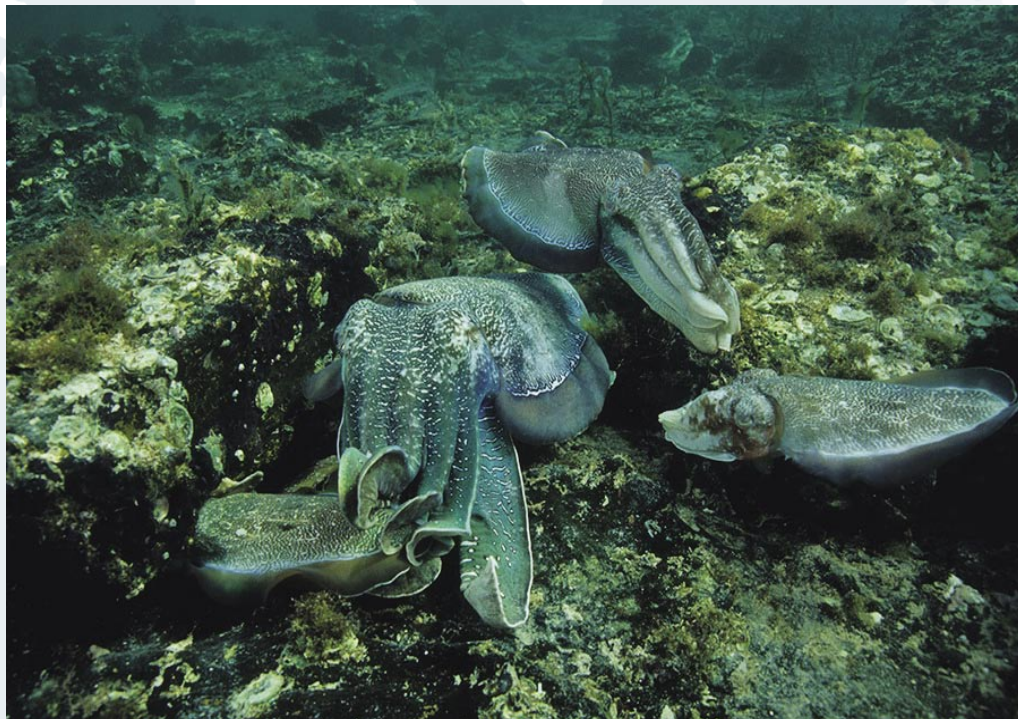
And that, of course, affects the fish. “In a half mile of forest stream we found about 35 species of fish. In an equivalent pasture stream, we found just one species,” says Deegan, who specializes in the impacts of ecosystems changes on fish and other animals.

Like doctors hoping to diagnose a patient, Neill and Deegan are carefully documenting these and other clear-cutting related symptoms in Rondônia’s streams—factors such as decreases in the water’s nitrogen levels that affect algae growth, and sediment buildup that changes how the streams flow—so they can eventually understand how problems in these smaller systems are impacting one of the most important ecosystems in the world.

“The streams in Rondônia are typical of the many thousands of miles of streams in the Amazon,” says Deegan. “They are connected to land and influenced by deforestation in fundamentally similar ways. This means we can use what we learn from these streams to extend our work to the broader Amazon River Basin.”

Wading into Brazilian streams to understand ecosystems may seem like the ultimate job, but Neill and Deegan are quick to point out that it’s painstaking work filled with long hours and even the occasional electric eel. It also takes patience, since piecing together environmental puzzles is science done over a lifetime, not a couple of years. But it’s work these MBL scientists and their Brazilian colleagues are clearly committed to for the long haul. And for now they’re taking it stream by stream, fish by fish.





Australia

Forget the beautiful view of South Australia's greenish-blue Spencer Gulf and the craggy Flinders Ranges that rise sharply in the distance. What Roger Hanlon loves most about the five-mile boat ride from the town dock in Whyalla to a restricted area of rocky

reef called Black Point is what he sees when he arrives. "You can literally look over [the side of] the boat and in ten feet of water you might see 10 to 30 large cuttlefish. You can see them fighting, you can see them mating, and you can see it right from the boat. It's amazing!"

Hanlon, a cephalopod expert and senior scientist in the MBL's Marine Resources Center, has been studying

the behavioral ecology of Australian giant cuttlefish (*Sepia apama*) at Black Point for the past five years. It is the only known spawning aggregation of cuttlefish in the world. And thanks to funders including the Sholley Foundation and the National Geographic Society, Hanlon and his research team

regularly dive eye-to-eye with hundreds of these 2- to 22-pound creatures, which gather annually during the late May to early June mating season. "The beauty of this study site is that you don't sit around and not see much behavior. It's nearly non-stop sex and fighting, not necessarily in that order," says Hanlon.

With its shallow, clear water and close proximity to shore, Black Point is indeed the perfect natural laboratory. Using underwater video cameras, a special identification system, and DNA fingerprinting techniques, Hanlon's research team has gathered "a mountain of data" on the cuttlefish that mate there. "I'm interested in animal behavior, particularly behavioral ecology," he says. "So my approach is to first study the animal's behavior in its natural ecosystem."

Hanlon is especially interested in sexual selection theory as described by Darwin and has been comparing squid and cuttlefish mating systems throughout his career. In the past decade Hanlon has amassed an impressive body of work on cuttlefish reproduction, including concepts such as female choice, male fighting behavior, and other critical aspects of sexual selection that were previously undocumented.



Roger Hanlon

Cuttlefish mating, which includes head-to-head copulation, is undeniably captivating. “The female lays one egg at a time, she lays them serially, she has temporary boyfriends, and there’s multiple paternity on a daily basis,” says Hanlon. And since the sex ratio on the breeding ground averages 8 to 11 males per female, and because the female holds sperm for fertilization after copulation, the so-called “sperm competition” is fierce.

Thanks to Black Point, Hanlon and his team have learned, among other things, that giant cuttlefish mating is a complicated undertaking, where the males resort to fighting, sneaking, and female impersonation.

In fact, in a recent *Nature* paper, the scientists presented behavioral and genetic data demonstrating that small male cuttlefish that disguise themselves as females are highly successful in tricking their larger competitors and fertilizing the female’s eggs. Behavioral ecologists call this sexual mimicry, and while it’s been widely reported among many species in the natural world, Hanlon and colleagues were the first to document fertilization success in an animal using this tactic.

Until 1999, much of Hanlon’s cuttlefish work was done in a lab, where he cultured European cuttlefish (*Sepia officinalis*) for neuroscience research and studied these animals under artificial conditions. But after searching for 25 years for a spawning aggregation he could study in the wild, an Australian graduate student, Karina Hall, told him about Black Point. “I’ve followed every nebulous lead and gone to places like Tahiti, Italy, and South Africa to find cuttlefish populations, but this is the only one that ever materialized,” says Hanlon.

From the start, he and the Black Point giant cuttlefish have had a somewhat symbiotic relationship. Hanlon and colleagues have published numerous scientific papers on the fascinating natural behavior of these animals, and resulting media and public interest may have ultimately saved them.

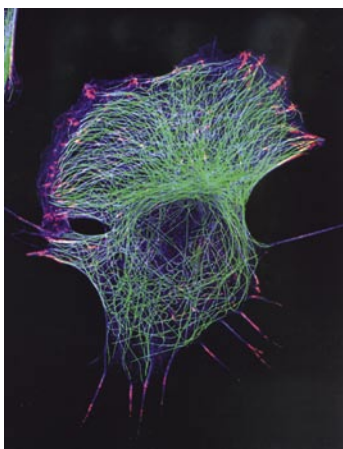
When Hanlon first learned about Black Point, fishermen, who saw easy prey in the large numbers of animals that gathered there annually, were decimating the cuttlefish. “The fishermen would use squid jigs to catch the cuttlefish by the hundreds and thousands, and they were sending them to China for 39 cents a pound. Little did they realize what a unique event this was,” Hanlon says.

Today, thanks to widespread interest in the cuttlefish, the small town of Whyalla has turned itself into an ecotourism center that is far more lucrative than the small fishing industry was. “I consider it a wonderful example of a biological discovery and human cleverness,” says Hanlon. “You can’t read that in any of the scientific papers and I think it’s the coolest part of the story in many ways.”





RESEARCH



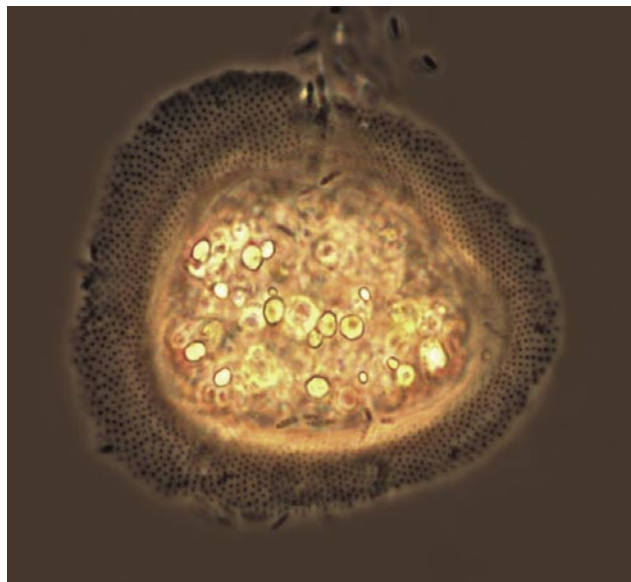
Throughout its history, the MBL has been a place where the world's top biologists can focus on their research, not distracted by departmental affairs, committee work, or other aspects of university life. The MBL provides both the resource support and the intellectual environment that enable many scientists to do their best work.

Today 58 Ph.D.-level investigators and their staff conduct research at the Laboratory year-round in areas such as cellular, developmental, and reproductive biology; molecular biology and evolution; neurobiology and sensory physiology; ecology and ecosystems studies; global infectious diseases; and marine biotechnology and aquaculture.

The population of investigators grows dramatically each summer when hundreds of distinguished scientists from around the world gather at the MBL's Whitman Center to do research.

During a typical MBL summer, researchers look for basic principles of life in organisms from squid to surf clams to zebrafish. They ask how nerve cells communicate, how cells regulate their complex processes, and how they proliferate. They explore how organisms reproduce and develop, how they fight disease, how sense organs gather information, and how brains process it. The investigators who gather each summer bring a diversity of approaches and questions. Along with the large number of faculty associated with the summer courses, they make the MBL the largest and most exciting biological laboratory in the world.

JOSEPHINE BAY PAUL CENTER FOR COMPARATIVE MOLECULAR BIOLOGY AND EVOLUTION



Investigators in the Josephine Bay Paul Center for Comparative Molecular Biology and Evolution seek to understand the molecular basis and origin of disease mechanisms, the evolution of microbial communities, and the influence of single-cell organisms on planetary processes. They study microbes from all three domains of life (Archaea, Bacteria, and Eukarya), their evolutionary history, their interactions with each other and macroscopic forms of life, and how members of diverse microbial communities contribute and respond to environmental change. The Josephine Bay Paul Center's interlocking programs in Global Infectious Diseases, Molecular Evolution, and Molecular Microbial Diversity foster a special environment that rarely, if ever, occurs in medical centers or university departments. Linkages between these biological disciplines have far-reaching implications for identifying and one day predicting origins and dispersal mechanisms of pathogenicity, and the development of systems-level approaches to environmental microbiology.

The Josephine Bay Paul Center supports these programs through its operation of state-of-the-art facilities for high-throughput DNA sequencing, DNA microarraying, and large-scale computational facilities within the W.M. Keck Ecological and Evolutionary

Genetics Facility. The National Institutes of Health provides major funding to investigate molecular processes and resistance to African trypanosomes, which cause human sleeping sickness, gene expression studies in the human parasites *Giardia*, *Trypanosoma*, and *Schistosoma*, the influence of endosymbiotic relationships on bacterial genome evolution, the relationships between diverse eukaryotic genera through genome-wide comparisons of expressed genes, and marine-

related studies of human disease through the new Woods Hole Center for Oceans and Human Health. The National Science Foundation provides support for molecular evolution studies of endosymbionts, development of digital resources for describing microbial diversity, and molecular evolution studies of rotifer and microsporidial genomes. The National Aeronautic and Space Administration supports the Josephine Bay Paul Center's membership in the astrobiology community, while the Department of Energy continues to support our bioinformatics initiative that focuses on annotation and evolution of gene families in the metal-reducing microbe *Shewanella oneidensis*.

Continuing support from the G. Unger Vetlesen Foundation underpins growth and stability of the center, and the Alfred P. Sloan Foundation has recently committed resources to support an International Census of Marine Microbes (ICoMM). This new initiative seeks to organize the international community in its effort to understand the diversity and role of microbes throughout the world's oceans. This is a collaborative project that engages investigators from around the world and is managed jointly by the Josephine Bay Paul Center and the Royal Netherlands Institute for Sea Research – NIOZ.

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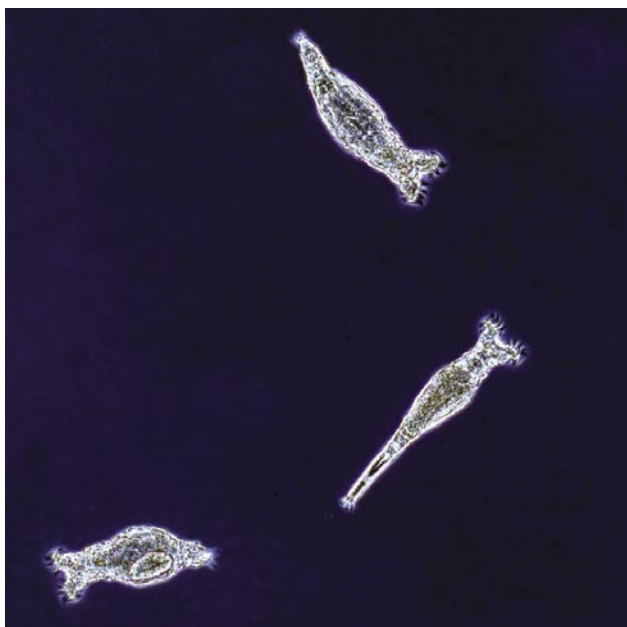
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An Evolutionary Exception Confirmed

MBL Researchers Provide Strong Evidence that an Asexual Invertebrate Thrives and Evolves Without Sex

Bay Paul Center evolutionary biologist Jessica Mark Welch and her colleagues David Mark Welch and Matthew Meselson have confirmed that a group of microscopic animals has evolved for tens of millions of years without sexual reproduction. Their results, published in the February 10, 2004 issue of *Proceedings of the National Academy of*

While many hypotheses have addressed this problem, the paradox raises one of the most perplexing questions in biology: If asexual reproduction is more efficient than sexual reproduction, why does sexual reproduction predominate so thoroughly? Jessica Mark Welch's results may help scientists come closer to an answer.



Sciences, provide the strongest evidence to date that a higher-ranking taxon has evolved without sexual reproduction and demonstrate a radical exception to the biological rule that abandonment of sexual reproduction is an evolutionary dead end.

While almost all multicellular organisms reproduce sexually, this form of reproduction is much less efficient than asexual reproduction (or mitosis) whereby females effectively make clones of themselves. Although asexual organisms often enjoy short-term success as compared to their sexual ancestors, they are rarely found as higher-order taxa, implying that they cannot survive in evolutionary time.

The researchers studied the bdelloid rotifer, a microscopic animal found throughout the world in almost all aquatic habitats. Bdelloids appear to have given up sex about 50 million years ago, yet the organism has evolved into 370 described species. While Mark Welch and her colleagues have previously demonstrated that bdelloid genomes contain two or more divergent gene copies, an observation consistent with long-term asexual reproduction, a significant shortcoming of their approach was the inability to detect nearly identical gene pairs, as might result from inbreeding or other rare forms of sexual reproduction.

To overcome this methodological shortcoming and conclusively demonstrate that bdelloids are, in fact, completely asexual, Mark Welch and her colleagues painstakingly analyzed the genome of the bdelloid species, *Philodina roseola*. Using a method called fluorescent *in situ* hybridization, they scoured the genome, looking for chromosome partners, also called homologous pairs. Identification of these would be a clear indication of sexual reproduction as each member of the chromosome pair is derived from a different parent.

The scientists identified four copies of a target *P. roseola* marker gene, however each gene was on a separate chromosome and all were quite a bit different from each other. These results, consistent with asexual reproduction, eliminate the possibility that bdelloids reproduce sexually and thus confirm that the organism has evolved without sexual reproduction or genetic exchange for tens of millions of years.



Matthew Meselson Receives Special Achievement Lasker Award

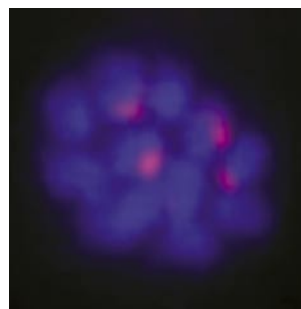
Marine Biological Laboratory adjunct scientist and Corporation Member Matthew Meselson received the Albert Lasker Award for Special Achievement in

Medical Science from The Albert and Mary Lasker Foundation in October, 2004. The Award honored Meselson "for a lifetime career that combines penetrating discovery in molecular biology with creative leadership in public policy aimed at eliminating chemical and biological weapons."

The Lasker Awards are the nation's most distinguished honor for outstanding contributions to basic and clinical medical research. Often called "America's Nobel," the Lasker Award has been presented to 68 scientists who went on to receive the Nobel Prize.

In 2001 Meselson, a Harvard professor since 1960, established a satellite laboratory in the MBL's Josephine Bay Paul Center for Comparative Molecular Biology and Evolution, where he is trying, with colleagues Jessica and David Mark Welch, to unravel the mystery behind one of the most perplexing questions in biology: What drives the early extinction of asexual organisms, and why it can be averted by sexual reproduction?

"The MBL, in particular Mitch Sogin and the Bay Paul Center, have provided a stimulating intellectual environment for me, David Mark Welch, and Jessica Mark Welch in our work with bdelloid rotifers," said Meselson. "The Bay Paul Center provides us with high throughput DNA sequencing facilities and computing facilities not available to me at Harvard. Because of this, postdoctoral fellows and students from my Harvard Lab often journey to Woods Hole to pursue their research. Without the Bay Paul Center, and Mitch Sogin's generous hospitality and interest, we would be seriously disadvantaged."



Tiny Invertebrate Evolves without Sex, cont.

What drives early extinction, and why it can be averted by sex, remains one of the central mysteries of biology, the resolution of which is likely to have far-reaching impact on scientists' understanding of basic biological and evolutionary processes. "Sex and genetic recombination are obviously tremendously important for life," says Jessica Mark Welch, "but we don't understand why they are so important." When we do eventually understand, it could have practical consequences we can't yet imagine."

Mark Welch and her colleagues will continue to study bdelloids as they offer an ideal model system in which to explore the effects of asexual reproduction. Their hope is to better understand how the animals have evolved without sexual reproduction and escaped extinction. "We can now use bdelloid rotifers to test the theories about why sex is important," says Mark Welch. "Any good theory will now have to account for why the bdelloids are an exception."

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Continued...

The Ecosystems Center, founded in 1975, operates as a collegial association of scientists under the leadership of co-directors John Hobbie and Jerry Melillo. Its mission is to investigate the structure of ecosystems and how they function, to predict their response to changing environmental conditions, to apply this knowledge to the preservation and management of natural resources, and to educate both future scientists and concerned citizens.

Because the complex nature of modern ecosystems research requires a multidisciplinary and collaborative approach, center scientists work on projects with experts from other MBL centers and from other institutions. Together they conduct research to answer a variety of questions at field sites ranging from Alaska, Sweden, and Russia to Brazil; and from the Arctic streams to the sandplains of Martha's Vineyard.

In 2004, Ecosystems Center scientists Paul Steudler, Jerry Melillo, and colleagues from other institutions studied methane consumption rates in soils in temperate forests to try to understand why some soils consume more methane than they produce. This is important because soil methane consumption counteracts the accumulation of the gas in the atmosphere. Methane is a far more potent greenhouse gas than carbon dioxide and will have 21 times more effect on global warming over the next century than carbon dioxide.

Conducting their experiments at the Harvard Forest Long Term Ecological Research site in central Massachusetts, center scientists looked at disturbances that added nitrogen to the soils. These include atmospheric deposition (rain and snow) due to the burning of fossil fuels and the use of fertilizers. The added nitrogen affected microbes in the soils, resulting in less methane consumption. Either the methane-consuming microbes actually decreased due to the nitrogen addition or the microbial population changed to a species that does not use methane as a carbon source. Decreases in methane consumption are observed shortly after nitrogen is added and persist for decades after the nitrogen additions have been discontinued.

These results have important long-term implications for the methane consumption capacity of temperate forest soils. It appears that even moderate levels of nitrogen deposition may diminish the potential for these soils to slow the future growth in atmospheric methane.

Microbes were also the focus of research at another Long Term Ecological Research project, the Plum Island Ecosystem site in northeastern Massachusetts.

Some species of bacteria are found only in salt water while others are found only in fresh water. Scientists have wondered whether there

Continued...

are other bacteria that are unique to estuaries, where salt water comes in from the ocean and gradually mixes with fresh water from a river. Center scientists John Hobbie, Chuck Hopkins, and Byron Crump collaborated with Bay Paul Center's Mitch Sogin to study the microbes found in the Parker River estuary.

Using a molecular technique involving the gene for ribosomal RNA, which allows identification of bacteria, they determined that there is indeed a unique estuarine bacterial community. It exists, however, only in the summer and fall, when there is a long residence time of water in the estuary and the bacteria are able to grow quickly due to warm water temperatures and abundant nutrients. In the spring, when the water flows in and out of the estuary at a more rapid rate, bacteria are washed out before they have a chance to grow.

The development of molecular methods to identify bacteria is an important first step in linking bacteria in nature to their functions in ecosystems.

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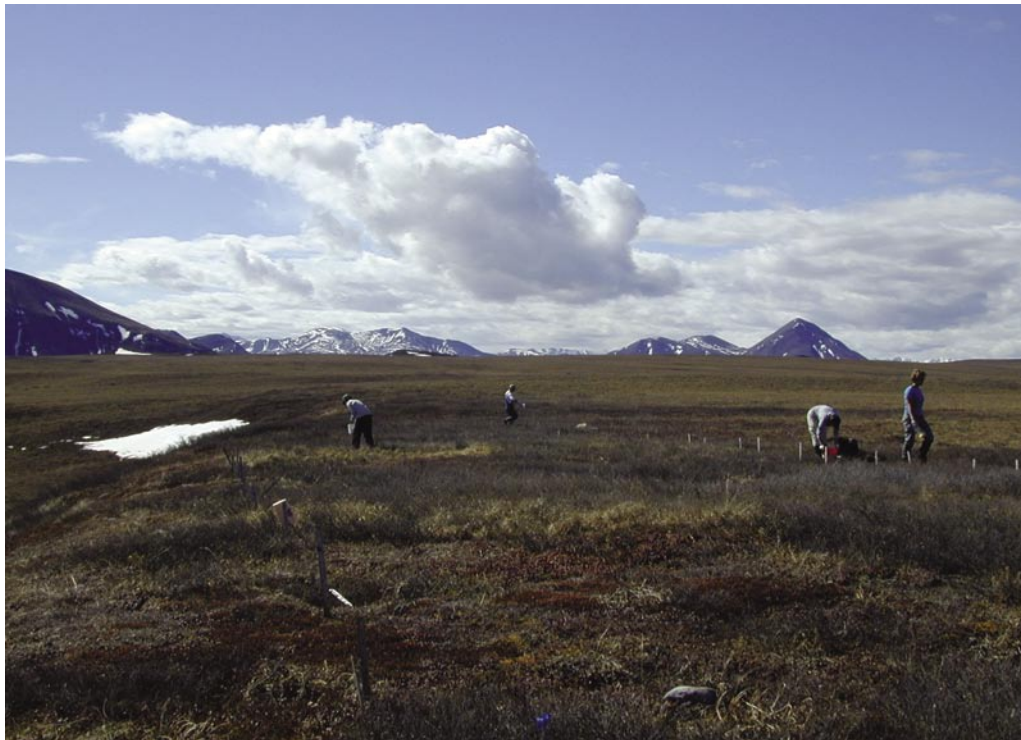
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Long-Term Arctic Study Yields Surprising Results

Tundra Thaw Could Release More CO₂ to Atmosphere than Expected



MBL Ecosystems Center senior scientist Gus Shaver focuses his research on Alaskan tundra ecosystems, where cold temperatures, low light, scarce nutrients, and a short growing season all interact to limit plant growth. For more than 20 years, Shaver has conducted experiments in large plots of tundra near Toolik Lake, at the Arctic Long Term Ecological Research (LTER) site in the foothills region of Alaska's North Slope. Since 1981, the plots have been continuously fertilized with nitrogen and phosphorous as a way to mimic the increased nutrient availability that is expected to occur in the soil as a result of global warming.



Scientists had long assumed that as tundra soils respond to climate change, more nutrients would be made available in the soils, leading to larger plants which would, in turn, absorb more carbon dioxide from the atmosphere and help lessen the effects of global warming. Results of a long-term fertilization experiment, published in the September 23, 2004, issue of the journal *Nature* by Shaver and his colleagues from the University of Florida and the University of Alaska, have revealed that this assumption is not the silver lining that some had hoped for.

The researchers found that tundra plants and soils responded to increased nutrient availability in opposite ways. While the plants grew larger and stored more carbon, as expected, under the fertilized conditions, loss

Continued...

LTER, cont.

of carbon and nitrogen from deep soils was substantial and more than offset the increased carbon stored aboveground.

Previous nutrient manipulation studies projected that total carbon storage would be enhanced in tundra ecosystems as a result of increased nutrient availability and higher plant productivity. However, the inferences were based on aboveground and surface soil measurements only. Armed with resources that only a long-term experiment could provide, Shaver and his colleagues were able to dig deeper, literally and figuratively, to investigate how deep soils responded to the fertilization.

“The changes that we observed were the net result of 20 years of relatively small annual changes in many interacting processes that added up to a large, cumulative change,” says Shaver. “In a shorter-term study, we could never have measured these changes in component processes with sufficient precision to accurately predict their long-term effects.”

Normally, decomposition is slow in wet and cold high-latitude environments and carbon accumulates in thick layers of organic matter on top of mineral soils. In fact, more than one-third of the world’s global soil carbon pool is stored in northern latitudes—an amount equivalent to two-thirds of all of the carbon found in the earth’s atmosphere.

Shaver and his colleagues discovered over the course of their experiment that lower layers of soil organic matter decreased in thickness, an indication of decomposition. They hypothesize that microbes were stimulated by the increased availability of nutrients, leading to accelerated rates of decomposition in the older, deeper soil layers.

“Most previous researchers have concluded that soil organic matter decomposition is limited more by the availability of high-quality carbon substrates than by other elements such as nitrogen,” says Shaver. “Our results suggest that decomposition as well as plant growth are strongly nutrient-limited in northern



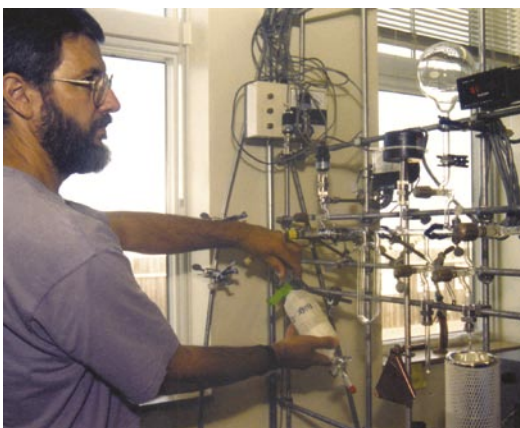
ecosystems, and that predictions of change in carbon balance in these systems must account for the effects of limitation on carbon cycling by other elements.”

The results of Shaver’s study suggest that in a warmer climate, decomposition of tundra soils will be stimulated more than plant production. As such, more carbon could be lost from the ecosystem than is taken up and stored. Carbon lost from the soils as carbon dioxide could create a positive feedback, further enhancing global warming.

Because vast amounts of carbon are stored in northern latitudes, there is considerable interest in understanding how arctic soils will respond to global warming. The discoveries made by Shaver and his colleagues in this experiment provide a glimpse into the effects climate change may have on tundra ecosystems. Their results also have important implications for simulation models, which must now account for a net carbon loss from tundra ecosystems under warming conditions. In their future research, the researchers plan to investigate in more detail the particular mechanisms by which increased availability of nitrogen and phosphorus allowed soil fungi and bacteria to break down the complex carbon compounds in deep soil.

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WHITMAN CENTER FOR SUMMER AND VISITING RESEARCH

This has been a landmark year for the Whitman Center, home to hundreds of biologists who come to Woods Hole each summer to conduct their research in the uniquely productive environment of the MBL.

In 2004, based on recommendations emerging from the MBL's strategic planning initiative, plans were finalized for the remodeling of the Whitman laboratory. The four-story 32,000 gross square foot building has served as the home of summer research at the MBL for over 40 years. The rewards of visiting scientists working in the Whitman laboratory over the years have been grand. Discoveries made there have led to Nobel Prizes and have enhanced the frontiers of research and their impact on advancing human health. But to keep the MBL the premier destination for basic biological inquiry, the quality of the facility must keep pace with the quality of the research being done within its walls.

The renovation of the Whitman laboratory is an exciting and long-overdue project that will allow the MBL to provide the modern research facilities that are essential for attracting outstanding summer and non-summer visiting scientists from all over the world. The space and systems renovations also will expand the use of the Whitman building beyond the summer months and allow scientists to meet and pursue their research year-round. The demands for time and resources placed on scientists today require the MBL to provide versatile, high-quality facilities that are always available and provide a community of

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resources collectively engaged in advancing biological research and applications.

The curiosity and collaboration that define the MBL's summer scientist program have transformed our knowledge and understanding of the natural world and had an enormous impact on the quality of human health. Each new discovery prompts a host of new questions, and the MBL seeks to continue to provide the outlet through which the issues of our day will be investigated, and our world made a better place.

Fundraising for the \$20 million project was approved by the MBL Board of Trustees and launched last summer. As of winter 2005, the MBL has raised \$3.8 million towards the Whitman project. As a result of this fundraising, the first phase of the project, except for spring landscaping, has been completed. Phase One involved the reconfiguration of most of the MBL's outside electric infrastructure. The goal is to complete the entire project by spring of 2007.

The Whitman Center continued to attract a large number of distinguished investigators and their research associates, graduate students, and postdoctoral fellows in 2004. One hundred thirty-three principal investigators and 171 other researchers from 133 institutions and 14 countries made the MBL their summer research home. All of the Whitman laboratories were filled and the results of work done there have produced scores of publications in peer-reviewed journals (see page 45).

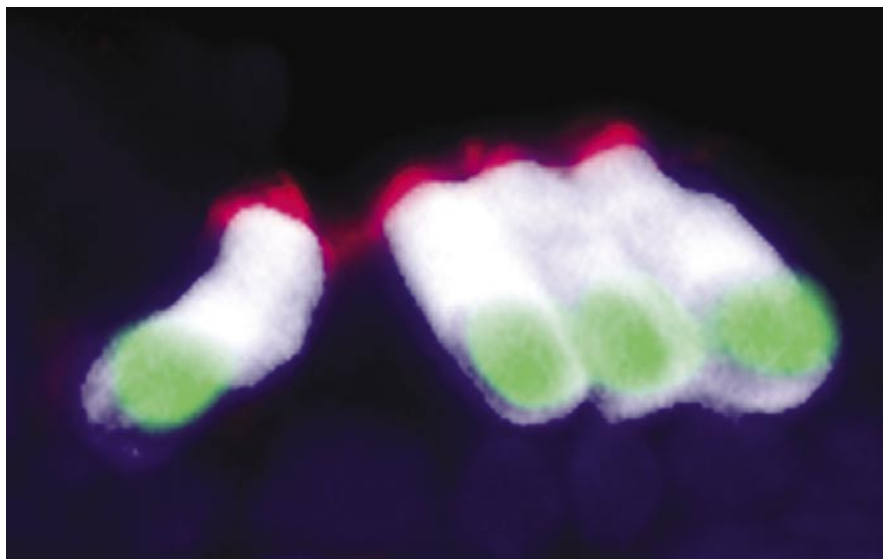
The MBL summer fellowship program supported many Whitman investigators in 2004. Eleven fellowships totaling \$160,000 were awarded to outstanding scientists in several areas including neurobiology, cell, and developmental biology. Additional funds were also awarded to two Dart Scholars in Learning and Memory; nine scientists were given Grass Faculty Awards in 2004.

Most notably, a long-time summer investigator, Dr. Avram Hershko, of Technion-Israel Institute of Technology, was awarded the Nobel Prize in Chemistry for his pioneering work on the ubiquitin-mediated protein degradation pathway. Hershko spends his summers studying the role of ubiquitin in regulating the cell cycle in the oocytes of the surf clam, *Spisula solidissima*. He has also spearheaded the development of the clam project in collaboration with Bob Goldman of Northwestern University, Feinberg School of Medicine; Yossi Gruenbaum of Hebrew University; and Bob Palazzo of the Rensselaer Polytechnic Institute. This project is funded through the generous support of The Gruss Lipper Family Foundation.



Whitman Renovation Advisory Committee

Robert Goldman, Northwestern University,
Feinberg School of Medicine, *Chair*
Peter Armstrong, University of California, Davis
George Augustine, Duke University
Leah Haimo, University of California, Riverside
Avram Hershko, Technion-Israel Institute
of Technology
Dan Johnston, Baylor College of Medicine
Roger Sloboda, Dartmouth College
Richard Cutler, MBL Director of Facilities
and Services
E. A. Dawidowicz, MBL Director of Education
Andrew Mattox, MBL Director of Environmental
Health & Safety
Jonathan Cohen, Architect, Tsoi/Kobus &
Associates



Stem Cells May Hold Key to Repairing Hearing Loss

In an effort that may someday lead to the treatment of hearing loss and balance disorders, Whitman Center investigators Jeffrey Corwin and Stefan Heller and their colleagues are working to develop methods to make large numbers of stem cells from mice and chicks “grow” into inner ear sensory hair cells—acoustic receptors that are a critical part of the auditory system. Corwin and Heller first convened at the MBL in the summer of 2004 and are planning to return in the summer of 2005 to continue their efforts to understand hearing loss at the cellular level.

In humans, inner ear sensory hair cells are a precious commodity. We are born with only about sixteen thousand of these sound detectors in each ear, which can be easily damaged by age, certain illnesses, exposure to loud sounds, and some medications. Once damaged, the cells do not grow back. And with the cell loss comes so-called irreversible hearing loss.

Corwin and Heller’s research, in combination with recent advances in understanding the genes that inhibit the regeneration of hair cells, offers hope for the treatment of hearing loss and balance disorders, which currently affect some 28 million Americans. This is the first step toward the ultimate goal of creating implantable human hair cells that will thrive and grow; eventually repairing damaged hearing and restoring balance.

Corwin, a neuroscience professor from the University of Virginia School of Medicine, and Heller, an associate professor at Harvard Medical School, will be joined in 2005 by Mark Warchol, a first-time MBL Whitman investigator, who is a professor at the School of Medicine at Washington University in St. Louis. “Nearly all of the scientists who worked in our group are returning,” says Corwin. “Several were first time MBL-ers and all seemed sold on the lab as a great place for the kind of work we are doing.”

Corwin, Heller, and Warchol will be working during the summer of 2005 to develop new methods to expand and maintain stem cells isolated from chicken embryos and the mouse inner ear to establish long-term stable cell lines. The ultimate goal? To learn how to eventually repair people’s damaged hearing and restore their balance.

The scientists’ MBL collaboration is part of the Albert and Ellen Grass Faculty Grant Program.



Whitman Investigator Avram Hershko Wins 2004 Nobel Prize in Chemistry for Discovery of Ubiquitin-Mediated Protein Degradation

Embryology course alumnus, Irwin Rose, shares award

Whitman investigator Avram Hershko was awarded the 2004 Nobel Prize in Chemistry for “the discovery of ubiquitin-mediated protein degradation.” Hershko, a professor of biochemistry at the Technion-Israel Institute of Technology in Haifa, Israel, shared the award with Aaron Ciechanover also of the Technion, and Irwin Rose of the University of California, Irvine. Rose is an alumnus of the MBL’s Embryology course.

The 2004 Nobel Prize in Chemistry honored the discovery of the ubiquitin system of regulated protein degradation, a fundamental process that influences key cellular events such as the cell cycle, malignant transformation, and responses to inflammation and immunity.

Ubiquitin is a protein found within cells that targets other proteins for elimination. Scientists have long known that all cells manufacture and subsequently discard an array of proteins involved in a variety of cellular processes. Although many scientists over the years have focused their research on learning more about how cells make proteins,

until recently few have explored how cells go about discarding proteins, and the impact that process has on disease.

More than thirty years ago, Avram Hershko took a road less traveled in science and began studying how cells rid themselves of unwanted or damaged proteins. With the help of his colleagues, Hershko discovered the ubiquitin system and eventually determined that it impacts major physiological processes in the body. Scientists now know that it is involved in regulating cell division, aids in controlling embryonic development, and helps maintain the immune system. It is implicated in a number of diseases as well, including cervical cancer caused by the human papilloma virus. Because it is involved in the body’s inflammatory response to invading microbes, it may also play a role in autoimmune diseases.



Hershko has been a summer investigator at the Marine Biological Laboratory since 1991. He was drawn to the MBL when he became interested in learning more about the role that ubiquitin plays in the cell division cycle.

“Many important regulators of the cell cycle are degraded in a programmed fashion, which allows the cell cycle to progress,” explains Hershko. The first of these proteins, known as cyclin B, was discovered by Tim Hunt, Joan Ruderman, and their colleagues working independently at the MBL in the early 1980s. (Hunt won the Nobel Prize in 2001 for this discovery.)

By 1989, MBL scientists had developed a means of studying cyclins and the cell cycle in the test tube using the eggs of local surf clams as models. It turned out to be exactly the system that Hershko needed to study what role, if any, ubiquitin played in the process. In collaboration with Robert Palazzo, now at Rensselaer Polytechnic Institute, Hershko determined that cyclin is degraded by the ubiquitin system during the cell cycle. Working with Joan Ruderman of Harvard University, he later identified a specific ubiquitin ligating complex that “targets cyclin B for degradation at the end of mitosis”—the final phase of cell division.

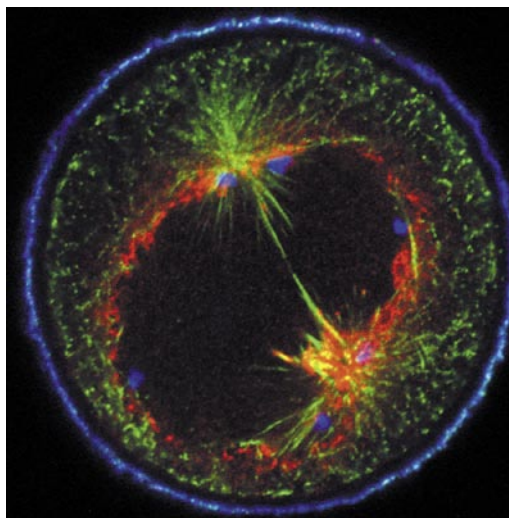
Today Hershko is studying that ubiquitin ligating complex in both clam eggs and cultured human cells in hopes of learning even more about cell division in general and cancer more specifically.

“Changes in the mechanisms that control the activity of this complex lead to chromosome instability, and ultimately to cancer,” Hershko says. “Thus, work done at the MBL on the mechanisms of cell division in clam eggs may provide novel insights into their aberration in human cancer.”

At the MBL, Hershko is also leading an effort to sequence some of the surf clam’s active genes—an effort, Hershko says, that is vital to the future of his research. “We are reaching a barrier in our work, unless we obtain this molecular knowledge,” he said.

The effort, called the Clam Project, is the first step toward sequencing the entire clam genome, and its goal is to provide scientists with better knowledge of the clam’s active DNA. Such information is crucial to the study of the basic cellular processes involved in many diseases. The scientists plan to use the new genetic information to create antibodies. And they hope to begin experiments impossible without those antibodies as soon as the project is complete.

“Sequencing the clam genome will be a quantum leap for our research,” said Hershko.



Whitman Investigators, cont.

Haimo, Leah, University of California, Riverside
 Hardwick, Marie, Johns Hopkins Medical School
 Harrington, John, State University of New York at New Paltz
 Heart, Emma, Boston University
 Heck, Diane, Rutgers University
 Heller, Stefan, Harvard Medical School
 Henson, John, Dickinson College
 Hershko, Avram, Technion-Israel Institute of Technology, Israel
 Highstein, Stephen M., Washington University School of Medicine
 Hilfiker, Sabine, Consejo Superior de Investigaciones Cientificas, Spain
 Hill, Susan, Michigan State University
 Hines, Michael, Yale University School of Medicine
 Holmgren, Miguel, National Institutes of Health

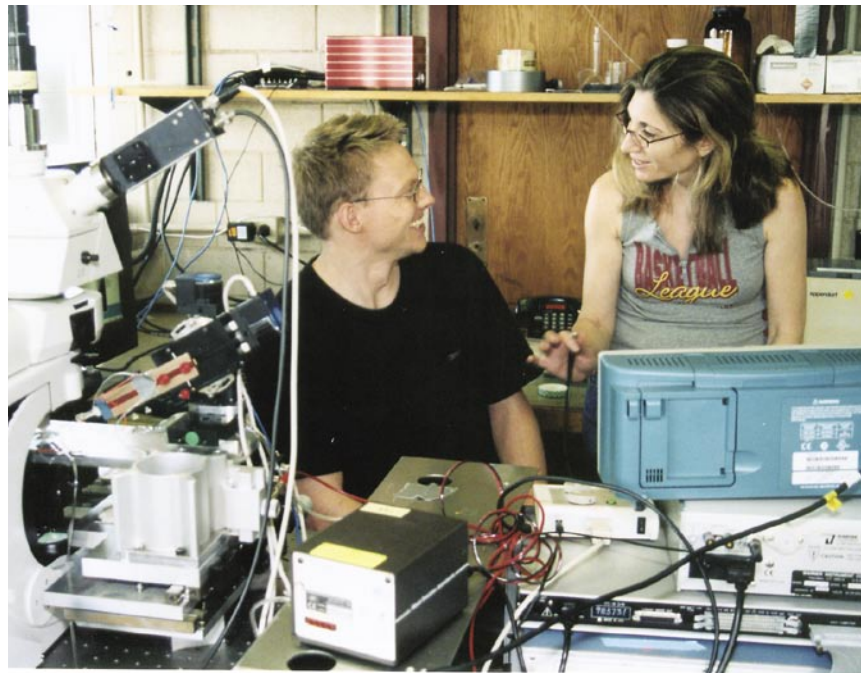
Jeffery, William, University of Maryland
 Johnston, Daniel, Baylor College of Medicine
 Jonas, Elizabeth, Yale University School of Medicine
 Jones, Teresa, National Institutes of Health
 Jovanovic, Jasmina, University of London, United Kingdom

Kaczmarek, Leonard, Yale University School of Medicine
 Kaplan, Ilene M., Union College
 Kaupp, U.B., Institut für Biologische Informationsverarbeitung, Germany
 Khodjakov, Alexey, Wadsworth Center
 Kirschner, Marc, Harvard Medical School
 Koester, Helmut, Baylor College of Medicine
 Kuhns, William, The Hospital for Sick Children, Canada

Lafer, Eileen, University of Texas Health Science Center
 Langford, George, Dartmouth College
 Larkum, Matthew, University of Bern, Switzerland
 Laskin, Jeffrey, University of Medicine & Dentistry of New Jersey
 Laufer, Hans, University of Connecticut
 Lauzon, Robert, Union College
 LeBaron, Richard, University of Texas, San Antonio
 Levine, Alex, The Hebrew University, Israel
 Li, Huawei, Harvard Medical School
 Lichtman, Jeff, Washington University School of Medicine
 Litman, Leib, Brooklyn College
 Llinás, Rodolfo R., New York University Medical Center
 Lovett, Donald, The College of New Jersey

Magee, Jeff, Louisiana State University
 Marshall, John, Brown University
 Martinez, Joe, University of Texas, San Antonio
 McNeil, Paul, Medical College Georgia
 Mensinger, Allen, University of Minnesota, Duluth

FELLOWSHIPS



MBL Research Fellows

Eleven scientists received fellowships from the Marine Biological Laboratory totaling \$160,000 to conduct research at the laboratory in 2004:

Jan Ellenberg, Ph.D.

European Molecular Biology Laboratory, Germany

"Meiotic chromosome dynamics in echinoderms"

Dr. Ellenberg was supported by the Evelyn and Melvin Spiegel, Frederik B. and Betsy G. Bang, Lucy B. Lemann, Robert Day Allen, and Herbert W. Rand Fellowships.

Simone Engelender, M.D., Ph.D.

Technion-Israel Institute of Technology, Israel

"Study of synphilin-1 function and its contribution to Parkinson's disease"

Dr. Engelender was supported by a Gruss Lipper Family Foundation Fellowship.

John H. Henson, Ph.D.

Dickinson College

"Cytoskeletal mechanisms underlying retrograde flow and spindle assembly in sea urchin cells"

Dr. Henson was supported by an MBL Associates Fellowship.

Eileen M. Lafer, Ph.D.

University of Texas Health Science Center at San Antonio

"Basic mechanisms underlying neurotransmission"

Dr. Lafer was supported by the Herbert W. Rand, H. Burr and Susie Steinbach, James A. and Faith Miller, Erik B. Fries, Charles R. Crane, Ann E. Kammer Memorial, and Plum Foundation John E. Dowling Fellowships.

Matthew E. Larkum, Ph.D.

University of Bern, Switzerland

"Characterization of the active dendritic properties of the pyramidal cells of turtle cortex—Part 2"

Dr. Larkum was supported by a Nikon Fellowship.

Alex Levine, Ph.D.

The Hebrew University of Jerusalem, Israel

"The role of reactive oxygen species (ROS) and nitric oxide (NO) in zebrafish mating"

Dr. Levine was supported by a Gruss Lipper Family Foundation Fellowship.

2004 Albert and Ellen Grass Faculty Grant Program

Donald L. Lovett, Ph.D.

The College of New Jersey
"Physiological significance of methyl farnesoate in osmoregulation by crabs"

Dr. Lovett was supported by the John O. Crane and Baxter Postdoctoral Fellowship Funds.

Eduardo A. Perozo, Ph.D.

University of Virginia Health Sciences Center

"Identification and characterization of novel ion channels from marine prokaryotes"

Dr. Perozo was supported by the MBL Associates, Stephen W. Kuffler, Frank R. Lillie, and M. G. F. Fuortes Fellowship funds.

Ehud Razin, Ph.D.

The Hebrew University Hadassah Medical School, Israel

"Lysyl tRNA synthase and Ap4A: New roles in the regulation of the activity of transcription factors"

Dr. Razin was supported by a Gruss Lipper Family Foundation Fellowship.

Charles B. Shuster, Ph.D.

New Mexico State University
"Spatio-temporal regulation of cytokinesis in echinoderm embryos"

Dr. Shuster was supported by the Laura and Arthur Colwin Endowed Summer Research Fellowship Fund.

Herman Wolosker, M.D., Ph.D.

Technion-Israel Institute of Technology, Israel

"Role of endogenous D-serine in the brain"

Dr. Wolosker was supported by a Gruss Lipper Family Foundation Fellowship.

Nine investigators were awarded Grass Faculty Awards at the MBL in 2004. The goal of this program is to take advantage of the collaborative environment of the MBL and bring together neuroscientists at the assistant or associate professor level from different institutions to work together to conduct specific research.

Helmut J. Koester, Ph.D., an instructor in the Division of Neuroscience at Baylor College of Medicine, and **Jackie Schiller, Ph.D.**, an associate professor in the Department of Physiology and Biophysics at the Technion Medical School, Israel, collaborated on a project titled *"Active dendritic integration in cortical sensory processing in vivo."*

Jasmina N. Jovanovic, Ph.D., a lecturer and group leader in the Department of Pharmacology, The School of Pharmacy at the University of London, UK, and **Sabine Hilfiker, Ph.D.**, a Ramon y Cajal Fellow and group leader at the Instituto de Parasitología y Biomedicina 'Lopez-Neyra,' Spain, collaborated on a project titled *"Dissecting the roles of protein phosphorylation in vesicle trafficking and secretion."*

Stefan Heller, Ph.D., an associate professor in the Department of Otolaryngology at Harvard Medical School, **Huawei Li, Ph.D.**, a professor in the Mass Eye and Ear Infirmary at Harvard Medical School, and **Jeffrey Corwin, Ph.D.**, a professor in the Departments of Neuroscience and Otolaryngology at the University of Virginia School of Medicine, collaborated on a project titled *"Quiescent stem cells in the mouse utricle."*

William N. Green, Ph.D., an associate professor in the Department of Neurobiology, Pharmacology and Physiology at the University of Chicago, and **John Marshall, Ph.D.**, an associate professor in the Department of Molecular Pharmacology, Physiology and Biotechnology at Brown University, returned to the MBL to continue their collaborative project titled *"Targeting and trafficking of glutamate receptors by PDZ domain proteins."*

Mitchison, Timothy, Harvard Medical School
 Moore, John W., Duke University Medical Center

Nasi, Enrico, Boston University School of Medicine

Palazzo, Robert, Rensselaer Polytechnic Institute
 Pant, Harish, National Institutes of Health
 Perozo, Eduardo, University of Virginia

Qian, Haohua, University of Illinois at Chicago
 Quigley, James, Scripps Research Institute

Rabbitt, Richard, University of Utah
 Rakowski, Robert F., Ohio University
 Razin, Ehud, Hebrew University - Hadassah Medical School, Israel
 Reese, Tom, National Institutes of Health
 Rhodes, Paul, New York University Medical School
 Rieder, Conly, Wadsworth Center
 Ripps, Harris, University of Illinois at Chicago
 Rome, Lawrence, University of Pennsylvania
 Ross, William, New York Medical College
 Ruderman, Joan, Harvard Medical School

Salmon, Edward, University of North Carolina, Chapel Hill
 Schiller, Jackie, Technion Medical School, Israel
 Shalinsky, Mark, Dartmouth College
 Shuster, Charles, New Mexico State University
 Sloboda, Roger D., Dartmouth College
 Sluder, Greenfield, University of Massachusetts Medical School
 Soares, Daphne, University of Maryland
 Spiegel, Melvin, Dartmouth College
 Spiegel, Evelyn, Dartmouth College
 Steinacker, Antoinette, University of Puerto Rico
 Sturley, Stephen, Columbia University Medical Center
 Sugimori, Mutsuyuki, New York University Medical Center

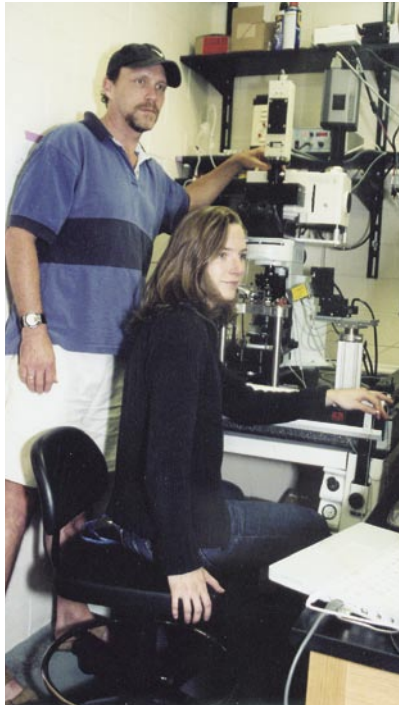
Telzer, Bruce, Pomona College
 Tong, James, University of California, Irvine

Umino, Yumiko, SUNY Upstate Medical University

Weidner, Earl, Louisiana State University
 Weissman, Tammy, Columbia University
 Wolosker, Herman, Technion-Israel Institute of Technology

Yeckel, Mark, Yale University School of Medicine

Zecevic, Dejan P., Yale University School of Medicine
 Zimmerberg, Joshua, National Institutes of Health
 Zottoli, Steven, Williams College
 Zukin-Bennett, R. Suzanne, Albert Einstein College of Medicine



2004 Dart Foundation Scholars Program in Learning and Memory

Sponsored by a generous grant from the Dart Foundation, the Dart Scholars Program brings top scientists in the field of learning and memory together to conduct research at the MBL for the summer. Two scientists were named Dart Scholars in Learning and Memory in 2004:

Daniel Johnston, Ph.D., is a professor in the Division of Neuroscience at the Baylor College of Medicine. His research project was "Calcium imaging in hippocampal neurons."

Mark F. Yeckel, Ph.D., is an assistant professor in the Department of Neurobiology at the Yale University School of Medicine. His research project was "Endoplasmic reticulum as a sensor for neuronal activity."

2004 Grass Fellows

Eleven young scientists received fellowships from the Grass Foundation to conduct research in neurobiology at the MBL during the summer of 2004. The program was directed by Susan Barry, Mount Holyoke College. Daphne Soares, University of Maryland, was the program's associate director.

Rachel Mary Berquist, Ph.D., University of Minnesota, Duluth
"Response dynamics of saccular afferent fibers in free-swimming toadfish, *Opsanus tau*"

Manuel Estrada, Ph.D., Yale University School of Medicine
"Effects of steroid hormones on intracellular Ca^{2+} signaling in a neuronal cell line"

Michael A. Farries, University of Washington Medical Center
"Long-term synaptic plasticity in nucleus RA of the zebra finch: A possible substrate for song learning"

Robert Crooks Froemke, University of California, Berkeley
"The cellular mechanisms and synaptic organization of neocortical receptive fields"

Eric Briant Gonzales, University of North Texas Health Science Center
"Kinetic determinants of the second transmembrane domain 7' position in the glycine $\alpha 1$ receptor"

Emma Heart, Ph.D., Evans Biomedical Research Center
"NAD(P)H oscillations in pancreatic islet cells and their modulations by metabolic and electric stimuli"

Leib Litman, Brooklyn College
"In search of a model organism for complex forms of implicit learning: Exploring crypsis and the serial reaction time task in cuttlefish"

Mark H. Shalinsky, Ph.D., Dartmouth College
"An electrophysiological study of the lung rhythm in the bullfrog, *Rana catesbeiana*, as an evolutionary precursor to gasping in mammals"

James Jiayuan Tong, Ph.D., University of California, Irvine
"Mitochondria dynamics in synaptic plasticity and learning"

Yumiko Umino, Ph.D., SUNY Upstate Medical University
"Processing of visual information of *Limulus* brain"

Tamily A. Weissman, Columbia University
"The Alzheimer's disease pathway meets neural development: Does presenilin process the reelin receptor and regulate neuronal migration?"



Domestic Institutions Represented

Albert Einstein College of Medicine

Baylor College of Medicine
Boston College

Boston University
Boston University School of Medicine
Brooklyn College
Brown University

California, University of, Berkeley
California, University of, Davis
California, University of, Irvine
California, University of, Riverside
Chicago, University of
Columbia University
Columbia University Medical Center
Connecticut, University of
Cornell University

Dartmouth College
Detroit Receiving Hospital
Dickinson College
Duke University
Duke University Medical Center

Georgetown University Medical Center
Georgia, Medical College of
Georgia, University of

Harvard Medical School
Harvard University
Hunter College

Illinois State University
Illinois, University of, at Chicago

Johns Hopkins Medical School

Louisiana State University
Louisiana State University Health Science
Center
Louisville, University of
Loyola University of Chicago

Maryland, University of
Massachusetts Medical School, University of
Michigan State University
Minnesota, University of, Duluth
Mount Holyoke College
Mount Sinai School of Medicine

NASA Ames Research Center
National Institute for Medical Research
National Institutes of Health
New Jersey, The College of
New Mexico State University
New York Medical College

New York University Medical Center
New York University School of Medicine
North Carolina, University of, Chapel Hill
Northwestern University
Northwestern University Medical School

Ohio University

Pennsylvania, University of
Pomona College
Princeton University
Puerto Rico, University of

Rensselaer Polytechnic Institute
Robert Wood Johnson Medical School
Rochester, University of
Rockefeller University
Rutgers University

Salk Institute
Scripps Research Institute
Skidmore College
State University of New York at New Paltz
State University of New York Downstate
Medical University
State University of New York Upstate
Medical University
St. Mary's College of Maryland

Texas A&M University
Texas Health Science Center, University of
Texas Health Science Center, University of,
North
Texas Medical Branch, University of
Texas, University of, Austin
Texas, University of, San Antonio
Tufts University School of Medicine

Union College
University of Medicine & Dentistry
of New Jersey
Utah, University of

Virginia School of Medicine, University of
Virginia, University of

Wadsworth Center
Washington Medical Center, University of
Washington University at St. Louis
Washington University School of Medicine
Wesleyan University
Williams College

Yale University
Yale University School of Medicine

OTHER RESEARCH PERSONNEL

Alber, Merryll, University of Georgia
Albertini, David, Tufts University School
of Medicine
Alliegro, Mark, Louisiana State University
Health Science Center
Ananth, Amitha, Boston University
Anyatonwu, Georgia, Yale University
Armstrong, Margaret, University of
California, Davis
Artigas, Pablo, Rockefeller University

Bai, Hua, University of Connecticut
Baker, Bradley, Yale University
Bautista, Jennifer, Hunter College
Bertetto, Lisa, Wesleyan University
Bhattacharya, Sharmila, NASA Ames
Research Center
Bosniak, Peter, Hunter College
Breneman, Katie, University of Utah
Britt, Joshua, University of Texas, Austin
Brown, Eric, University of Rochester
Bucior, Iwona, Friedrich Miescher Institute,
Switzerland
Burbank, Kendra, Harvard University
Burkart, Werner, International Atomic
Energy Agency
Burton, Oliver, Williams College

Cameron, Lisa, University of North
Carolina, Chapel Hill
Canepari, Marco, National Institute for
Medical Research
Cefaliello, Carolina, University of Naples,
Italy
Chang, Lynne, Northwestern University
Chang, Victoria, National Institutes
of Health
Chen, Xixi, Baylor College of Medicine
Chen, Xiaobing, National Institutes
of Health
Chiao, Chuan-Chin, National Tsing Hua
University, Taiwan
Chun, Jong Tai, Stazione Zoologica
"A Dohrn," Italy
Clarkson, Melissa, Rensselaer Polytechnic
Institute
Commons, Kathryn, University of
Pennsylvania
Corona, Kaitlin, SUNY Upstate Medical
University
Corrales, Carleton, Harvard Medical School
Cuajungco, Math, Harvard Medical School
Cuello, Luis, University of Virginia

Daigle, Nathalie, European Molecular
Biology Laboratory, Germany
De Stefano, Rosanna, University of Naples,
Italy
DeGiorgis, Joe, National Institutes
of Health
Deutch, Jamie, Dickinson College
DiMaio, Michael, Rensselaer Polytechnic
Institute
Djurisic, Maja, Yale University
Donnelly, Erin, Boston College
Duchalvsky, Scott, Detroit Receiving
Hospital

Continued...

Other Research Personnel, cont.

Duistermars, Brian, University of California, Riverside

Eyman, Maria, University of Naples, Italy

Fernandez-Busquets, Xavier, University of Barcelona, Spain

Ferrara, Eugenia, University of Naples, Italy

Fitzpatrick, John, Yale University School of Medicine

Flores, John, Dartmouth College

Fried, Christopher, Dickinson College

Galbraith, Jim, National Institutes of Health

Gallant, Paul, National Institutes of Health

Gasparini, Sonia, Louisiana State University Health Science Center

Gerlich, Daniel, European Molecular Biology Laboratory, Germany

Gherardi, Francesca, University of Florence, Italy

Gibson, Craig, Yale University

Gilland, Edwin, New York University Medical School

Goda, Makoto, Kyoto University, Japan

Goldman, Ann, Northwestern University Medical School

Gomez, Maria, Boston University School of Medicine

Gonzalez, Carlos, University of Virginia

Gray, Joshua, Rutgers University
Greenblatt, Sarah, University of North Carolina, Chapel Hill

Griffith, William, Texas A&M University

Groen, Aaron, Harvard Medical School

Guo, Mira, Princeton University

Hadrys, Thorsten, New York University Medical School

Hagenston, Anna, Yale University School of Medicine

Haller, Jorge, Boston University School of Medicine

Harrington, John M., University of California, Davis

Harrison, Kenneth, Yale University

Harrison, Reed, Williams College

Hawkins, Christopher, Hunter College

Helbig, Annika, Institut für Biologische Informationsverarbeitung, Germany

Hellemons, Anita, Rudolf Magnus Institute of Neuroscience, The Netherlands

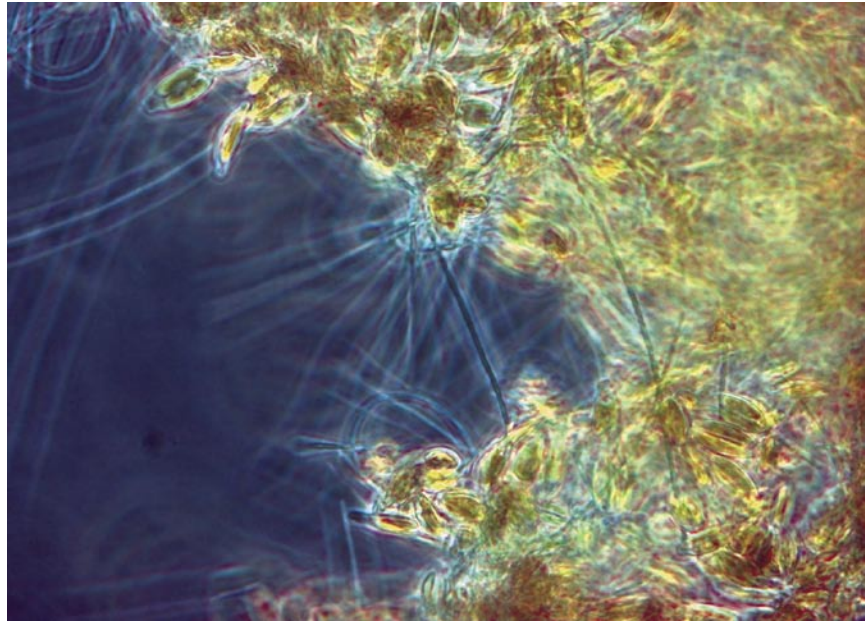
Hernandez, Carlos, New York University School of Medicine

Hernandez, Ruben, University of Texas, San Antonio

Hoang, Quan, University of Illinois at Chicago

Holley, Matthew, University of Sheffield, United Kingdom

Inman, Melissa, Louisiana State University



Friday Evening Lecture Series

June 18

Kenneth Miller, Brown University
"Time to Abandon Darwin? The Challenge from 'Intelligent Design'"

June 25

Jerry Melillo, Marine Biological Laboratory
"Biology, Earth's Atmosphere, and Climate Change: Making Connections and Looking to the Future"

July 2

Catherine Carr, University of Maryland
"Sound Localization in Owls and Alligators"

July 9 – Keith Porter Lecture

Ron Vale, University of California, San Francisco
"Molecular Motor Proteins: A Story Home-Grown from the Marine Biological Laboratory"

July 16

Mark Hughes, Genesis Genetics Institute
"Preimplantation Genetic Diagnosis: The Technology, the Medicine and the Bioethics"

July 21 and 22 – Forbes Lectures

Marc Tessier-Lavigne, Genentech
"Wiring the Brain: The Logic and Molecular Mechanisms of Axon Guidance and Regeneration" and
"Brain Development and Brain Repair: Molecules and Mechanisms that Control Nerve Growth"

July 23 – Glassman Lecture

Arnold Levine, Institute for Advanced Study, and the Cancer Institute of New Jersey
"Genetic Predispositions for Cancers in Humans"

July 30

Elisabetta Ullu, Yale University
"Tiny RNAs as Powerful Regulators of Gene Expression: Insights from Protozoan Parasites"

August 6 – Lang Lecture

Russell Fernald, Stanford University
"The Influence of Behavior on Brain Structure and Function"

August 13

Amar Klar, National Cancer Institute
"Genetics of Human Handedness, Schizophrenia, and Bipolar Traits"

Foreign Institutions Represented

Barcelona, University of, Spain
Bern, University of, Switzerland
Brain Science Institute, Japan

Consejo Superior de Investigaciones
Cientificas, Spain

Department of Fisheries, Australia

European Molecular Biology Laboratory,
Germany

Florence, University of, Italy
Friedrich Miescher Institute, Switzerland

Hebrew University - Hadassah Medical
School, Israel
Hebrew University, Israel

Hong Kong University of Science and
Technology, China
Hospital for Sick Children, Canada

International Atomic Energy Agency, Austria
Instituto de Investigacion Medica "Mercedes
y Martin Ferreyra," Argentina
Institut für Biologische
Informationsverarbeitung, Germany
Instituto Venezolano de Investigaciones
Cientificas, Venezuela

Kyoto University, Japan

London, University College, United Kingdom
London, University of, United Kingdom

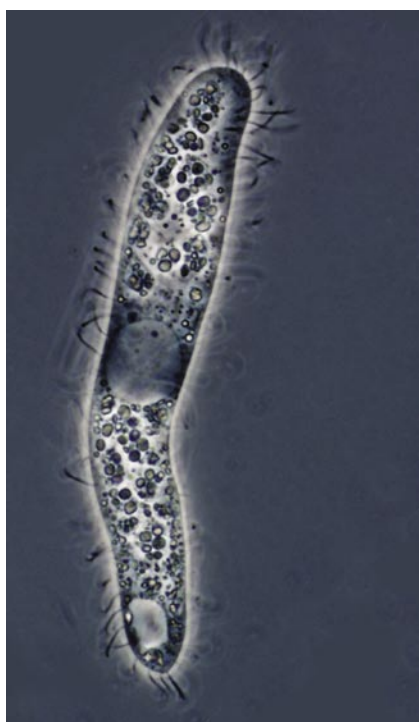
Medical Research Council, London,
United Kingdom

Napoli "Federico II," Universita di, Italy
Naples, University of, Italy
National Tsing Hua University, Taiwan
Novartis International AG, Switzerland

Rudolf Magnus Institute for Neurosciences,
The Netherlands

Sheffield, University of, United Kingdom
Stazione Zoologica "A Dohrn," Italy
Sussex, University of, United Kingdom

Technion Medical School, Israel
Technion-Israel Institute of Technology, Israel
Tokyo, University of, Japan
Tsukuba University, Japan



Jeyifous, Okun, University of Chicago
Johnson, Whitney, Williams College

Kaltenbach, Jane, Mount Holyoke College
Kidder, Sarah, Union College
King, Curtis, University of Utah
Kosmidis, Efstratios, Yale University

Lahey, Bridget, Illinois State University
Lasser-Ross, Nechama, New York Medical
College

Latham, Erika, Williams College
Lee, Joan, The College of New Jersey
Lee, Kyeng Gea, Hunter College
Lee, Ying, Dartmouth College
Lenart, Peter, European Molecular Biology
Laboratory, Germany

Levy, Carmit, Hebrew University, Israel
Li, Yulong, Duke University
Lioy, Paul, Robert Wood Johnson Medical
School

Loshkajian, Gina, Skidmore College
Lund, Amanda, Rensselaer Polytechnic
Institute

Lytton, William, SUNY Downstate Medical
Center

Mabuchi, Issei, University of Tokyo, Japan
Malchow, Robert, University of Illinois at
Chicago

Mandigo, Morgan, Harvard University
Manzana, Ehrine, University of Chicago
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Pielak, Rafal, Hunter College

Pocovi, Maria, Instituto Venezolano de
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Pollema, Sarah, University of Illinois at
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Zhang, Zhi, Wesleyan University

GENERAL SCIENTIFIC MEETINGS AWARDS

The MBL's General Scientific Meetings have, for decades, been providing an informal forum for the presentation of research carried out at the MBL, thereby fostering scientific exchange within the MBL community. The 2004 meetings were held August 9 to 10 in the Lillie Auditorium and were co-chaired by Karen Crawford (St. Mary's College of Maryland), Kenneth Foreman (MBL), Robert Gould (University of Illinois at Chicago), and Robert Paul Malchow (University of Illinois at Chicago). Awards were given for the best papers in the following categories.

Senior Investigator

WINNER

Peter B. Armstrong with **Margaret T. Armstrong, Steven M. Theg, Nikolai Braun, Norman Wainwright,** and **R. Pardy**

Histochemical evidence for lipopolysaccharide (endotoxin) in eukaryotes

HONORABLE MENTION

Robert M. Gould with **Hilary Morrison, Robert Campbell,** and **Edwin Gilland**
Evolution of myelin proteins

Junior Investigator

WINNER

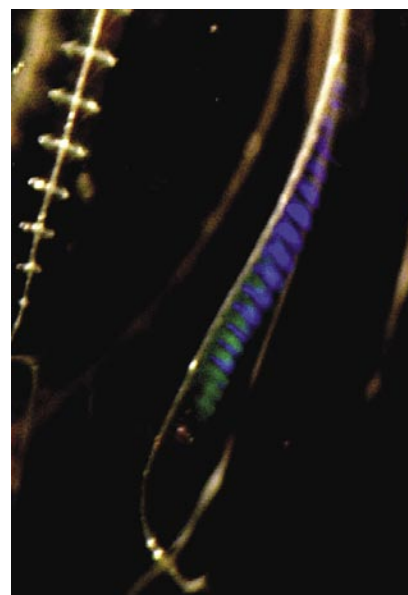
Robert C. Froemke with **Dan Yang**
Transient NMDA receptor suppression induces long-lasting synaptic depression

HONORABLE MENTIONS

Chuan-Chin Chiao with **Emma J. Kelman** and **Roger T. Hanlon**
*Disruptive body patterning of cuttlefish (*Sepia officinalis*) requires visual information on edges and brightness of objects on natural substrate backgrounds*

James J. Tong

*Mitochondrial dynamics in synaptic plasticity in *Drosophila melanogaster**



Graduate Student

WINNER

Daniel E. Golden with **Stephen L. Hajduk**

*Cis editing in *Trypanosoma brucei* brucei as a model for understanding guide-RNA structural and functional requirements*

HONORABLE MENTION

Omicron L. Ma with **Sarah E. Webb** and **Andrew L. Miller**

Imaging patterns of Ca²⁺ transients during the blastula period in zebrafish embryos

Undergraduate Student

WINNERS

Patrick Flight with **Gabriele Gerlach** and **Jelle Atema**

*Sperm load impact on female courtship behavior in the American lobster (*Homarus americanus*)*

Leanna R. Heffner with **Mirta Teichberg, Sophia Fox,** and **Ivan Valiela**

*Nitrate reductase and glutamine synthetase activity and growth in *Ulva lactuca* in Waquoit Bay: A time sequence of responses to differences in nitrogen supply*

HONORABLE MENTION

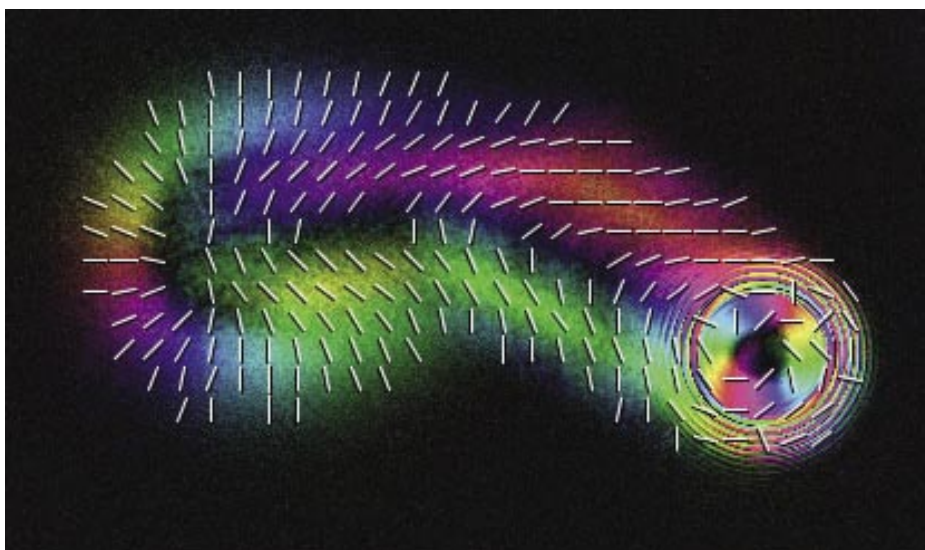
Clarissa A. Sabella with **Ellen E. Faszewski, Jane C. Kaltenbach, William J. Kuhns, Max M. Burger,** and **Xavier Fernandez Busquets**

*Immunocytochemical detection of integrins 3 and β 1 in allografts of the marine sponge, *Microciona prolifera**

Publications

- Albertini, DF; Barrett, SL. 2004. The developmental origins of mammalian oocyte polarity. *Seminars Cell Dev Biol* 15(5):599-606.
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- Djurisic, M; Antic, S; Chen, WR; Zecevic, D. 2004. Voltage imaging from dendrites of mitral cells: EPSP attenuation and spike trigger zones. *J Neurosci* 24(30):6703-6714.
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ARCHITECTURAL DYNAMICS IN LIVING CELLS PROGRAM



**DISTINGUISHED
SCIENTIST**
Shinya Inoué

SENIOR SCIENTIST
Rudolf Oldenbourg

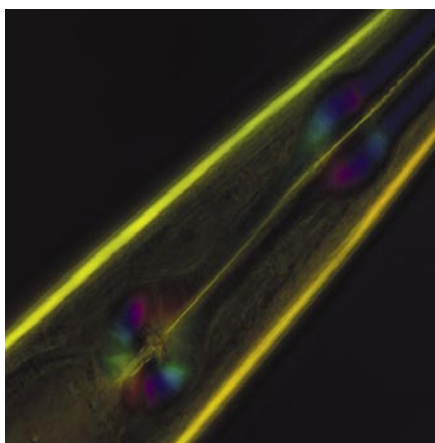
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**POSTDOCTORAL
SCIENTISTS**
Brigitte de Saint Phalle
Yuki Kagawa

RESEARCH ASSISTANT
Grant Harris

The Architectural Dynamics in Living Cells Program (ADLC), established at the MBL by Shinya Inoué in 1992, continues the pioneering research and educational activities in biophysical inquiries directly in living cells that Inoué started at Princeton University in 1949. The program focuses on architectural dynamics in living cells: the timely and coordinated assembly and disassembly of macromolecular structures essential for the proper functioning and differentiation of cells, the spatial and temporal organization of these structures, and their physiological and genetic control.

The program is also devoted to the development and application of powerful new imaging tools that permit such studies directly in living cells and functional cell-free extracts. Program members have special expertise in the use of polarized light for analyzing the local arrangement of molecular bonds and fine structure in biological specimens. Unique instrumentation developed by program members includes the universal light microscope, centrifuge polarizing microscope, the liquid-crystal based LC-PolScope, and related technology. Biological phenomena currently under investigation include mitosis/meiosis and related motility, amoeboid movement, microtubule-centrosome interaction, and optical properties of green fluorescent protein. The Architectural Dynamics in Living Cells



Program is an active component of the MBL's resident cell research group and promotes interdisciplinary research and training among its resident core researchers, visiting investigators, and collaborating manufacturers.

During 2004, program members published articles and made conference presentations on: (a) mechanisms of chromosome positioning during meiosis in insect spermatocytes, (b) cell division dynamics of *Drosophila* kc cells without functional mitotic centrosomes, (c) mapping polymer birefringence in three dimensions using a polarizing microscope with oblique illumination, and (d) orientation-independent unbiased DIC microscopy. In addition, students of the Physiology course and many visitors (see Whitman investigator list) took advantage of the special instrumentation for exploratory projects, including the analysis of the rapid stalk contraction in *Vorticella* exposed to centrifugal forces, stratification of the cytosol in red blood cells (centrifuge polarizing microscope), analysis of filament alignment in f-actin-based comet tails of *Listeria*, and liquid-crystal ordering in solutions of bacterial flagella (LC-PolScope).

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Kenneth Breuer, Brown University
 Lisa Cameron, University of North Carolina at Chapel Hill
 William D. Cohen, Hunter College of the City University of New York
 Danielle Cook, Massachusetts Institute of Technology
 Zvonimir Dogic, Harvard University
 Susan Gerbi, Brown University
 Makoto Goda, Kyoto University, Japan
 John Henson, Dickinson College
 Joseph Hoffman, Yale University School of Medicine
 Ted Inoué, New Hope, Pennsylvania
 David Keefe, Women & Infants Hospital of Rhode Island
 James LaFountain, University at Buffalo
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 Issei Mabuchi, University of Tokyo, Japan
 Tim Megrew, University of North Carolina
 Andrew Millard, University of Connecticut
 Tim Mitchison, Harvard University
 Ted Salmon, University of North Carolina
 Charles B. Schuster, New Mexico State University
 Julie Theriot, Stanford University
 James Valles, Brown University

ADMINISTRATIVE STAFF

Jane MacNeil, Executive Assistant

Publications

Oldenbourg, R. 2004. Polarization microscopy with the LC-PolScope. Pp 205-237 in *Live Cell Imaging: A Laboratory Manual*, Goldman, RD; Spector, DL, eds. Cold Spring Harbor Laboratory Press, NY.

Kagawa, Y; Megraw, TL; Oldenbourg, R. 2004. Cell division dynamics of *Drosophila* kc cells without functional mitotic centrosomes. *Biol Bull* 207: 161.

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Shribak, M; Oldenbourg, R. 2004. Mapping polymer birefringence in three dimensions using a polarizing microscope with oblique illumination. Pp 57-67 in *Biophotonics Micro- and Nano-Imaging*, Anselmetti, D, ed. Strasbourg, France: SPIE Proceedings, Vol. 5462.

BOSTON UNIVERSITY MARINE PROGRAM



The Boston University Marine Program (BUMP) offers undergraduate and graduate studies in marine biology leading to B.A., M.A., and Ph.D. degrees. The program places a strong emphasis on individual achievement in hands-on field and laboratory work. Students work with BUMP faculty and MBL scientists as well as scientists from other marine institutions in Woods Hole including the Woods Hole Oceanographic Institution and the National Marine Fisheries Service. In 2004 BUMP celebrated its 35th anniversary. Although this was a milestone year for BUMP in terms of accomplishments, casting a shadow over the program at year's end was the likelihood that after 35 years at the MBL, Boston University may move BUMP to its Charles River campus in mid-2006.

Of particular note, 2004 saw the naming of a new BUMP director. In August Jelle Atema stepped down from the position he had held since 1990 to devote more time to his research. Replacing him as director ad interim is Vince Dionne who joined BUMP in 1993. Dionne is a neurobiologist with research interests in olfaction and the biophysics of ion channels. Prior to his appointment as director ad interim, Dionne had served as Director of Graduate Studies and Acting Director of the Program; in 2001 his lab moved from the MBL to BU's Charles River campus. Atema's contributions to BUMP were celebrated at the Program's 35th Anniversary and Awards Dinner attended by faculty, staff, students, alumni, and guests at the J. Erik Jonsson Center.

The laboratories of the BUMP resident faculty were well funded and active during 2004, providing support for many of the 20 graduate students associated with the program. Atema, known for his work on the sensory biology of marine arthropods, began work on a major new project examining odor-guided behavior in sharks. Supported by DARPA, his studies examine the acute chemosensitivity of the animals.

FACULTY

Jelle Atema, Professor of Biology, Director
 Paul Barber, Assistant Professor of Biology
 Vincent Dionne, Professor of Biology,
 Director ad interim
 Stjepko Golubic, Professor of Biology
 Les Kaufman, Associate Professor of Biology
 Phillip Lobel, Associate Professor of Biology
 Gil Rosenthal, Assistant Professor of Biology
 Ivan Valiela, Professor of Biology

ADJUNCT FACULTY

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 Gabriele Gerlach, MBL
 Anne Gibling, MBL
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VISITING FACULTY

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 Sheri Hall, Program Manager
 Mary Elizabeth Jones, Senior Research Technician,
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 Michelle McCafferty, Program Coordinator
 Nick Neeley, Research Technician, Rosenthal Lab
 Joy Ramstack, Research Assistant, Valiela Lab
 Linda Seeley, Senior Staff Coordinator



Gil Rosenthal studies the evolution of visual communication in fishes. His laboratory has been examining the relation between the banding patterns of coral reef fish (important for visual communication) and contaminants that reduce water clarity. Their work in freshwater streams indicates that contaminants may interfere not only with water clarity, but with chemical signaling in fishes, leading to interspecies mating and hybridization.

Paul Barber works on marine population dynamics. He received a five-year CAREER grant to study the origins of marine biodiversity in the Indo-Pacific. He also developed and funded a program that takes under-represented minority students into the field in Indonesia and into his laboratory in Woods Hole. Two students working with Barber won competitive awards: Josh Drew received a Tegner Fellowship for marine conservation work in Fiji, and Eric Crandall received both a Lerner Gray Grant and a grant from the Concologists of America.



Phil Lobel's laboratory continued to play an important research role studying the military impact on marine environments in the Pacific during 2004. He also expanded ongoing work on visual and aural communication in reef fishes and on shark behavior.

Ivan Valiela studies the ecological impact of land use on coastal estuaries and waters. Using data on population density, waste

water release, estuarine nitrogen, and other measures acquired over several decades, he and his students have modeled these processes to predict future impacts and consequences of present-day land-use and land-management decisions. Among their results, they also found that petroleum residues spilled over 30 years ago in salt marshes on Cape Cod continued to have measurable biological effects on feeding and behavior of fiddler crabs, pointing out the long-term consequences of many contaminants. The laboratory also began a study on the role of mangrove estuaries and the impact of deforestation on coastal ecosystems in Panama.

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Amee Mehta
Catherine O'Keefe
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Publications

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MARINE RESOURCES PROGRAMS

The Marine Resources Center (MRC) is a national facility for the development and use of aquatic organisms in basic biological research, biomedical research, aquaculture, and fisheries science. Our research programs focus on biological processes integrated at the level of the whole organism.



Program in Sensory Biology, Behavioral Ecology, and Population Genetics

The tactics and mechanisms of camouflage are being elucidated by studying how cuttlefish choose among their numerous body patterns when confronted with different backgrounds. A visual sensorimotor bioassay has been refined to study the animals' visual perception of backgrounds. At the level of the skin, we have been measuring reflectance in tiny skin patches, and relating these optical effects to skin ultrastructure.

Sexual selection and sperm competition studies using DNA fingerprints demonstrated that transient female mimicry by small male cuttlefish leads to fertilization success (*Nature*, 2005, Vol 433).

For squid fishery management, we developed an acoustic methodology to map the distribution and abundance of squid eggs, which provide a proxy for recruitment potential.

We defined some major time domains of short-term, and long-term consolidated memory in the nudibranch mollusc, *Hermisenda*, using behavioral analyses and molecular pathway inhibitors. We published results defining two different forms of long-term memory: one lasting 24 hours, and a second, long-term consolidated memory that persists for at least six days. Via behavioral and electrophysiology studies, we discovered that the anti-cancer drug, bryostatin (now in phase-2 human oncology testing), can enhance the acquisition and retention of memory in *Hermisenda*. Our results extend the potential usefulness of bryostatin from cancer therapy to use in treating dementia.

DNA microsatellite analyses showed very limited gene flow between cod populations on Western and Eastern Georges Bank. Fish from both populations spawn at different times of the year suggesting that they should be managed separately. We demonstrated that larval reef fishes use olfactory cues to differentiate between reefs when they are about to settle. Populations at adjacent reefs differed genetically, which might indicate homing behavior to natal reefs.

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Nancy Roderick, Executive Assistant
Janice Simmons, Water Quality and Animal
Health Technician
Daniel Sullivan, Boat Captain/ Life Support
Technical Assistant
Eugene Tassinari, Senior Biological Collector
Kevin Uhlinger, Research Assistant
Sean Whelan, Diver/Marine Specimen Collector
Erika Woods, Research Assistant

VOLUNTEERS

Jim Dudac, AmeriCorps
Bill Geise, AmeriCorps
Leo Stanford, AmeriCorps

Continued...

Program in Scientific Aquaculture

A major disease concern for many cultured marine fish species, nodavirus, has affected commercial culture of Atlantic cod. We have developed specific and sensitive viral detection techniques using real-time PCR that are proving useful for understanding the etiology of the disease. Methods to effectively disinfect eggs have been developed to prevent vertical transmission of the virus. Practical methods are being developed to use hydrogen peroxide as a treatment to help prevent disease in fish and shellfish grown in recirculating aquaculture systems.

Research was completed on characterizing genes regulated during larval metamorphosis in the bay scallop. Additionally, a suite of microsatellite and other DNA markers were developed and characterized for the bay scallop. These genetic markers were used to show genetic diversity of scallop populations on Cape Cod and New England, and demonstrated the contribution of hatchery-reared scallops in population enhancement efforts.



Using PCR detection methods, we are conducting environmental studies of sediment, water column, and marine snow samples to identify reservoirs of Quahog Parasite Unknown (QPX—a disease-causing agent in hard clams), and how the QPX content of those reservoirs vary with environmental factors (with Becky Gast, WHOI). Studies are underway to develop real-time PCR quantification methods of QPX, and to determine the best growing conditions for hard clams in an area known to be infected with QPX.

We initiated a scientific and humanitarian project titled, “Feed the Fish to Feed the People” to develop fish diets from native vegetation in Haiti. Diets were made by simple means from combinations of Haitian leaves, seeds and roots, and tested in feeding trials to replicate tanks of the fish, tilapia. Early trial results suggest that six pounds of previously unvalued vegetation can yield one pound of high-quality fish protein to feed malnourished Haitians.

Marine Resources Staff, cont.

INTERNS

Amanda Carroll, Falmouth High School
Ellisa Cygan, Cape Cod Community College
Ross Glidden, Maine Maritime Academy
Heather Whitaker, Marine Maritime Academy

Laboratory of Roger Hanlon

STAFF

Roger Hanlon, Senior Scientist
Alexandra Barbosa, Ph.D. Student, Universidade do Porto
Lydia Mathger, Postdoctoral Investigator

VISITING INVESTIGATORS

Philip Alatalo, Woods Hole Oceanographic Institution
Chuan-Chin Chiao, National Tsing Hua University, Taiwan
Leib Litman, Grass Fellow
John W. Forsythe, University of Texas Medical Branch
Philip McFadden, Oregon State University
Kenneth G. Foote, Woods Hole Oceanographic Institution

INTERNS

Emily Fain, Yale University
Clare Gupta, Dartmouth College
Simon Minor, Cape Cod Community College
Ashley Neway, Southhampton College
Celeste Plautz, Lake Forest College
Stacy Williams, Cornell University

Laboratory of Alan Kuzirian

STAFF

Alan Kuzirian, Associate Scientist
Hemant Chikarmane, Investigator
Herman Epstein, Investigator

VISITING INVESTIGATORS

Daniel Alkon, Director, Blanchette Rockefeller Neurosciences Institute, Johns Hopkins University
Manabu Sakakibara, Laboratory of Neurobiology & Engineering, Tokai University, Shizuoka Japan
Chie Toyoshima, Laboratory of Neurobiology & Engineering, Tokai University, Shizuoka Japan

INTERNS

Drew Scioletti, Cape Cod Community College
Nathan P. Twichell, St. Lawrence University

Laboratory of Gabriele Gerlach

STAFF

Gabriele Gerlach, Associate Scientist
Martha Delaney, Research Assistant
Andrea Hodgins-Davis, Research Assistant

VISITING INVESTIGATOR

Alex Levine, The Hebrew University of Jerusalem

INTERNS

Carlee Belliveau, Roger Williams University
Seija Cope, Massachusetts Maritime Academy
Christopher Dickson, University of Colorado
Mary Green, Brown University
Lauren Thomas, Tufts University

Publications

- Behrmann-Godel, J; Gerlach, G; Eckmann, R. 2004. Postglacial colonization shows evidence for sympatric population splitting of Eurasian perch (*Perca fluviatilis* L.) in Lake Constance. *Mol Ecol* 13(2):491-497.
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Laboratory of Frederick Goetz

STAFF

Frederick Goetz, Senior Scientist
Peggy Biga, Postdoctoral Investigator
Linda McCauley, Research Assistant

Laboratory of Steven Roberts

STAFF

Steven Roberts, Assistant Research Scientist
Phoenix Becker, Summer Research Assistant
Christina Romano, Research Assistant
Raquel Sussman, Investigator

INTERNS

Adam Bissonette, St. Anselm College
Kristen Ettensohn, Dartmouth College

Laboratory of Roxanna Smolowitz

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Daniel Johnson, Animal Care Assistant, Mammalian Animal Care
Jet Stukey, Research Assistant, Mammalian Animal Care
Kevin Uhlinger, Research Assistant

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Carolyn Emery, Falmouth High School
Shira Horenstein, Veterinary Intern
Maille Lyons, Graduate Student, University of Connecticut
Morgan Porter, Southampton College
Katie Szymanska, Dedham High School

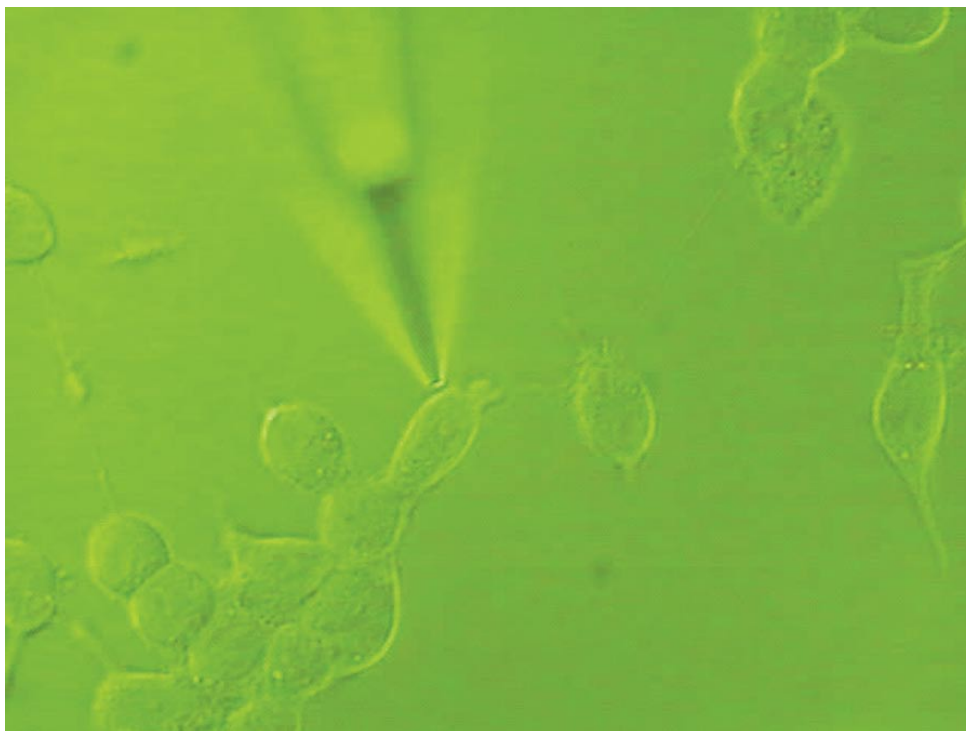
Laboratory of Scott Lindell

STAFF

Scott Lindell, Marine Resources Center Manager and Interim Director, Scientific Aquaculture Program
Phoenix Becker, Summer Research Assistant

INTERNS

Carly Allen, University of Hawaii
Eric Pilsmaier, Massachusetts Maritime Academy



PROGRAM IN MOLECULAR PHYSIOLOGY

DIRECTOR
P.J.S. Smith

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Miquel Holmgren, NINDS, NIH,
Bethesda
George Holz, New York University

*BioCurrents Research Center/
Laboratory of Peter Smith*

DIRECTOR/SENIOR SCIENTIST
P.J.S. Smith

STAFF SCIENTIST
Mark Messerli

POSTDOCTORAL SCIENTIST
Damon Osbourn

RESEARCH ASSOCIATE
Richard Sanger

RESEARCH ASSISTANTS
Daniel Bogorff
Erica Corson
Craig Hamilton
Laurel Moore

The goal of the Program in Molecular Physiology (PMP) is to advance our knowledge of basic and biomedical problems through the study of cellular dynamics in the living cell. An important component of these studies is the development and application of techniques for the detection of specific molecules and structures. A key, indeed critical, event of the past year has been the successful competitive renewal of the BioCurrents Research Center for five years. The grant was fully funded, and included the purchase of a spinning disc confocal, and low light imaging system, both to be installed on electrophysiology platforms. This represents a major new initiative within the program, bringing in advanced imaging technologies to our development and collaborative activities.

A further development in 2004 was the arrival of Robert Greenberg as a member of the PMP. Robert works on the molecular biology and channel biophysics of schistosome parasites, a major and debilitating disease in several parts of the world. Robert's appointment forms a new bridge between the PMP and the Program in Infectious Diseases in the Bay Paul Center.

Studies within the PMP continue to be diverse, most focusing on mechanisms underlying trans-membrane transport. Broadly, our interests lie in secretory events along with vesicle transport and docking—notably in diabetes; channel biophysics; the characterization, molecular biology, and pharmacology of pumps and porters; cellular metabolism and messenger molecules; reproductive biology and development; and infectious disease. Members of the program hosted approximately 40 visiting investigators this year.

Several new developments in instrumentation and signal processing were launched this year, notably the use of ion selective electrodes to follow channel activity and amperometric techniques for analysis of transport through the multidrug resistant transporters. Our bioinformatics project, Pharmabase, continued to expand in 2004 (www.pharmabase.org) with future plans to include a graphic interface.

Members of the program continue to provide support for numerous educational ventures and external investigators. This reporting year PMP members wrote in support of several joint grants (11 from NIH). Our Small Business Innovation Research (SBIR) grant, with previous center collaborator, R. Nuccitelli, moved to Phase II with the goal of producing a clinically applicable skin diagnostic tool.

INFORMATICS MANAGER

David Remsen

SUPPORT ENGINEER

Robert Lewis

RESEARCHER

David Compton

SUMMER INTERNS

Michael Dacey

James Pringle

Laboratory of Robert Greenberg

ASSOCIATE SCIENTIST

Robert Greenberg

POSTDOCTORAL SCIENTIST

Joseph Consiglio

RESEARCH ASSISTANT

Christina Evola

Laboratory for Reproductive Medicine

DIRECTOR/ADJUNCT SCIENTIST

David Keefe, Brown University

ADJUNCT SCIENTISTS

Eva Czerwiec, Brown University

Lin Liu, Brown University

James Trimarchi, Brown University

Publications

Jaffe, H; Vinade, L; Dosemeci, A. 2004.

Identification of novel phosphorylation sites on postsynaptic density Proteins. *Biochem Biophys Res Commun* 32:210-218.

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Lew, RR; Levina, NN. 2004. Oxygen flux magnitude and location along growing hyphae of *Neurospora crassa*. *FEMS Microbiol Lett* 233: 125-130.

Liu, L; Franco, S; Spyropoulos, B; Moens, PB; Blasco, MA; and Keefe, DL. 2004. Irregular telomeres impair meiotic synapsis and recombination in mice. *PNAS* 101: 6496-6501.

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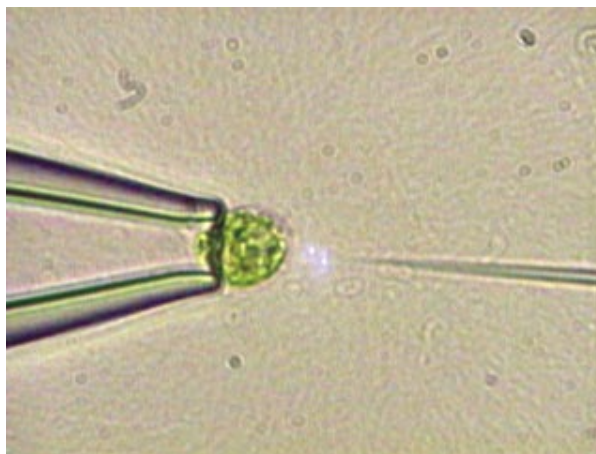
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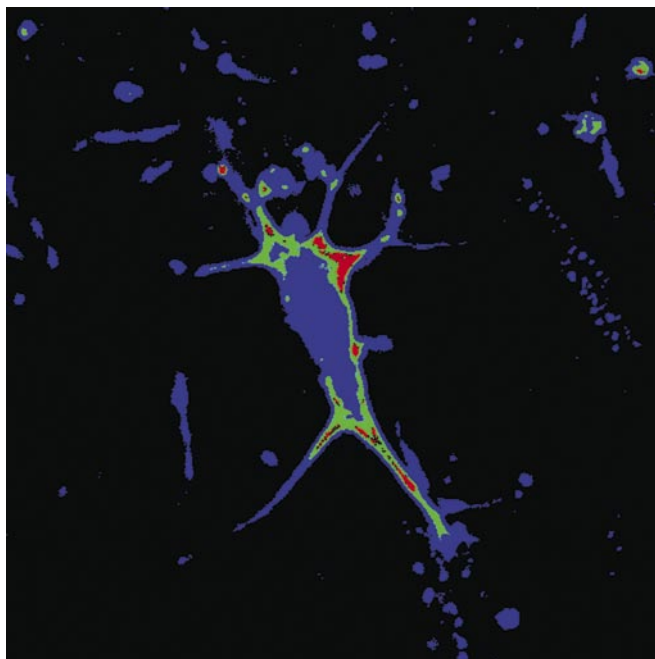
Messerli, MA; Smith, PJS; Lewis R; Robinson, K. 2004. Cl⁻ fluxes in lily pollen tubes: A critical reevaluation. *Plant J* 40(5): 799-812.

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LABORATORY OF AQUATIC BIOMEDICINE

Our goal is to use marine animals as biomedical models. We have explored mechanisms of neurotoxicity using surf clam embryos (*Spisula solidissima*). We have discovered that a mixture of chemicals found in polluted wells in Brick, New Jersey, causes an increase in an enzyme critical for neuronal development. By focusing on the p53 gene family, we have proven that p73 (not p53) may be exclusively expressed by *Spisula* neurons. Whether or not p73 is a molecular target of environmental neurotoxins remains to be determined.



In our second model, we define the impact of environmental contaminants on a leukemia developed by blue mussels (*Mytilus edulis*). In collaboration with Environment Canada, we have discovered that industrial chemicals plus untreated human waste results in much higher levels of leukemia throughout a polluted harbor in Pictou, Nova Scotia. We have also discovered leukemia in *Mytilus trossolus* in Vancouver Harbor, British Columbia.

We use both molecular and cellular assays to determine the level of toxicity and carcinogenicity in these molluscan species. Currently we are examining mechanisms of action using zebrafish embryos where more powerful and accurate probes are available for our research.

SENIOR SCIENTIST
Carol L. Reinisch

STAFF SCIENTIST II
Rachel Cox

POSTDOCTORAL SCIENTIST
Jill Kreiling

VISITING INVESTIGATORS
Raymond Stephens, Boston University
Sylvie St. Jean, Environment Canada
Annette Muttray, University of British Columbia

Publication

Kreiling, J; Stephens, R; Reinisch, CA. 2005. Mixture of environmental contaminants increases cAMP-dependent protein kinase A expression in *Spisula* embryos. *Env Toxicol Pharmacol* 19: 9-18. (Published online in 2004.)

LABORATORY OF BRUCE AND BARBARA FURIE

γ -Carboxyglutamic acid (Gla) is a calcium-binding amino acid that is found in the conotoxins of the cone snail, *Conus*. This laboratory investigates the vitamin K-dependent biosynthesis of this amino acid in *Conus* and the structural role of γ -carboxyglutamic acid in the conotoxins. This satellite laboratory relates closely to the main laboratory, the Center for Hemostasis and Thrombosis, at Harvard Medical School in Boston.

The marine cone snail is the sole invertebrate known to contain the vitamin K-dependent amino acid, γ -carboxyglutamic acid. We have cloned and compared the γ -glutamyl carboxylase, the enzyme required to synthesize Gla from vertebrates and invertebrates, and demonstrated marked sequence similarity despite evolutionary divergence over 500 million years ago. These results demonstrate the vitamin K-dependent biosynthesis of Gla is a highly conserved function in the animal kingdom. To identify novel Gla containing proteins conserved in animal species, we are identifying the vitamin K proteome using fluorescence-based differential imaging gel electrophoresis (DIGE), computer-based image analysis and electrospray mass spectroscopy.



ADJUNCT SCIENTISTS

Barbara C. Furie, Harvard Medical School
Bruce Furie, Harvard Medical School
Alan Rigby, Harvard Medical School
Leisa Stenberg, Harvard Medical School

VISITING INVESTIGATOR

Johan Stenflo, University of Lund, Sweden

STAFF SCIENTIST II

Mark Brown

Publications

Grant, MA; Hansson, K; Furie, BC; Furie, B; Stenflo, J; Rigby, AC. 2004. The metal-free and calcium-bound NMR structures of a Gla-containing contryphan from *Conus marmoreus*, Glacontryphan-M. *J Biol Chem* 279:32464-32473.

Hansson, K; Ma, X; Eliasson, L; Furie, B; Furie, BC; Rorsman, P; Stenflo, J. 2004. The first Gla-containing contryphan: A selective L-type calcium ion channel blocker isolated from the venom of *Conus marmoreus*. *J Biol Chem* 279:32453-32463.

Hansson, K; Furie, B; Furie, BC; Stenflo, J. 2004. Isolation and characterization of three novel Gla-containing *Conus marmoreus* venom peptides, one with a novel cysteine pattern. *Biochem Biophys Res Comm* 319:1081-1087.

LABORATORY OF NORMAN WAINWRIGHT



SENIOR SCIENTIST
Norman Wainwright

RESEARCH ASSISTANTS
Alice Child
Kendra Williams

VISITING INVESTIGATOR
Porter Anderson

The mission of this laboratory is to understand the molecular defense mechanisms exhibited by marine invertebrates in response to invasion by bacteria, fungi, and viruses. Their primitive immune systems demonstrate unique and powerful strategies for survival in diverse marine environments. The key model has been the horseshoe crab *Limulus polyphemus*. *Limulus* hemocytes exhibit a very sensitive LPS-triggered protease cascade that results in blood coagulation. Several proteins found in the hemocyte and hemolymph display microbial binding properties that contribute to antimicrobial defense. *Limulus* amoebocyte lysate (LAL) is being adapted for use as a tool to assess bioburden on spacecraft and to search for microbial life in the universe. Collaborations with several NASA centers are actively developing technology in the field of astrobiology.



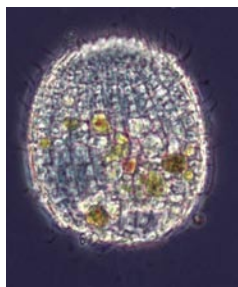
Publication

Maule, J; Fogel, M; Steele, A; Wainwright, N; Pierson, D; McKay, DS. 2004. Antigen-antibody interactions during altered gravity: Implications for immunosorbent assay during spaceflight. *J Gravitational Physiol* 10(2): 47-56.

CENTER FOR ADVANCED STUDIES IN THE SPACE LIFE SCIENCES

In 1995, the Gravitational Biology and Ecology (GB&E) program in the NASA Life Sciences Division and the MBL established a cooperative agreement and formed the Center for Advanced Studies in the Space Life Sciences (CASLS at MBL). The goals of the center were to:

- Increase awareness of the NASA Life Sciences Program within the basic science community in order to expand NASA's interactions with talented biologists, and
- Examine and discuss potential uses of microgravity and other aspects of spaceflight as probes to provide new insights to fundamental processes of importance to basic biology and medicine.



STAFF

Diana E. Jennings,
Administrator

Mary P. Jeffery,
Administrative
Assistant

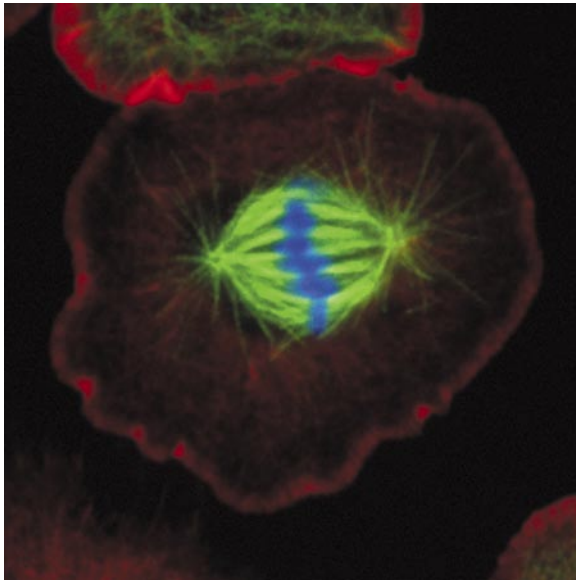
The center sponsored and organized the workshop, "Animal Research in Support of Human Space Exploration" in April 2004. The workshop was chaired by Charles Sawin and Ken Souza of NASA. Participants were leading scientists and science managers directly involved with human research and a similar cadre of scientists and science managers that use animal models, primarily, but not limited to, rodents. Their home institutions included NASA, universities, medical institutions, and the Russian Space Agency (Institute of Medical and Biological Problems, Moscow). A major white paper from this meeting, coauthored by Jennings and Souza, was the primary output and was distributed widely in print and also on the Internet.

The center sponsored a symposium held at the 2004 Experimental Biology meeting in April 2004. The meeting was chaired by Stephen Moorman (Robert Wood Johnson Medical School). Speakers included four leading space biologists.



Finally, CASLS coordinated a unique training workshop in the Summer of 2004. Directed by astronaut Dan Barry, the goal of the workshop was to increase space station and shuttle crewmembers' scientific autonomy through lectures, hands-on laboratory activities, discussions, and collaboration with leading scientists. Approximately 130 hours of training activities were provided over three weeks. Specific areas of laboratory investigation included cell and molecular biology using yeast and fruit fly model systems, cardiovascular measurement, ultrasound investigation, planetary protection, life detection, and *in situ* resource extraction. Throughout these investigations students interacted directly with working scientists and tested specific hypotheses, applying scientific method to arrive at their conclusions.

At the end of October, 2004, the center ceased its activities. The center's web site will remain online through 2005.



EDUCATION

The MBL's outstanding educational programs have a global reach, attracting top tier students and faculty from around the world. In 2004, 473 students from 292 institutions and 38 countries came to the MBL to study a range of biological topics with some of the world's best scientists serving as course faculty and lecturers. The courses' 575 faculty members and staff and 193 lecturers represented 267 institutions and 33 countries.



In 2004, the MBL's summer courses in Physiology (directed by Ron Vale and Tim Mitchison), Neurobiology (directed by Ed McCleskey and Rae Nishi), Microbial Diversity (directed by Tom Schmidt and Bill Metcalf), and Molecular Biology of Aging (directed by Gary Ruvkun and Steve Austad) had a spectacular year under new leadership. Applicant pools were stronger than ever, and new sources of funding were obtained. The Physiology course was one of six programs selected for funding under the NIH Director's Roadmap Initiative "Short Programs for Interdisciplinary Research Training." The Microbial Diversity course received funding from a new source, the Gordon and Betty Moore Foundation. In addition, the Ellison Medical Foundation renewed funding for the Molecular Biology of Aging course.

The MBL said farewell to Rick Levine and Catherine Carr, who did a wonderful job directing the Neural Systems & Behavior course for the past five years. We are very fortunate that Sarah Bottjer and Mike Dickinson have agreed to take on the role as course directors for NS&B. Will Talbot also completed his term as co-director of the Zebrafish course. He will be succeeded by Mary Mullins, who will co-direct the course with Cecilia Moens, making the Zebrafish course the first in the history of the MBL to be directed exclusively by women.

SUMMER COURSES

Biology of Parasitism: Modern Approaches

June 9 – August 7, 2004

COURSE DIRECTOR

Bangs, Jay, University of Wisconsin-Madison

FACULTY

Artis, David, University of Pennsylvania
 Barry, Dave, University of Glasgow
 Crabb, Brendan, The Walter and Eliza Hall Institute
 Hunter, Christopher, University of Pennsylvania
 Johnson, Patricia, University of California, Los Angeles
 Matthews, Keith, University of Edinburgh
 McFadden, Geoff, University of Melbourne
 Reiner, Steven, University of Pennsylvania
 Scherf, Artur, Institut Pasteur
 Sinai, Anthony, University of Kentucky
 Tarleton, Rick, University of Georgia

LECTURERS

Andrews, Norma, Yale University
 Belkaid, Yasmine, Cincinnati Children's Hospital Research
 Beverley, Stephen, Washington University
 Boothroyd, John, Stanford University
 Carucci, Daniel, Naval Medical Research Center
 Dobbelaere, Dirk, University of Bern
 Doering, Tamara, Washington University Medical School
 Doolan, Denise, Naval Medical Research Center
 Englund, Paul, The Johns Hopkins School of Medicine
 Ferguson, Michael, University of Dundee
 Goldberg, Daniel, Washington University
 Goldenberg, Samuel, Fundação Oswaldo Cruz
 James, Anthony, University of California, Berkeley
 Kirk, Kieran, Australian National University
 Lightowers, Marshall, University of Melbourne
 Lujan, Hugo, National University of Cordoba
 McConville, Malcolm, University of Melbourne
 Pearlman, Eric, Case Western Reserve University
 Phillips, Meg, Southwestern Medical Center, University of Texas
 Riley, Eleanor, London School of Hygiene and Tropical Medicine
 Roos, David, University of Pennsylvania
 Rudenko, Gloria, University of Oxford
 Shapiro, Theresa, The Johns Hopkins School of Medicine
 Sher, F. Alan, National Institutes of Health
 Striepen, Boris, University of Georgia
 Tschudi, Christian, Yale Medical School
 Ward, Gary, University of Vermont
 Waters, Andy, Leiden University Medical Center
 Wynn, Thomas, National Institutes of Health

TEACHING ASSISTANTS

Bastida-Corcuera, Felix, University of California, Los Angeles
 Martin, Diana, University of Georgia
 Mayho, Matthew, University of Manchester
 Molestina, Robert, University of Kentucky
 Peck, Ron, University of Wisconsin-Madison



Pew, Marion, University of Pennsylvania
 Ralph, Stuart, Institut Pasteur
 Van Dooren, Giel, University of Melbourne

COURSE ASSISTANTS

Normand, Danielle, University of New Hampshire
 Tarleton, Jessica, Marine Biological Laboratory

STUDENTS

Casanova, Carlo, University of Bern
 Conte, Ianina, Fundacion Instituto Leloir
 Dossin, Fernando, Federal University of Sao Paulo
 Fouts, Ashley, Stanford University
 Harder, Simone, Bernhard Nocht Institute for Tropical Medicine
 Kafsack, Björn, Johns Hopkins University
 Kats, Lev, Monash University
 Korbel, Daniel, London School of Hygiene and Tropical Medicine
 Kwok, Lai Yu, University of Geneva
 Lavazec, Catherine, Pasteur Institute
 Long, Gráinne, University of Edinburgh
 Oberholzer, Michael, University of Bern
 Okumura, Cheryl, University of California, Los Angeles
 Pakpour, Nazy, University of Pennsylvania
 Stephens, Jennifer, The Johns Hopkins School of Medicine
 Vincensini, Laetitia, Institut Pasteur

Embryology

June 12 – July 25, 2004

COURSE DIRECTORS

Harland, Richard, University of California, Berkeley
 Rothman, Joel, University of California, Santa Barbara

FACULTY

Bronner-Fraser, Marianne, California Institute of Technology
 Collazo, Andres, House Ear Institute
 Dunaway, Marietta, University of California, Berkeley
 Etensohn, Charles, Carnegie Mellon University
 Fraser, Scott, California Institute of Technology
 Halpern, Marnie, Carnegie Mellon University
 Henry, Jonathan, University of Illinois

Holland, Peter, University of Oxford
 Krumlauf, Robb, Stowers Institute for Medical Research
 Levine, Michael, University of California, Berkeley
 Martindale, Mark, University of Hawaii
 Niswander, Lee, Sloan-Kettering Institute
 Patel, Nipam, University of California, Berkeley
 Rokhsar, Daniel, University of California, Berkeley
 Rothenberg, Ellen, California Institute of Technology
 Sanchez Alvarado, Alejandro, University of Utah, School
 of Medicine
 Sherwood, David, California Institute of Technology
 Telford, Max, University College London
 Wessel, Gary, Brown University
 Wiedemann, Leanne, Stowers Institute for Medical Research
 Wieschaus, Eric, Princeton University
 Zeller, Robert, San Diego State University

LECTURERS

Furutani-Seiki, Makoto, Japan Science and Technology Agency
 Keller, Ray, University of Virginia
 McGinnis, William, University of California, San Diego
 Nagy, Lisa, University of Arizona
 Pourquie, Olivier, Stowers Institute for Medical Research
 Sanes, Joshua, Harvard University
 Schupbach, Trudi, Princeton University
 Trainor, Paul, Stowers Institute for Medical Research
 Yelon, Deborah, Skirball Institute, New York University School
 of Medicine

S. MERYL ROSE LECTURER

Davidson, Eric, California Institute of Technology

TEACHING ASSISTANTS

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 Chang, Chenbei, University of Alabama, Birmingham
 Cheeks, Rebecca, University of Oregon
 Cooper, Kimberly, Fred Hutchinson Cancer Research Center
 Extavour, Cassandra, University of Cambridge
 Fletcher, Russell, University of California, Berkeley
 Gamse, Joshua, Carnegie Institution of Washington
 Glickman, Nathalia, New York University School of Medicine
 Gross, Jeffrey, Harvard University
 Lee, Jen-Yi, University of North Carolina, Chapel Hill
 Macurak, Michelle, Carnegie Institution of Washington
 Matus, David, University of Hawaii
 Monsoro-Burq, Anne-Helene, University of California, Berkeley
 Murata, Patricia, University of Hawaii, Manoa
 Nouri, Ali, Princeton University
 Pang, Kevin, University of Hawaii
 Parchem, Ron, University of California, Berkeley
 Sandell, Lisa, Stowers Institute for Medical Research
 Seaver, Elaine, University of Hawaii
 Wilson, Sara, Columbia University
 Wolfe, Adam, University of Illinois, Urbana-Champaign



COURSE ASSISTANTS

Broussard, Christine, University of La Verne
 McCluskey, Kathryn, St. Lawrence University
 Peralta, Kristina, University of La Verne

STUDENTS

Ahnfelt-Ronne, Jonas, Hagedorn Research Institute
 Bastock, Rebecca, Sheffield University
 Brauchle, Michael, New York University
 Cone, Angela, San Diego State University
 D'Aniello, Salvatore, Stazione Zoologica Anton Dohrn
 Doyle, Michelle, University of Colorado Health Science Center
 Feigin, Michael, State University of New York, Stony Brook
 Fernandez Serra, Montserrat, Stazione Zoologica Anton Dohrn
 Johnson, Aaron, Arizona State University
 Kamei, Noriko, University of California, Irvine
 Klein, Ophir, University of California, San Francisco
 Ma, Leung-Hang, Hong Kong University of Science
 and Technology
 Modrell, Melinda, University of California, Berkeley
 Nechiporuk, Alex, University of Washington
 Paul, Sarah, Northwestern University
 Peyrot, Sara, University of California, Berkeley
 Roffers, Julaine, University of Minnesota
 Rolo, Ana, University of Virginia
 Saudemont, Alexandra, CNRS
 Tapanes-Castillo, Alexis, University of Miami School of Medicine
 Thomas, Elizabeth, Cold Spring Harbor Laboratory
 Wagner, Teresa, University of Washington
 Waxman, Josh, University of Washington
 Wise, Sarah, University of Colorado at Boulder

Microbial Diversity

June 12 – July 30, 2004

COURSE DIRECTORS

Metcalf, William, University of Illinois
Schmidt, Tom, Michigan State University

FACULTY

Breznak, John, Michigan State University
Garcia, Amaya, Rocky Mountain College
Garcia-Pichel, Ferran, Arizona State University
Griffin, Benjamin, Universitaet Konstanz
Whitaker, Rachel, University of California, Berkeley

LECTURERS

Bazylnski, Dennis, Iowa State University
Bryant, Don, Pennsylvania State University
Buckley, Dan, Cornell University
Cavanaugh, Colleen M., Harvard University
DeLong, Ed, Massachusetts Institute of Technology
Harwood, Caroline, University of Iowa
Katz, Laura, Smith College
Kolter, Roberto, Harvard Medical School
Kuenen, J. Gijs, Delft University of Technology
Lewis, Kim, Northeastern University
Lidstrom, Mary, University of Washington
Lovley, Derek, University of Massachusetts
Martin, Mark, Occidental College
Miller, Eric, North Carolina State University
Pace, Norman, University of Colorado
Reznikoff, William, University of Wisconsin
Woese, Carl, University of Illinois
Wolfe, Ralph, University of Illinois

TEACHING ASSISTANT

Warnecke, Falk, Max Planck Institute for Marine Microbiology

COURSE COORDINATOR

Lewis, Wynne, Michigan State University

STUDENTS

Blazejak, Anna, Max Planck Institute for Marine Microbiology
Bonilla-Findji, Osana, Laboratoire d'Océanographie de Villefrance, Station Zoologique
Conover, Adele, Freelance Journalist
Dalmacio, Leslie, University of the Philippines
Ekstrom, Eileen, Princeton University
Gontang, Erin, University of California, San Diego
Huang, Jean, California Institute of Technology
Hunt, Dana, Massachusetts Institute of Technology
Lennon, Jay, Dartmouth College
Luna, Gian Marco, Polytechnic University of Marche
Milferstedt, Kim, University of Illinois at Urbana-Champaign
O'Mullan, Gregory, Princeton University
Ober, Craig, Weber State University
Powers, Jennifer, State University of New York, Stony Brook
Reed, Heather, University of Colorado at Boulder

Roeselers, Guus, Delft University of Technology
Santibáñez Bustos, Juan, Universidad de Concepcion
Simmons, Sheri, Woods Hole Oceanographic Institution
Smith, Eric, University of Washington
Walsh, David, Dalhousie University
Wier, Andrew, University of Wisconsin, Milwaukee

Neural Systems & Behavior

June 12 – August 7, 2004

COURSE DIRECTORS

Carr, Catherine, University of Maryland
Levine, Richard, University of Arizona

FACULTY

Calabrese, Ronald, Emory University
Chitwood, Raymond, Baylor College of Medicine
Davis, Graeme, University of California, San Francisco
Ewer, John, Cornell University
French, Kathy, University of California, San Diego
Glanzman, David, University of California, Los Angeles
Golowasch, Jorge, New Jersey Institute of Technology
Keith, Julian, University of North Carolina at Wilmington
Knierim, James, University of Texas, Medical School at Houston
Kristan, William, University of California, San Diego
Markham, Michael, Florida International University
McAnelly, Lynne, University of Texas
Nadim, Farzan, Rutgers University
Philpot, Ben, University of North Carolina
Prusky, Glen, University of Lethbridge
Reyes, Alex, New York University
Sillar, Keith, University of St. Andrews
Simon, Jonathan, University of Maryland
Stein, Wolfgang, Universitaet Ulm
Szczipak, Lidia, Universidad de Buenos Aires
Weeks, Janis, University of Oregon
Wenning-Erxleben, Angela, Emory University
Wilson, Richard, University of Calgary
Wood, Debra, Case Western Reserve University
Zakon, Harold, University of Texas, Austin

LECTURERS

Eisthen, Heather, Michigan State University
Friedrich, Rainer, Max Planck Institute for Medical Research
Hildebrand, John, University of Arizona
Marder, Eve, Brandeis University
Murphey, Rod, University of Massachusetts
Taylor, Adam, Brandeis University
Trussell, Larry, Oregon Health & Science University

TEACHING ASSISTANTS

Albin, Stephanie, University of California, San Francisco
Briggman, Kevin, University of California, San Diego
Bucher, Dirk, Brandeis University
Chen, Shanping, House Ear Institute
Crozier, Robert, Massachusetts Institute of Technology



Dorval, Chuck, Boston University
 Frick, Andreas, Baylor College of Medicine
 Lee, Inah, Boston University
 Macleod, Katrina, University of Maryland
 McGill, Trevor, University of Lethbridge
 McLean, David, New York State University, Stony Brook
 Merrywest, Simon, University of St. Andrews
 Poskanzer, Kira, University of California, San Francisco
 Rao, Geeta, University of Texas, Medical School at Houston
 Rela, Lorena, University of Buenos Aires
 Roberts, Adam, University of California, Los Angeles
 Sanyal, Subhabrata, University of Arizona
 Schiff, Max, New York University
 Siegel, Jennifer, University of Texas, Health Science Center,
 Houston
 Stengel, Casey, Neuralynx, Inc.
 Villareal, Greg, University of California, Los Angeles
 Zee, M. Jade, University of Oregon

COURSE ASSISTANTS

Corty, Megan, Stanford University
 Heygate, Judith, University of St. Andrews

STUDENTS

Brown, Bruce, Case Western Reserve University
 Castelló, Maria, Instituto de Investigaciones Biológicas
 Chacron, Maurice, University of Ottawa
 Degoursac, Liz, Emory University
 Donaldson, Zoe, Emory University
 Field, Evelyn, University of Lethbridge
 Gabriel, Jens, University of Cologne
 Goldberg, Ethan, New York University School of Medicine
 Heyman, Karen, Freelance Journalist
 Ihlefeld, Antje, Boston University
 Jaramillo, Santiago, New York University
 Lau, Chun-Yue Geoffrey, Albert Einstein College of Medicine
 Liao, James, Harvard University
 Lundfald, Line, Karolinska Institutet
 Miller-Sims, Vanessa, Boston University Marine Program
 Serrano, Geidy, University of Puerto Rico
 Teng, Ching-Ling, University of California, San Francisco
 Vig Nissen, Ulla, University of Oslo
 Vogels, Tim, Brandeis University
 Yang, Eun-Jin, Columbia University
 Zhang, Yifeng, University of California, San Diego

Neurobiology

June 6 – August 7, 2004

COURSE DIRECTORS

McCleskey, Edwin, Oregon Health and Science University
 Nishi, Rae, University of Vermont

SECTION DIRECTOR

Vogel, Steven, National Institutes of Health

FACULTY

Avery, Leon, University of Texas, Southwestern Medical Center
 Balice-Gordon, Rita, University of Pennsylvania, School
 of Medicine
 Bergles, Dwight, Johns Hopkins University
 Blank, Paul, National Institutes of Health
 Commons, Kathryn, Pennsylvania Children's Hospital
 of Philadelphia
 Fieber, Lynne, University of Miami
 Khodakhah, Kamran, Albert Einstein College of Medicine
 Kuner, Thomas, Max-Planck-Institute for Medical Research
 Lambert, Nevin, Medical College of Georgia
 Lichtman, Jeff, Washington University
 Maue, Robert, Dartmouth Medical School
 Noebels, Jeffrey, Baylor College of Medicine
 Pereda, Alberto, Albert Einstein College of Medicine
 Saugstad, Julie, Legacy Research
 Smith, Corey, Case Western Reserve University
 Smith-Maxwell, Catherine, Axon Instruments, Inc.
 Svoboda, Karel, Cold Spring Harbor Laboratory
 Tanouye, Mark, University of California, Berkeley
 Terasaki, Mark, University of Connecticut, Health Center
 Yau, King-Wai, Johns Hopkins School of Medicine
 Zenisek, David, Yale University

LECTURERS

Armstrong, Clay, University of Pennsylvania
 Augustine, George, Duke University Medical Center
 Bezanilla, Francisco, University of California, Los Angeles
 Blatz, Andrew, Axon Instruments, Inc.
 Campagnola, Paul, University of Connecticut, Health Center
 Chalfie, Martin, Columbia University
 Charlton, Milton, University of Toronto
 D'Arcangelo, Gabriella, Baylor College of Medicine
 Darnell, Robert, The Rockefeller University
 DeWeer, Paul, University of Pennsylvania
 Dickinson, Mary, California Institute of Technology
 Ellis-Davies, Graham, Drexel University
 Fischbach, Gerald, Columbia University
 Gadsby, David, The Rockefeller University
 Garcia, Maria, Merck Research Laboratories
 Glowatzki, Elisabeth, The Johns Hopkins School of Medicine
 Goldstein, Lawrence, University of California, San Diego,
 and HHMI
 Halpern, Marnie, Carnegie Mellon University
 Heidelberger, Ruth, The University of Texas Medical School
 at Houston

Hopkins, Nancy, Massachusetts Institute of Technology
 Jay, Daniel, Tufts University School of Medicine
 Jorgensen, Erik, University of Utah
 Kramer, Richard, University of California, Berkeley
 Kravitz, Edward, Harvard Medical School
 Madison, Daniel, Stanford University School of Medicine
 Meisler, Miriam, University of Michigan
 Meredith, Andrea, Stanford University School of Medicine
 Patterson, George, National Institutes of Health
 Price, Donald, Johns Hopkins School of Medicine
 Ramaswami, Mani, University of Arizona
 Reese, Thomas, National Institutes of Health
 Regehr, Wade, Harvard Medical School
 Selkoe, Dennis, Harvard Medical School
 Sigworth, Fred, Yale University
 So, Peter, Massachusetts Institute of Technology
 Spiro, John, Nature Publishing Group
 Tsien, Roger, University of California, San Diego
 Weinberg, Richard, University of North Carolina
 Yellen, Gary, Harvard Medical School

TEACHING ASSISTANTS

Alvina, Karina, Albert Einstein College of Medicine
 Boegle, Aimee, Dartmouth Medical School
 Cachepe, Roger, Albert Einstein College of Medicine
 Clark, Michael, Medical College of Georgia
 Cushman, Kenneth, Oregon Health and Science University
 Digby, Gregory, Medical College of Georgia
 Dussor, Greg, Ohio State University
 Gibbs, Sarah, University of Pennsylvania, School of Medicine
 Hekmat-Scafe, Daria, University of California, Berkeley
 Hendricks, Susan, University of Vermont
 Hess, Sam, National Institutes of Health
 Hruska, Martin, University of Vermont
 Irons, Hillary, Georgia Tech/Medical College of Georgia
 Panzer, Jessica, University of Pennsylvania, School of Medicine
 Porter, Donna, Dartmouth Medical School
 Prescott, Elizabeth, Yale University
 You, Young-jai, University of Texas, Southwestern Medical Center

COURSE ASSISTANTS

Brush, James, Middlebury College
 Ene, Smaranda, Middlebury College

STUDENTS

Balu, Ramani, Case Western Reserve University
 Bright, Rachel, Stanford University School of Medicine
 Cheng, Ning, The Johns Hopkins School of Medicine
 Corbo, Joseph, Harvard Medical School/Brigham and Women's Hospital
 Davis, Denise, Yale University School of Medicine
 Doan, Thuy, University of Washington
 Dominguez, Reymundo, University of Southern California
 Glykys, Joseph, University of California, Los Angeles
 Lin, John, University of Auckland
 Merlo, Emiliano, Ciudad Universitaria
 Sann, Sharon, University of California, San Diego
 Wienisch, Martin, Max Planck Institute for Biophysical Chemistry

Physiology: Modern Cell Biology Using Microscopic, Biochemical and Computational Approaches

June 12 – July 24, 2004

COURSE DIRECTORS

Mitchison, Tim, Harvard Medical School
 Vale, Ronald, University of California, San Francisco/HHMI

FACULTY

Bray, Dennis, University of Cambridge
 Heald, Rebecca, University of California, Berkeley
 Hunt, Tim, Cancer Research UK
 Khan, Shahid, Molecular Biology Consortium, Chicago
 Li, Rong, Harvard Medical School
 Mahadevan, Lakshminarayanan, Harvard University
 Meyer, Tobias, Stanford University
 Mullins, Dyche, University of California, San Francisco, Medical School
 Murray, Andrew, Harvard University
 Nedelec, Francois, European Molecular Biology Laboratory
 O'Shea, Erin, University of California, San Francisco/HHMI
 van Oudenaarden, Alexander, Massachusetts Institute of Technology
 Stuurman, Nico, University of California, San Francisco
 Waterman, Clare, The Scripps Research Institute

LECTURERS

Ferrell, James, Stanford University
 Gorbosky, Gary, Oklahoma Medical Research Foundation
 Groves, Jay, University of California, Berkeley
 Hahn, Klaus, The Scripps Research Institute
 Kirschner, Marc, Harvard Medical School
 Pollard, Thomas, Yale University
 Taylor, Ed, Northwestern University
 Theriot, Julie, Stanford University School of Medicine
 Waters Shuler, Jennifer, Harvard Medical School
 Xie, Sunney, Harvard University
 Yaffe, Michael, Massachusetts Institute of Technology

IRVIN EISENBURG LECTURER

Murray, Andrew W., Harvard University

GERTRUDE FORKOSH WAXLER LECTURER

Raff, Martin, Medical Research Council Laboratory of Molecular Biology

ARTHUR K. PARPART LECTURER

Hunt, Tim, Cancer Research UK

TERU HAYASHI LECTURER

Hyman, Tony, Max Planck Institute of Molecular Cell Biology and Genetics

TEACHING ASSISTANTS

Akin, Orkun, University of California, San Francisco
 Goshima, Gohta, University of California, San Francisco
 Groen, Aaron, Harvard Medical School



Lipkow, Karen, University of Cambridge
 Maresca, Thomas, University of California, Berkeley
 Mora Corral, Maria, European Molecular Biology Laboratory
 Pedraza, Juan, Massachusetts Institute of Technology
 Perlman, Zachary, Harvard Medical School
 Ponti, Aaron, Scripps Research Institute
 Quintero, Omar, University of North Carolina, Chapel Hill
 Raser, Jonathan, University of California, San Francisco
 Shimizuo, Thomas, Harvard University
 Shin, Jennifer, Harvard University
 Springer, Michael, Harvard Medical School
 Thattai, Mukund, Massachusetts Institute of Technology
 Vitorino, Philip, Stanford University
 Wedlich-Soldner, Roland, Harvard Medical School
 Wehrman, Tom, Stanford University
 Wittmann, Torsten, The Scripps Research Institute

COURSE ASSISTANTS

Alibrandi, Tara, St. Lawrence University
 Woods, Shane, Queens University

STUDENTS

Allen, Rosalind, FOM Institute for Atomic and Molecular Physics
 Biron, David, Weizmann Institute of Science
 Brandman, Onn, Stanford University
 Chang, Lynne, Northwestern University Medical School
 Cook, Danielle, Massachusetts Institute of Technology
 Dance, Amber, University of California, San Diego
 DePristo, Mark, University of Cambridge
 Ehmsen, Jeffrey, The Johns Hopkins School of Medicine
 Foethke, Dietrich, European Molecular Biology Laboratory
 Gardel, Margaret, Harvard University
 George, Olivia, New Mexico State University
 Gupton, Stephanie, The Scripps Research Institute
 Keren, Kinneret, Stanford University
 Kunwar, Prabhat, New York University Medical Center
 Lucks, Julius, Harvard University
 Mirny, Leonid, Massachusetts Institute of Technology
 Needleman, Daniel, University of California, Santa Barbara
 Niethammer, Philipp, EMBL Heidelberg
 Nonaka, Mio, Kyoto University
 Sakai, Miho, Swiss Federal Institute
 Sheth, Ujwal, University of Arizona
 Sironi, Lucia, European Molecular Biology Laboratory
 Strongin, Daniel, University of Chicago
 Toth, Judit, National Institutes of Health
 Wiedmann, Anna, Yale University
 Wollman, Roy, University of California, Davis
 Yang, Janet, University of California, San Francisco

SPECIAL TOPICS COURSES

Advances in Genome Technology & Bioinformatics

October 5 – November 3, 2004

COURSE DIRECTORS

Fraser, Claire, The Institute for Genomic Research
 Jaffe, David, Broad Institute - Massachusetts Institute
 of Technology
 Sogin, Mitchell L., Marine Biological Laboratory

FACULTY

Bertonati, Claudia, Columbia University
 Feldblyum, Tamara, The Institute for Genomic Research
 Hoffman, Eric, Children's National Medical Center
 Keeling, Patrick, University of British Columbia
 Lee, Norman, The Institute for Genomic Research
 McArthur, Andrew, Marine Biological Laboratory
 Morrison, Hilary, Marine Biological Laboratory
 Nierman, William, The Institute for Genomic Research
 Olsen, Gary, University of Illinois
 Pearson, William, University of Virginia
 Pop, Mihai, The Institute for Genomic Research
 Quackenbush, John, The Institute for Genomic Research
 Salzberg, Steven, The Institute for Genomic Research
 Tettelin, Herve, The Institute for Genomic Research
 Tolonen, Andrew, Massachusetts Institute of Technology
 White, Owen, The Institute for Genomic Research

LECTURERS

Churchill, Gary, The Jackson Laboratory
 Gentleman, Robert, Dana-Farber Cancer Institute
 Gill, Steven, The Institute for Genomic Research
 Kirkness, Ewen, The Institute for Genomic Research
 Majoros, William, The Institute for Genomic Research
 Pickett, Siobhan, Molecular Devices
 Punta, Marco, Columbia University

TEACHING ASSISTANTS

Andersson, Tove, The Institute for Genomic Research
 Bhagabati, Nirmal, The Institute for Genomic Research
 Birkeland, Shanda, Marine Biological Laboratory
 Cipriano, Michael, Marine Biological Laboratory
 Davidsen, Tanja, The Institute for Genomic Research
 Fox, Richard, Marine Biological Laboratory
 Gill, John, Venter Institute
 Graham, Leslie, Marine Biological Laboratory
 Hammar, Kasia, Marine Biological Laboratory
 Liang, Wei, The Institute for Genomic Research
 Olsson, Bertil, Marine Biological Laboratory
 Rubio, Renee, The Institute for Genomic Research
 Saeed, Alexander, The Institute for Genomic Research
 Sharov, Vasily, The Institute for Genomic Research
 Tallon, Luke, The Institute for Genomic Research
 White, Joseph, The Institute for Genomic Research

STUDENTS

Adkins, Scott, USDA-ARS-USHRL
 Aguilera, Angeles, Centro de Astrobiología
 Aley, Stephen, University of Texas at El Paso
 Anderson, Sedrick, Meharry Medical College
 Biermann, Christiane, Portland State University
 Cheung, Wang-Kit, University of Hawaii Cancer Research Center
 Chu, Shenghui, Eastern Michigan University
 de Miguel, Natalia, Instituto Tecnológico Chascomus (INTECH)
 Djimde, Abdoulaye, University of Bamako
 Escobar, Viviana, Instituto de Biotecnología, UNAM
 Etchebarne, Brett, Michigan State University
 Hullar, Meredith, University of Washington
 Isokpehi, Raphael, Jackson State University
 Li, Sheng, Illinois State University
 Pommier, Thomas, Kalmar University
 Summers, Anne, University of Georgia
 Thompson, Dawn, Harvard University
 Weigt, Lee, Smithsonian Institution, National Museum
 Whistler, Cheryl, University of New Hampshire

Analytical and Quantitative Light Microscopy

May 6 – May 14, 2004

COURSE DIRECTORS

Sluder, Greenfield, University of Massachusetts Medical School
 Wolf, David, Sensor Technologies

FACULTY

Axelrod, Daniel, University of Michigan
 Cardullo, Richard, University of California, Riverside
 Heintzmann, Rainer, Max Planck Institute for Biophysical Chemistry
 Hinchcliffe, Edward, University of Notre Dame
 Inoue, Shinya, Marine Biological Laboratory
 Murray, John, University of Pennsylvania
 Salmon, Edward, University of North Carolina, Chapel Hill
 Silver, Randi, Weill Medical College, Cornell University
 Spring, Kenneth
 Swedlow, Jason, University of Dundee
 Tran, Phong, University of Pennsylvania

LECTURERS

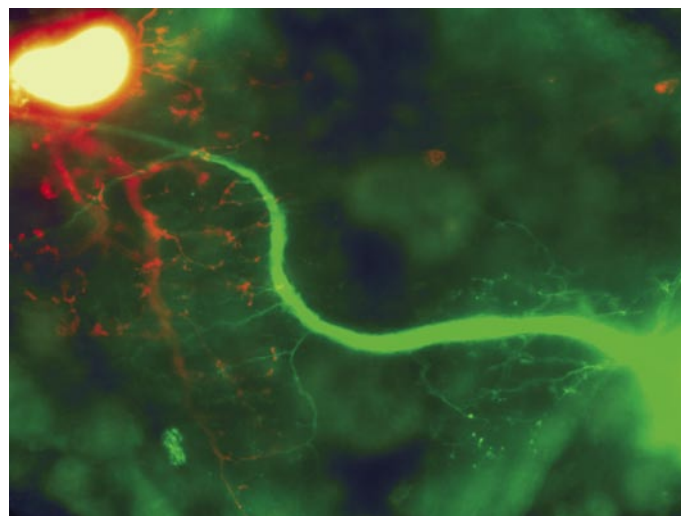
Bowser, Samuel, Wadsworth Center
 Keller, H. Ernst, Retired from Carl Zeiss
 Oldenbourg, Rudolf, Marine Biological Laboratory
 Straight, Aaron, Stanford University School of Medicine

TEACHING ASSISTANTS

English, Christopher, University of Massachusetts Medical School
 Uetake, Yumi, University of Massachusetts Medical School

COURSE COORDINATOR

Nordberg, Joshua, University of Massachusetts Medical School



STUDENTS

Adams, Dany, The Forsyth Institute
 Bicek, Andrew, University of Minnesota
 Brisch, Ellen, Minnesota State University Moorhead
 Carricaburu, Valerie, Boston Biomedical Research Institute
 Escuin, Daniel, Emory University
 Galanopoulou, Aristeia, Albert Einstein College of Medicine
 Heetderks, Julia, Pennsylvania State University
 Jowsey, Ian, University of Dundee
 Kagawa, Yuki, Marine Biological Laboratory
 Kline, Erik, Emory University
 Kruchten, Anne, Mayo Clinic School of Medicine
 Kumar, Ashish, University of California, Santa Barbara
 Kyoung, Minjoung, Pennsylvania State University
 Lacayo, Catherine, Stanford University
 Liu, ChaoTuan, University of California, Los Angeles
 Marcus, Adam, Emory University
 Masek, Katherine, University of Pennsylvania
 Michie, Sara, Stanford University
 Nagarajan, Naveen, Massachusetts Institute of Technology
 Novak, Ivana, Karolinska Institutet
 Peretti, Diego, Weill Medical College, Cornell University
 Peterman, Kaye, Wellesley College
 Rabino, Claudia, Millennium Pharmaceuticals, Inc.
 Reid, Alicia, Weill Graduate School, Cornell University
 Sanders, Lori, University of Illinois at Urbana-Champaign
 Seo, Hee-Chan, University of Bergen
 Shieh, Ru-Chi, Institute of Biomedical Sciences
 Smith, Mark, University of Utah
 Sobota, Jackie, University of Connecticut Health Center
 Stehman, Stephanie, Columbia University
 Zani, Brett, Indiana University

Frontiers in Reproduction

May 16 – June 27, 2004

COURSE DIRECTORS

Albertini, David, Kansas University Medical Center
Ascoli, Mario, University of Iowa
Fazleabas, Asgi, University of Illinois
Hunt, Patricia, Case Western Reserve University

FACULTY

Carroll, David, Florida Institute of Technology
Christenson, Lane, University of Pennsylvania
Cooke, Paul, University of Illinois
Cross, James, University of Calgary
Dean, Wendy, The Babraham Institute
DeMayo, Francesco, Baylor College of Medicine
Dobranski, Ina, University of Pennsylvania
Downs, Karen, University of Wisconsin-Madison
Ducibella, Thomas, Tufts-New England Medical Center
Hardy, Matt, Population Council
Hassold, Terry, Case Western Reserve University
Hunt, Joan, University of Kansas, Medical Center
Jaffe, Laurinda, University of Connecticut, Health Center
Jameson, Larry, Northwestern University
Keri, Ruth, Case Western Reserve University
Liu, Lin, Women and Infants' Hospital of Rhode Island
McClure, Mike, Frontiers Fund
Overstrom, Eric, Tufts University
Powers, Douglas, Boston IVF
Rao, Mahendra, National Institutes of Health
Rowan, Brian, Medical College of Ohio
Schultz, Richard, University of Pennsylvania
Shupnik, Margaret, University of Virginia
Sutherland, Ann, University of Virginia
Terasaki, Mark, University of Connecticut Health Center

LECTURERS

Conti, Marco, Stanford University
Eppig, John, The Jackson Laboratory
Guillette, Louis, University of Florida
Hackett, Richard, Women and Infants' Hospital of Rhode Island
Keefe, David, Women and Infants' Hospital of Rhode Island
Mayo, Kelly, Northwestern University
Nilson, John, Washington State University
Soto, Ana, Tufts-New England Medical Center
Strauss, III, Jerome, University of Pennsylvania
Suarez-Quian, Carlos, Georgetown University Medical Center
Thomas, Peter, University of Texas
Trimarchi, James, Women and Infants' Hospital of Rhode Island
Yao, Humphrey, University of Illinois
Ying, Ying, Women and Infants' Hospital of Rhode Island

TEACHING ASSISTANTS

Barrett, Susan, Tufts University
Brudney, Allison, University of Illinois, Chicago
DeMayo, Janet, Baylor College of Medicine
DiNapoli, Leo, Duke University
Galet, Colette, University of Iowa



Hadsell, Louise, Baylor College of Medicine
Hastings, Julie, University of Chicago, Illinois
Hodges, Craig, Case Western Reserve University
Huntress, Victoria, Tufts University, School of Veterinary Medicine
Ibáñez, Elena, Universitat Autònoma de Barcelona
Inman, Kimberly, University of Wisconsin, Madison
Jackson, Jodi, Case Western Reserve University
Limke, Tobi, National Institutes of Health
Lin, Vicky, University of Virginia
Mueller, Thomas, University of Iowa
Runft, Linda, University of California, Santa Barbara
Sanfins, Alexandra, Tufts University School of Medicine
Shah, Yatrik, Medical College of Ohio
Susiarjo, Martha, Case Western Reserve University
Wang, Jie, Baylor College of Medicine
Wang, Min Kang, Tufts University, School of Veterinary Medicine
Weiss, Mark, National Institute on Aging/NIH
Zeng, Wenxian, University of Pennsylvania

COURSE COORDINATOR

Cherry, Jonathan, Case Western Reserve University

COURSE ASSISTANT

Laronda, Monica, Northwestern University

STUDENTS

Caperton, Lee, University of Texas
Chirinos, Mayel, Instituto Nacional de Ciencias Medicas
Chrostowski, Magdalena, Brown University
Da Ros, Vanina, National Research Council
Grossman, Francesca, University of Pennsylvania
Huang, Ivan, University of Utah
Jackson, Kevin, University of Illinois, Chicago
Langat, Daudi, University of Kansas Medical Center
Michaut, Marcela, University of Pennsylvania
Mukherjee, Srabani, ICMR, Government of India
Nores, Rodrigo, National University of Cordoba
Ribeiro, Maria Laura, National Research Council
Ryan, Ginny, University of Iowa Hospitals and Clinics
Seli, Emre, Yale University
Tayade, Chandrakant, University of Guelph
Vidsiunas, Alex Kors, University of Sao Paulo

Medical Informatics: Spring Session

May 30 – June 6, 2004

COURSE DIRECTOR

Cimino, James, Columbia University

FACULTY

Ackerman, Michael, National Library of Medicine
 Ash, Joan, Oregon Health and Science University
 Bakken, Suzanne, Columbia University
 Canese, Kathi, National Library of Medicine
 Cimino, Christopher, Albert Einstein College of Medicine
 Dematos, Chris, Marine Biological Laboratory
 Hammond, Ed, Duke University
 Hripcsak, George, Columbia University
 Johnson, Kevin, Vanderbilt University
 Kingsland, Lawrence, National Library of Medicine
 Kukafka, Rita, Columbia University
 Lindberg, Donald, National Library of Medicine
 McCray, Alexa, National Library of Medicine
 Miller, Perry, Yale University
 Norton, Cathy, Marine Biological Laboratory
 Remsen, David, Marine Biological Laboratory
 Stout, Amy, Marine Biological Laboratory
 Uhlinger, Eleanor, Marine Biological Laboratory

STUDENTS

Angelo, Wendy, NH Dartmouth Family Practice Residency
 Arnold, Noreen, VA Information Resource Center
 Bodin, Gregory, Houston Academy of Medicine,
 Texas Medical Center
 Britigan, Denise, University of Cincinnati Medical Center
 Byrnes, Jennifer, Rochester University
 Chuang, Philip, University of California, Berkeley
 Croft, Vicki, Washington State University
 Davis, Frank, Memorial Health University Medical Center
 De Groote, Sandra, University of Illinois at Chicago
 Doarn, Charles, University of Cincinnati
 Epelbaum, Marcia, Vanderbilt University
 Fleury, Patrick, University of Chicago
 Gallagher Gordon, Mary, Drexel University
 Hinostroza, Nelson, Ecuadorian Society for Informatics in Health
 Jacobs, Ellen, College of Saint Mary
 Knight, Amy, Johns Hopkins Bayview Medical Center
 Lugo, Ramon, Temple University School of Dentistry
 Luoma, David, Marquette General Health Systems/Michigan State
 Martin, Sandra, Vanderbilt University
 O'Connor, Gerald, Dartmouth Medical School
 Prottzman, Mary, US Army Aeromedical Center
 Reddy, Chandra, Indian Health Service
 Rhodes, Catherine, University of North Texas Health Science
 Richart, Robert, Madigan Army Medical Center
 Rockstraw, Leland, Drexel University
 Shah, Jayesh, San Mateo Medical Center
 Smith, Lisa, University North Texas Health Science Center
 Stone, David, VISICU
 Tirmizi, Syed, Department of Veterans Affairs
 Zender, Paul, University of Cincinnati

Medical Informatics: Fall Session

September 26 – October 3, 2004

COURSE DIRECTOR

Cimino, James, Columbia University

FACULTY

Dematos, Chris, Marine Biological Laboratory
 Friedman, Charles, National Library of Medicine
 Kingsland, Lawrence, National Library of Medicine
 Kukafka, Rita, Columbia University
 Lorenzi, Nancy, Vanderbilt University Medical Center
 McCray, Alexa, National Library of Medicine
 Miller, Randolph, Vanderbilt University Medical Center
 Mitchell, Joyce, University of Missouri, Columbia
 Nahin, Annette, National Institutes of Health
 Nesbitt, Thomas, University of California, Davis Health System
 Norton, Cathy, Marine Biological Laboratory
 Remsen, David, Marine Biological Laboratory
 Shortliffe, Edward, Columbia University
 Starren, Justin, Columbia University
 Stead, William, Vanderbilt University
 Stout, Amy, Marine Biological Laboratory
 Uhlinger, Eleanor, Marine Biological Laboratory

STUDENTS

Abate, Laura, The George Washington University
 Bell, Tanvir, University of Texas Medical Branch
 Chakravorty, Bonnie, Tufts University
 Clark, Nancy, VA North Texas Health Care System
 Creasey, Graham, Case Western Reserve University
 Crossette, Jonathan, The Children's Hospital of Philadelphia
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Methods in Computational Neuroscience

August 1 – August 29, 2004

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Molecular Biology of Aging

August 2 – August 21, 2004

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Molecular Mycology: Current Approaches to Fungal Pathogenesis

August 5 – August 22, 2004

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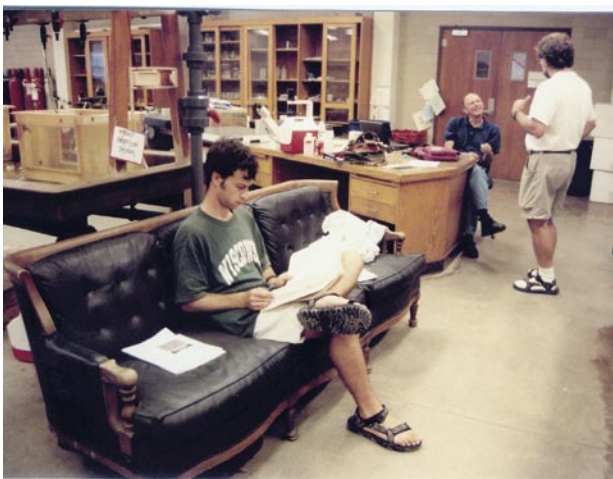
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Neural Development and Genetics of Zebrafish

August 15 – August 28, 2004

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Neuroinformatics

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Fundamental Issues in Vision Research

August 8 – August 21, 2004

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Summer Program in Neuroscience, Ethics, and Survival (SPINES)

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BIOMEDICAL FACULTY

Bloom, Kerry, University of North Carolina, Chapel Hill, co-director
 Palazzo, Rensselaer Polytechnic Institute, co-director
 Mythreye Karthikeyan, University of North Carolina, Chapel Hill
 Pearson, Chad, University of North Carolina, Chapel Hill
 Bradley J. Schnackenberg, University of Arkansas for Medical Sciences

ENVIRONMENT FACULTY

Foreman, Kenneth, Marine Biological Laboratory, co-director
 Neill, Christopher, Marine Biological Laboratory, co-director
 Rich McHorney, Marine Biological Laboratory

BIOMEDICAL FELLOWS

Collins, Graham, Editor, *Scientific American*
 Clabby, Catherine, Science Reporter, *The News & Observer*, Raleigh, NC
 Cooney, Elizabeth, Health Reporter, *Worcester Telegram & Gazette*
 Heyman, Karen, Freelance
 Kenney, Diana, Writer, *Cape Cod Times*
 Mow, Jacqueline, Freelance Producer

ENVIRONMENT FELLOWS

Carey, John, Sr. Correspondent, *BusinessWeek*
 Clarren, Rebecca, Freelance
 Conover, Adele, Freelance
 Grossman, Elizabeth, Freelance
 Russo, Eugene, Freelance

Semester in Environmental Science

DIRECTOR

Foreman, Kenneth H.

FACULTY

Deegan, Linda A.
 Foreman, Kenneth H.
 Giblin, Anne E.
 Hobbie, John E.
 Hopkinson, Charles S., Jr.
 Liles, George
 Melillo, Jerry M.
 Neill, Christopher
 Peterson, Bruce J.
 Rastetter, Edward B.
 Shaver, Gaius R.
 Vallino, Joseph J.

RESEARCH AND TEACHING ASSISTANTS

Broughton, Laura
 Burce, Allison
 Kwiatkowski, Bonnie
 McHorney, Richard
 Washbourne, Ian

ADMINISTRATIVE ASSISTANT

Berthel, Dixie

STUDENTS

Brunie, Lisa H., Mount Holyoke College
 Foster, Sarah Q., Hampshire College
 Hicks, Sarah L., Hampshire College
 Kingsland, Kevin M., Beloit College
 de Moor, Emily B., Brown University
 Nolan, Katharine M., Bates College
 Phillips, Rose A., Mount Holyoke College
 Ross, Noam M., Brown University
 Sampson, Emily A., Mount Holyoke College
 Yaindl, Chad E., Lafayette College

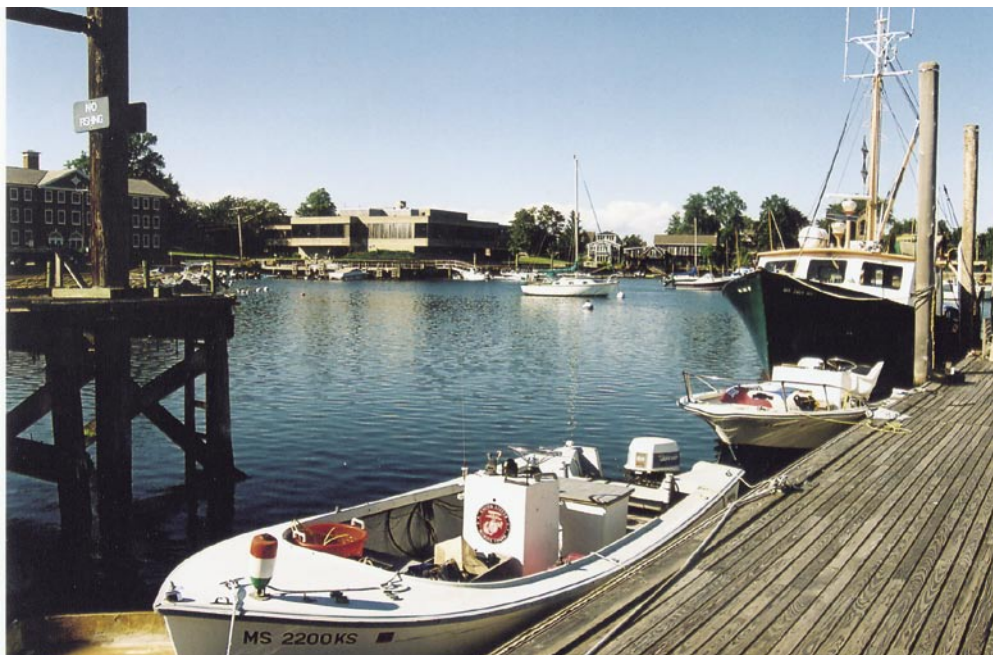
The Science Journalism Program is supported by the:

American Society for Biochemistry and Molecular Biology
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 Waksman Foundation for Microbiology



SCHOLARSHIP AWARDS

In 2004, the MBL awarded the following scholarships to 225 highly qualified students, enabling them to participate in our total-immersion courses.



THE BRUCE AND BETTY ALBERTS ENDOWED SCHOLARSHIP IN PHYSIOLOGY

Yang, Janet, University of California, San Francisco

AMERICAN SOCIETY FOR CELL BIOLOGY

Davis, Denise, Yale University School of Medicine
 Dominguez, Reymundo, University of Southern California
 George, Olivia, New Mexico State University
 Jackson, Kevin, University of Illinois, Chicago
 Lucas, Marsha, Ohio State University
 Serrano, Geidy, University of Puerto Rico
 Tapanes-Castillo, Alexis, University of Miami School of Medicine

AMERICAN SOCIETY FOR REPRODUCTIVE MEDICINE

Caperton, Lee, University of Texas
 Huang, Ivan, University of Utah
 Seli, Emre, Yale University

BIOLOGY CLUB OF THE COLLEGE OF THE CITY OF NEW YORK

Lau, Chun-Yue Geoffrey, Albert Einstein College of Medicine

JOHN & ELISABETH BUCK ENDOWED SCHOLARSHIP

Degoursac, Liz, Emory University

C. LALOR BURDICK SCHOLARSHIP

Caperton, Lee, University of Texas
 Cone, Angela, San Diego State University
 Fernandez-Serra, Montserrat, Stazione Zoologica Anton
 Dorhn, Naples, Italy

SCHOLARS OF THE BAUER CENTER FOR GENOMICS RESEARCH AT HARVARD

Brandman Onn, Stanford University
 Cook Danielle, Massachusetts Institute of Technology
 DePristo Mark, University of Cambridge
 Foethke Dietrich, European Molecular Biology Laboratory
 Keren Kinneret, Stanford University
 Lucks Julius, Harvard University
 Needleman Daniel, University of California, Santa Barbara

BURROUGHS WELLCOME FUND-BIOLOGY OF PARASITISM COURSE

Harder, Simone, Bernhard Nocht Institute for Tropical Medicine
 Kats, Lev, Monash University
 Kwok, Lai Yu, University of Geneva

BURROUGHS WELLCOME FUND-FRONTIERS IN REPRODUCTION COURSE

Chirinos, Mayel, Instituto Nacional de Ciencias Medicas
 Chrostowski, Magdalena, Brown University
 Da Ros, Vanina, National Research Council
 Grossman, Francesca, University of Pennsylvania
 Jackson, Kevin, University of Illinois, Chicago
 Langat, Daudi, University of Kansas Medical Center
 Michaut, Marcela, University of Pennsylvania
 Mukherjee, Srabani, ICMR, Government of India
 Nores, Rodrigo, National University of Cordoba
 Ribeiro, Maria Laura, National Research Council
 Ryan, Ginny, University of Iowa Hospitals and Clinics
 Seli, Emre, Yale University
 Tayade, Chandrakant, University of Guelph
 Vidsiunas, Alex Kors, University of Sao Paulo

BURROUGHS WELLCOME FUND- MOLECULAR MYCOLOGY COURSE

Armstrong-James, Darius, Imperial College London
Campbell, Leona, University of Sydney
Diezmann, Stephanie, Duke University Medical Center
Magill, Shelley, The Johns Hopkins School of Medicine
Olson, Gillian, Tulane University Medical Center
Palmer, Glen, Louisiana State University Health Science Center
Reedy, Jennifer, Duke University
Robertson, Emma, University of Southern Denmark
Rutherford, Julian, University of Utah
Shea, John, Medical University of South Carolina
Tarcha, Eric, Medical College of Ohio
Tournu, Helene, Flanders Interuniversity Institute for Biotechnology

MAX M. BURGER ENDOWED SCHOLARSHIP

D'Aniello, Salvatore, Stazione Zoologica Anton Dohrn
Rolo, Ana, University of Virginia

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Rolo, Ana, University of Virginia
Saudemont, Alexandra, Centre National de la Recherche Scientifique

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Ma, Leung-hang, Hong Kong University of Science and Technology
Paul, Sarah, Northwestern University

EDWIN GRANT CONKLIN MEMORIAL FUND

Rolo, Ana, University of Virginia

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Santibáñez Bustos, Juan, Universidad de Concepcion
Walsh, David, Dalhousie University

WILLIAM F. AND IRENE C. DILLER MEMORIAL FUND

Casanova, Carlo, University of Bern

MAC V. EDDS, JR. ENDOWED SCHOLARSHIP FUND

Cone, Angela, San Diego State University

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Casanova, Carlo, University of Bern
Kafsack, Björn, Johns Hopkins University
Korbelt, Daniel, London School of Hygiene and Tropical Medicine
Lavazec, Catherine, Pasteur Institute

THE ELLISON MEDICAL FOUNDATION - MOLECULAR BIOLOGY OF AGING COURSE

Carvalho, Gil, California Institute of Technology
Chen, Howard, Boston College
Cocheme, Helena, University of Cambridge
Curran, Sean, University of California, Los Angeles
Ding, Qunxing, University of Kentucky
Dominici, Fernando, University of Buenos Aires

Gomes, Nuno, UT Southwestern Medical Center at Dallas
Greer, Kimberly, Texas A&M University
Grone, Brian, University of California, Berkeley
McFarlane, Dianne, Atlantic Veterinary College
Moriarty-Craige, Siobhan, Emory University
Nukala, Vidya, University of Kentucky
Paul, Anirban, Howard University
Penner, Marsha, University of Arizona

Rossmislova, Lenka, Institute of Experimental Medicine
Rotter, Andrej, The Ohio State University
Sobol, Robert, University of Pittsburgh
Tang, Fusheng, University of Iowa
Ungvari, Zoltan, New York Medical College
Zhu, Haiyan, University of Kentucky

CASWELL GRAVE SCHOLARSHIP FUND

Bastock, Rebecca, Sheffield University
Saudemont, Alexandra, Centre National de la Recherche Scientifique
Thomas, Elizabeth, Cold Spring Harbor Laboratory

THOMAS B. GRAVE AND ELIZABETH F. GRAVE SCHOLARSHIP

Ekstrom, Eileen, Princeton University
Facchin, Lucilla, University of Padova
Leung, Yuk Fai, Harvard University
Nabel-Rosen, Helit, Weizmann Institute of Science
Noche, Ramil, Case Western Reserve University
Sumbre, German, Hebrew University of Jerusalem

DANIEL S. AND EDITH T. GROSCH SCHOLARSHIP FUND

Bonilla-Findji, Osana, Laboratoire d'Océanographie de Villefranche, Station Zoologique

ALINE D. GROSS SCHOLARSHIP FUND

Hunt, Dana, Massachusetts Institute of Technology
Vincensini, Laetitia, Institut Pasteur

HOWARD HUGHES MEDICAL INSTITUTE - BIOLOGY OF PARASITISM COURSE

Conte, Ianina, Fundacion Instituto Leloir

HOWARD HUGHES MEDICAL INSTITUTE

Bonilla-Findji, Osana, Laboratoire d'Océanographie de Villefranche, Station Zoologique
Chang, Lynne, Northwestern University Medical School
Davis, Denise, Yale University School of Medicine
Dossin, Fernando, Federal University of Sao Paulo
Long, Gráinne, University of Edinburgh
Luna, Gian Marco, Polytechnic University of Marche
Lundfald, Line, Karolinska Institutet
Milferstedt, Kim, University of Illinois at Urbana/Champaign
Oberholzer, Michael, University of Bern

2004 Post-Course Research Awards

EMBRYOLOGY

Ma, Leung-hang, Hong Kong University of Science and Technology

MICROBIAL DIVERSITY

Warnecke, Falk, Max Planck Institute for Marine Microbiology

PHYSIOLOGY

Chang, Lynne, Northwestern University Medical School
DePristo, Mark, University of Cambridge
Nonaka, Mio, Kyoto University

Rolo, Ana, University of Virginia
 Saudemont, Alexandra Centre National de la Recherche Scientifique
 Teng, Ching-Ling, University of California, San Francisco
 Vig Nissen, Ulla, University of Oslo
 Vogels, Tim, Brandeis University
 Yang, Eun-Jin, Columbia University
 Zhang, Yifeng, University of California, San Diego

WILLIAM RANDOLPH HEARST EDUCATIONAL ENDOWMENT

Ehmsen Jeffrey, Johns Hopkins School of Medicine
 Gardel Margaret, Harvard University
 Gupton Stephanie, The Scripps Research Institute
 Strongin Daniel, University of Chicago
 Wiedmann Anna, Yale University
 Wollman Roy, University of California, Davis

INTERNATIONAL BRAIN RESEARCH ORGANIZATION

Castelló, Maria, Instituto de Investigaciones Biologicas
 Merlo, Emiliano, Ciudad Universitaria
 Khoboko, Thabelo, University of Cape Town
 Winograd, Milena, Universidad Miguel Hernandez

HOLGER & FRIEDERUN JANNASCH SCHOLARSHIP IN MICROBIAL DIVERSITY

Simmons, Sheri, Woods Hole Oceanographic Institution

ARTHUR KLORFEIN SCHOLARSHIP AND FELLOWSHIP FUND

Brauchle, Michael, New York University
 Cone, Angela, San Diego State University
 Doyle, Michelle, University of Colorado Health Science Center
 Fernandez Serra, Montserrat, Stazione Zoologica Anton Dohrn
 Johnson, Aaron, Arizona State University
 Kamei, Noriko, University of California, Irvine
 Ma, Leung-hang, Hong Kong University of Science and Technology
 Modrell, Melinda, University of California, Berkeley

FRANK R. LILLIE FELLOWSHIP AND SCHOLARSHIP FUND

Chang, Lynne, Northwestern University Medical School
 Keren, Kinneret, Stanford University
 Kunwar, Prabhat, New York University Medical Center
 Modrell, Melinda, University of California, Berkeley

THE GRUSS LIPPER FOUNDATION SCHOLARSHIP

Biron, David, Weizmann Institute of Science

JACQUES LOEB FOUNDERS' SCHOLARSHIP FUND

Allen, Rosalind, FOM Institute for Atomic & Molecular Physics

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Sann, Sharon, University of California, San Diego
 Sironi, Lucia, European Molecular Biology Laboratory
 Wienisch, Martin, Max Planck Institute for Biophysical Chemistry

MBL ASSOCIATES ENDOWED SCHOLARSHIP FUND

Oberholzer, Michael, University of Bern

MBL PIONEERS SCHOLARSHIP FUND

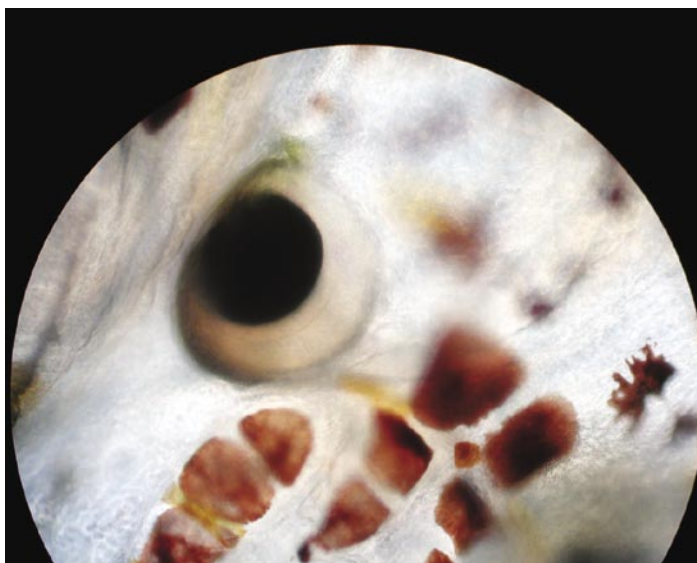
D'Aniello, Salvatore, Stazione Zoologica Anton Dohrn
 Brauchle, Michael, New York University
 Feigin, Michael, SUNY, Stony Brook
 Fernandez Serra, Montserrat, Stazione Zoologica Anton Dohrn
 Kamei, Noriko, University of California, Irvine

FRANK MORRELL ENDOWED MEMORIAL SCHOLARSHIP

Cheng, Ning, Johns Hopkins University School of Medicine
 Lin, John, University of Auckland

MOUNTAIN MEMORIAL FUND SCHOLARSHIP

Allen, Rosalind, FOM Inst for Atomic & Molecular Physics
 Dance, Amber, University of California, San Diego
 Ehmsen, Jeffrey, Johns Hopkins School of Medicine
 Gardel, Margaret, Harvard University
 Gupton, Stephanie, The Scripps Research Institute
 Strongin, Daniel, University of Chicago



ALBERTO MONROY FOUNDATION

D'Aniello, Salvatore, Stazione Zoologica Anton Dohrn

**NEURAL SYSTEMS & BEHAVIOR COURSE
ENDOWED SCHOLARSHIP FUND**

Field, Evelyn, University of Lethbridge

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Casanova, Carlo, University of Bern

Dossin, Fernando, Federal University of Sao Paulo

Harder, Simone, Bernhard Nocht Institute for Tropical Medicine

Kafsack, Björn, The Johns Hopkins University

PLANETARY BIOLOGY INTERNSHIP SCHOLARSHIPS

O'Mullan, Gregory, Princeton University

Reed, Heather, University of Colorado at Boulder

WILLIAM TOWNSEND PORTER SCHOLARSHIP

Davis, Denise, Yale University School of Medicine

Dominguez, Reymundo, University of Southern California

George, Olivia, New Mexico State University

Jackson, Kevin, University of Illinois, Chicago

Serrano, Geidy, University of Puerto Rico

Tapanes-Castillo, Alexis, University of Miami School of Medicine

HERBERT W. RAND FELLOWSHIP AND SCHOLARSHIP

Balu, Ramani, Case Western Reserve University

Blazejak, Anna, Max Planck Institute of Marine Microbiology

Bright, Rachel, Stanford University School of Medicine

Chacron, Maurice, University of Ottawa

Dalmacio, Leslie, University of the Philippines

Doan, Thuy, University of Washington

Doyle, Michelle, University of Colorado Health Science Center

Field, Evelyn, University of Lethbridge

Gabriel, Jens, University of Cologne

Luna, Gian Marco, Polytechnic University of Marche

Milferstedt, Kim, University of Illinois at Urbana/Champaign

Roeselers, Guus, Delft University of Technology

Sheth, Ujwal, University of Arizona

Zhang, Yifeng, University of California, San Diego

**FLORENCE C. ROSE AND S. MERYL ROSE
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Paul, Sarah, Northwestern University

RUTH SAGER MEMORIAL SCHOLARSHIP

Dance, Amber, University of California, San Diego

Roffers, Julaine, University of Minnesota

**HOWARD A. SCHNEIDERMAN ENDOWED
SCHOLARSHIP**

Ihlefeld, Antje, Boston University

Jaramillo, Santiago, New York University

MILTON L. SHIFMAN ENDOWED SCHOLARSHIP

Lennon, Jay, Dartmouth College

CATHERINE FILENE SHOUSE SCHOLARSHIP

Blazejak, Anna, Max Planck Institute of Marine Microbiology

Cheng, Ning, Johns Hopkins University School of Medicine

Dalmacio, Leslie, University of the Philippines

Kwok, Lai Yu, University of Geneva

Lavazec, Catherine, Pasteur Institute

Vig Nissen, Ulla, University of Oslo

Vincensini, Laetitia, Institut Pasteur

MARJORIE W. STETTEN SCHOLARSHIP FUND

Lavazec, Catherine, Pasteur Institute

Simmons, Sheri, Woods Hole Oceanographic Institution

HORACE W. STUNKARD SCHOLARSHIP

Ihlefeld, Antje, Boston University

Jaramillo, Santiago, New York University

SOCIETY FOR GENERAL PHYSIOLOGY

Field, Evelyn, University of Lethbridge

Kunwar, Prabhat, New York University Medical Center

Roffers, Julaine, University of Minnesota

Wienisch, Martin, Max Planck Institute for Biophysical Chemistry

(Fumio Mekata Scholar)

SURDNA FOUNDATION SCHOLARSHIP

Blazejak, Anna, Max Planck Institute for Marine Microbiology

Corbo, Joseph, Harvard Medical School/Brigham & Women's

Hospital

Lin, John, University of Auckland

Mirny, Leonid, Massachusetts Institute of Technology

Niethammer, Philipp, EMBL Heidelberg

Nonaka, Mio, Kyoto University

Toth, Judit, National Institutes of Health

Wienisch, Martin, Max Planck Institute for Biophysical Chemistry

EVA SZENT-GYÖRGYI SCHOLARSHIP FUND

Toth, Judit, National Institutes of Health

**JOHN & MADELEINE TRINKAUS ENDOWED
SCHOLARSHIP**

Paul, Sarah, Northwestern University

**SELMAN A. WAKSMAN ENDOWED SCHOLARSHIP
IN MICROBIAL DIVERSITY**

Bonilla-Findji, Osana, Laboratoire d'Océanographie

de Villefranche, Station Zoologique

THE IRVING WEINSTEIN ENDOWED SCHOLARSHIP

Nechiporuk, Alex, University of Washington

Peyrot, Sara, University of California, Berkeley

**WILLIAM MORTON WHEELER FAMILY FOUNDERS'
SCHOLARSHIP**

Nechiporuk, Alex, University of Washington

Peyrot, Sara, University of California, Berkeley

WALTER L. WILSON ENDOWED SCHOLARSHIP FUND

Allen Rosalind, FOM Institute for Atomic & Molecular Physics

WORLD HEALTH ORGANIZATION

Chirinos, Mayel, Instituto Nacional de Ciencias Medicas

Da Ros, Vanina, National Research Council

INSTITUTIONS REPRESENTED (students)



Alaska Department of Veteran Affairs
 Alaska, University of, Fairbanks
 Albert Einstein College of Medicine
 Amsterdam, University of
 Angelo State University
 Arizona State University
 Arizona, University of
 Atlantic Veterinary College
 Auckland, University of

Bamako, University of
 Bath, University of
 Baylor College of Medicine
 Bergen, University of
 Bern, University of
 Bernhard Nocht Inst for Tropical Medicine
 Beth Israel Deaconess Medical Center
 Boston Biomedical Research Institute
 Boston College
 Boston University
 Brandeis University
 Brown University
 Buenos Aires, University of

California Institute of Technology
 California, University of, Berkeley
 California, University of, Davis
 California, University of, Irvine
 California, University of, Los Angeles
 California, University of, San Diego
 California, University of, San Francisco
 California, University of, San Francisco Mission Bay
 California, University of, Santa Barbara
 Cambridge, University of
 Cape Town, University of
 Carnegie Mellon University
 Case Western Reserve University
 Centers for Disease Control & Prevention
 Centre National de la Recherche Scientifique
 Centro de Astrobiología
 Charite of Humboldt University Berlin
 Chicago State University
 Chicago, University of
 Children's Hospital Boston
 Children's Hospital of Philadelphia, The
 CHW St. Johns Regional Medical Center
 Cincinnati Medical Center, University of
 Cincinnati, University of
 City College of New York
 Ciudad Universitaria
 Cold Spring Harbor Laboratory
 College of Saint Mary
 Cologne, University of
 Colorado Health Sciences Center, University of
 Colorado State University
 Colorado, University of, Boulder
 Colorado, University of, Health Science Center
 Columbia University

Connecticut, University of
 Connecticut, University of, Health Center
 Cornell University
 Costa Rica, University of
 CUNY-Hunter College

Dalhousie University
 Dartmouth College
 Dartmouth Medical School
 Delft University of Technology
 Department of Veterans Affairs
 Drexel University
 Duke University
 Duke University Medical Center
 Dundee, University of

Eastern Michigan University
 Ecuadorian Society for Informatics in Health
 Edinburgh, University of
 Ellis Hospital
 Emory University
 ETH Zurich University
 European Molecular Biology Laboratory, Heidelberg

Federal University of Sao Paulo
 Flanders Interuniversity Institute for Biotechnology
 Florida Atlantic University
 Florida Marine Research Institute
 Florida, University of
 Folkhalsan Institute of Genetics
 FOM Institute for Atomic & Molecular Physics
 Forsyth Institute, The
 Fox Chase Cancer Center
 Fundacion Instituto Leloir

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 Geneva, University of
 Genomics Institute of the Novartis Research
 Foundation
 George Mason University
 George Washington University, The
 Georgetown University
 Georgia, University of
 Glaxo Smith Kline
 GSF-Research Center for Environment & Health
 Guelph, University of

Hagedorn Research Institute
 Harvard Medical School/Brigham and Women's
 Hospital
 Harvard University
 Hawaii, University of
 Hebrew University of Jerusalem
 Hong Kong University of Science and Technology
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 Institute of Experimental Medicine
 Instituto de Biotecnologia, UNAM
 Instituto de Investigaciones Biologicas
 Instituto Nacional de Ciencias Medicas
 Instituto Tecnologico Chascomus (INTECH)
 International Center for Tropical Agriculture
 Iowa, University of
 Iowa, University of, Hospitals and Clinics
 Italian National Research Council

Jackson Laboratory, The
 Jackson State University
 JD Gladstone Institute of Neurological Disease
 Johns Hopkins Bayview Medical Center
 Johns Hopkins University, The
 Johns Hopkins Hospital, The
 Johns Hopkins School of Medicine, The

Kalmar University
 Kansas, University of, Medical Center
 Karolinska Institutet
 Kentucky, University of
 Kitasato University
 Konstanz, University of
 Kyoto University

Laboratoire d'Océanographie de Villefranche,
 Station Zoologique
 Lethbridge, University of
 London School of Hygiene and Tropical Medicine
 Louisiana State University Health Science Center

Madigan Army Medical Center
 Maine, University of
 Marine Biological Laboratory
 Marquette General Health System/Michigan State
 University
 Maryland, University of
 Massachusetts Eye and Ear Infirmary
 Massachusetts Institute of Technology
 Mathematical Biosciences Institute
 Max Planck Institute for Chemical Ecology
 Max Planck Institute for Marine Microbiology
 Max Planck Institute for Biophysical Chemistry
 Mayo Clinic College of Medicine
 McGill University
 Medical College of Ohio
 Medical University of Innsbruck

Medical University of South Carolina
 Meharry Medical College
 Memorial Health University Medical Center
 Memorial Sloan-Kettering Cancer Center
 Merck Research Laboratories
 Miami University
 Miami, University of, School of Medicine
 Michigan State University
 Michigan, University of
 Millennium Pharmaceuticals, Inc.
 Minnesota State University Moorhead
 Minnesota, University of
 Missouri, University of, St. Louis
 Monash University
 Montana State University
 Montreal, University of
 Morgan State University
 Mount Sinai School of Medicine
 Mt. Desert Island Biological Laboratory

National Autonomous University of Mexico
 National Institutes of Health
 National Research Council
 National University of Cordoba
 Nevada, University of, School of Medicine
 New Hampshire, University of
 New Jersey, University of Medicine and Dentistry of
 New Mexico State University
 New York Medical College
 New York University
 New York University School of Medicine
 New York, State University of, Downstate Medical Center
 New York, State University of, Stony Brook
 NH-Dartmouth Family Practice Residency Program
 Nijmegen, University of, NCMLS
 North Carolina, University of, Chapel Hill
 North Texas Health Science Center, University of
 North Texas, University of, Health Science
 Northwestern University
 Northwestern University Medical School
 Norton Healthcare

Ohio State University
 Oregon Health & Science University
 Oregon, University of
 Oslo, University of
 Ottawa Health Research Institute
 Ottawa, University of

Padova, University of
 Partners HealthCare System
 Pennsylvania State University
 Pennsylvania, University of
 Philippines, University of, The
 Pittsburgh, University of
 Platypus Technologies
 Polytechnic University of Marche





COUNTRIES REPRESENTED (students)

Argentina
 Australia
 Austria
 Brazil
 Canada
 Chile
 Colombia
 Costa Rica
 Czech Republic
 Denmark
 Ecuador
 Finland
 France
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 Israel
 Italy
 Japan
 Madagascar
 Mali
 Mexico
 Netherlands, The
 New Zealand
 Norway
 Philippines, The
 Romania
 Scotland
 Senegal
 South Africa
 Spain
 Sweden
 Switzerland
 Taiwan
 United Kingdom
 Uruguay
 USA

Ponce School of Medicine
 Portland State University
 Pretoria, University of
 Princeton University
 Puerto Rico, University of
 Purdue University

 Queensland, University of

 Rice University
 Rochester University
 Rockefeller University, The
 Rutgers University

 Salk Institute, The
 San Diego State University
 San Mateo Medical Center
 Sao Paulo, University of
 Scripps Research Institute, The
 Seattle Biomedical Research Institute/University of Washington
 Sheffield University
 Smithsonian Institution
 South Alabama, University of
 South Dakota, University of
 Southern California, University of
 Southern Denmark, University of
 Spectrum Health Sciences Library
 Speleological Institute
 St. Joseph Regional Medical Center
 Stanford University
 Stanford University School of Medicine
 Stazione Zoologica Anton Dohrn
 Stimson Library, U.S. Army Medical Dept.
 Stony Brook University - Health Sciences
 Strathclyde, University of
 Swiss Federal Institute
 Sydney, University of

Technion-Israel Institute of Technology
 Temple University School of Dentistry
 Texas A&M University
 Texas, University of
 Texas, University of, El Paso
 Texas, University of, Health Science Center
 Texas, University of, Medical Branch
 Texas, University of, San Antonio
 Texas, University of, Southwestern Medical Center at Dallas
 Tufts University
 Tulane University Medical Center

Universidad Autonoma de Madrid
 Universidad de Concepcion
 Universidad de la Republica
 Universidad Miguel Hernandez
 Universidad Nacional Autonoma de Mexico
 Universidade Federal do Rio de Janeiro
 Universite Paris-Sud
 University College London
 University Graz
 University of Montreal Hospital Research Center/St. Luc Hospital
 US Army Aeromedical Center
 USDA-ARS-USHRL
 Utah, University of

VA Information Resource Center
 VA North Texas Health Care System
 Vanderbilt University
 Victoria University of Wellington
 Vienna University of Technology
 Virginia, University of
 VISICU

Washington State University Spokane
 Washington University
 Washington University School of Medicine
 Washington, University of
 Weber State University
 Weill Medical College, Cornell University
 Weizmann Institute of Science
 Wellesley College
 West Virginia University
 Wichita State University
 Wisconsin, University of, Madison
 Wisconsin, University of, Milwaukee
 Woods Hole Oceanographic Institution
 WWF-Madagascar

Yale University
 Yale University School of Medicine

Zoological Society of London

INSTITUTIONS REPRESENTED (faculty)

Aberdeen, University of
Alabama, University of, Birmingham
Albert Einstein College of Medicine
American Psychological Association
Arizona State University
Arizona, University of
Australian National University
Axon Instruments, Inc.

Babraham Institute, The
Baylor College of Medicine
Bern, University of
Biozentrum, University of Basel
Boston College
Boston IVF
Boston University
Brandeis University
British Columbia, University of
Broad Institute - Massachusetts Institute
of Technology
Brown University
Buenos Aires, University of

Calgary, University of
California Institute of Technology
California State University San Marcos
California, University of, Berkeley
California, University of, Davis
California, University of, Davis Health System
California, University of, Irvine
California, University of, Los Angeles
California, University of, Riverside
California, University of, San Diego
California, University of, San Francisco
California, University of, San Francisco, Medical
School
California, University of, Santa Barbara
Cambridge, University of
Cancer Research UK
Canterbury, University of
Carnegie Institution of Washington
Carnegie Mellon University
Case Western Reserve University
Chicago, University of
Children's Hospital Research Foundation
Children's National Medical Center
Cincinnati Children's Hospital Research
Cincinnati, University of
Cold Spring Harbor Laboratory
Colorado, University of
Columbia University
Columbus Children's Research Institute
Connecticut, University of
Connecticut, University of, Health Center
Cornell University



Dalhousie University
Dana-Farber Cancer Institute
Dartmouth College
Dartmouth Medical School
Delft University of Technology
Drexel University
Duke University
Duke University Medical Center
Dundee, University of

Edinburgh, University of
Emory University
European Molecular Biology Laboratory

Florida Institute of Technology
Florida International University
Florida State University
Florida, University of
Florida, University of, College of Medicine
Fred Hutchinson Cancer Research Center
Frontiers Fund
Fundação Oswaldo Cruz

George Washington University Medical Center
Georgetown University Medical Center
Georgia Tech/Medical College of Georgia
Georgia, University of
Glasgow, University of

Hannover, University of
Harbor-UCLA Medical Center
Harvard Medical School
Harvard Medical School/Children's Hospital
Harvard University
Hawaii, University of
Hawaii, University of, Manoa
Hebrew University of Jerusalem
House Ear Institute
Houston, University of

COUNTRIES REPRESENTED (faculty)

Argentina
Australia
Brazil
Canada
Chile
China
Colombia
England
France
Germany
India
Indonesia
Israel
Italy
Japan
Mexico
Netherlands, The
New Zealand
People's Republic
of China
Portugal
Republic of Korea
Romania
Russia
South Korea
Spain
Sweden
Switzerland
Taiwan
Turkey
United Kingdom
USA

Idaho, University of
 Illinois, University of
 Illinois, University of, Chicago
 Illinois, University of, Urbana-Champaign
 Indiana University, Bloomington
 Institut Pasteur
 Iowa State University
 Iowa, University of
 Italian National Research Council (CNR)

Jackson Laboratory, The
 Japan Science and Technology Agency
 Johns Hopkins School of Medicine, The
 Johns Hopkins University, The

Kansas University Medical Center
 Keck School of Medicine, University of
 Southern California
 Kentucky, University of
 King's College London

La Verne, University of
 Lawrence Berkeley National Laboratory
 Legacy Research
 Leiden University Medical Center
 Lethbridge, University of
 London School of Hygiene and Tropical Medicine
 Los Angeles Biomedical Research Institute at
 Harbor-UCLA
 Louisiana State University
 Louisiana State University Health Sciences Center

Manchester, University of
 Marine Biological Laboratory
 Maryland, University of
 Massachusetts Eye & Ear Infirmary
 Massachusetts General Hospital
 Massachusetts Institute of Technology
 Massachusetts, University of
 Massachusetts, University of, Medical School
 Massachusetts, University of, Worcester
 Max Planck Institute for Biological Cybernetics
 Max Planck Institute for Biophysical Chemistry
 Max Planck Institute for Marine Microbiology
 Max Planck Institute for Medical Research
 Max Planck Institute for Molecular Cell Biology
 and Genetics
 Medical College of Georgia
 Medical College of Ohio
 Medical College of Wisconsin
 Medical Research Council
 Meharry Medical College
 Melbourne, University of
 Merck Research Laboratories
 Miami, University of
 Michigan State University
 Microbia Inc.

Middlebury College
 Minnesota, University of
 Missouri, University of, Columbia
 Molecular Biology Consortium, Chicago
 Molecular Devices
 Monell Chemical Senses Center
 Montana State University
 Montana, University of
 Morehouse School of Medicine
 Mount Sinai School of Medicine
 MRC Laboratory of Molecular Biology

National Eye Institute
 National Institute of Environmental Health
 Sciences/NIH
 National Institute of Mental Health/NIH
 National Institute of Neurological Disorders
 and Strokes/NIH
 National Institute on Aging/NIH
 National Institutes of Health
 National Library of Medicine
 National University of Cordoba
 Nature Publishing Group
 Naval Medical Research Center
 Neuralynx, Inc.
 New Hampshire, University of
 New Jersey Institute of Technology
 New York, State University of, Albany
 New York, State University of, Buffalo
 New York, State University of, Stony Brook
 New York University
 New York University School of Medicine
 New York, City College of
 New York, State University of
 Normandale Community College
 North Carolina State University
 North Carolina, University of
 North Carolina, University of, Wilmington
 North Carolina, University of, Chapel Hill
 Northeastern University
 Northwestern University
 Notre Dame, University of

Occidental College
 Ohio State University
 Oklahoma Medical Research Foundation
 Oklahoma, University of
 Oregon Health & Science University
 Oxford, University of

Pennsylvania Children's Hospital of Philadelphia
 Pennsylvania State University
 Pennsylvania, University of
 Pennsylvania, University of, School of Medicine
 Pittsburgh, University of
 Population Council
 Princeton University



Queens University

Rochester, University of
Rockefeller University, The
Rocky Mountain College
Rutgers University
Rutgers University, School of Pharmacy

Saint Louis University
Salk Institute, The
San Diego State University
Scottish Association for Marine Science
Scripps Research Institute, The
Seattle Biomedical Research Institute
Sensor Technologies
Skirball Institute, NYU School of Medicine
Sloan-Kettering Institute
Smith College
Southern California, University of
Southern Illinois University School of Medicine
St. Andrews, University of
St. Lawrence University
Stanford University
Stanford University School of Medicine
Stellenbosch, University of
Stowers Institute for Medical Research
Swiss Federal Institute of Technology

Texas A&M University
Texas, University of
Texas, University of, Austin
Texas, University of, Health Science Center, Houston
Texas, University of, Health Science Center, San Antonio
Texas, University of, Medical School at Houston
Texas, University of, San Antonio
Texas, University of, Southwestern Medical Center
The Institute for Genomic Research
Toronto, University of
Tufts University
Tufts University School of Medicine
Tufts University, School of Veterinary Medicine
Tufts-New England Medical Center

Universidad de Buenos Aires
Universidad Nacional Autonoma de Mexico
Universitaet Konstanz
Universitaet Ulm
Universitat Autònoma de Barcelona
University College London
University of Connecticut Health Center
Upstate Medical University
Utah, University of
Utah, University of, School of Medicine

Vanderbilt University
Vanderbilt University Medical Center
Venter Institute
Vermont, University of
Virginia, University of

Wadsworth Center
Wake Forest University Health Sciences
Walter and Eliza Hall Institute, The
Washington State University
Washington University
Washington University Medical School
Washington, University of
Weill Medical College Cornell University
Weizmann Institute of Science
Wellesley College
Wheaton College
Williams College
Wisconsin, University of
Wisconsin, University of, Madison
Women & Infants' Hospital of Rhode Island
Woods Hole Oceanographic Institution

Yale Medical School
Yale University

Zebrafish International Resource Center

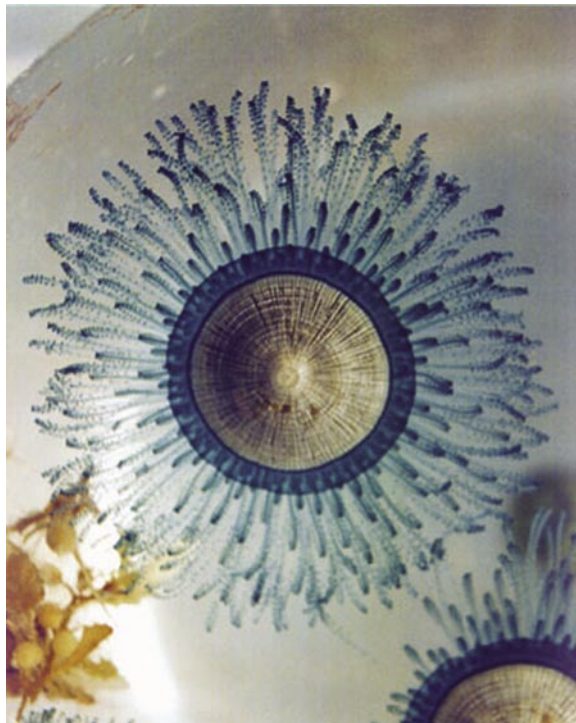
MBLWHOI LIBRARY

REPORT OF THE LIBRARY DIRECTOR

Last year's report stated that change is ever present in today's science libraries. During the past three years the MBLWHOI Library has changed in many ways. Today's scientists are more familiar with online journals, Google, and services such as PubMed, which provide online access to citations from biomedical literature, than the contents of the library shelves. Just one look in our library's reading rooms and you will notice the shrinking number of slots for recent hardcopy journals. The virtual library has arrived, the information commons, or infosphere, is a reality, and most of the information the library catalogues and disseminates is handled electronically.

Scholarly communication is being transformed in unpredictable ways. We are beginning to manage our own digital assets, and make them more widely available to our patrons. The library is also assuming preservation and asset management responsibilities. We have initiated a new digital repository, called the Woods Hole Open Access Server (WHOAS), which involves digitizing the latest WHOI Technical Reports and making them available through open source software developed at the Massachusetts Institute of Technology.

The library will continue to digitize and present our electronic content through WHOAS and related services. We will also continue our role as a gatherer and manager of the institutional repository, as a licensor of external services, such as electronic journals and databases, and as a facilitator for self-archiving our local resources. While the job of the library as an aggregator has yet to be finalized, we have an opportunity to take a



leadership role in developing policies and programs that contribute to a coherent, institutional-wide knowledge management system.

One of our most successful projects is the uBio initiative, the aim of which is to create a comprehensive and collaborative catalog of names of all living (and once-living) organisms. In 2004 uBio received further funding from The Andrew W. Mellon Foundation and the Global Biodiversity Information Facility. The uBio project is a technological innovation that has become a collaborative revolution with input from taxonomists around the globe.

The library's budget reductions in 2004 brought shared challenges and opportunities as our collection development policies underwent scrutiny. While we were forced to reduce local resources, our outreach efforts to library consortia members increased and collaboration with scientists and publishers was established. Within the past 12 months we have sent and received more than 10,000 interlibrary loans within our consortium of 19 academic libraries.

A science library supports research, learning, and scholarship. It is not an end in and of itself, but must adapt as research and learning behaviors change. Whatever changes lie on the horizon, libraries are a place of social assembly and are vitally important to their communities. The MBLWHOI Library is committed to providing the Woods Hole scientific community with the tools and means to access scientific information no matter what changes lie ahead.

— Catherine N. Norton



Jim Watson and Alex Rich, wearing their ties from the RNA Tie Club, returned to the MBL for the "Summer of '54 — Science is We" library celebration and exhibit.

Library Researchers

Jayne B. Abbott, Marine Research Inc.
Josephine Adams, Cleveland Clinic Foundation
Vernon Ahmadjian, Clark University
Garland E. Allen, Washington University
Nina S. Allen, North Carolina State University
Tom Allnutt, Advanced BioNutrition Corporation
Andy Applegate, New England Fishery Management Council
Michael Armstrong, Massachusetts Division of Fisheries

Baccio Baccetti, University of Siena
Ruth Barratt, Advanced BioNutrition Corporation
Thomas L. Benjamin, Harvard Medical School
Charles Blake, University of South Carolina
Deirdre Boelke, New England Fishery Management Council
Thomas A. Borgese, Lehman College-CUNY
Heather C. Boyd, MBLWHOI Library
John F. Boyer, Union College
Axel A. Brakhage, University of Hanover
Sabine Brauckmann, Konrad Lorenz Institute
Robert A. Bullis, Advanced BioNutrition Corp
Don Burke, Johns Hopkins University
Arthur H. Burr, Simon Fraser University

Graciela Candelas, University of Puerto Rico
Stephen Cannon, University of Texas, Southwestern
Paul Caruso, Massachusetts Division of Marine Fisheries
James Cervino, MBLWHOI Library
Brad Chase, Massachusetts Division of Marine Fisheries
Frank M. Child, Trinity College
John Chisholm, Massachusetts Division of Marine Fisheries
Kenneth L. Clarkson, Bell Labs, Lucent Technologies
Jewel P. Cobb, California State University
Seymour S. Cohen, American Cancer Society
Jamus Collier, Center for Coastal Studies
R. John Collier, Harvard Medical School
Rena Conti, Harvard Medical School
Steven Correia, Massachusetts Division of Marine Fisheries
John Costello, Providence College
Jeffrey T. Corwin, University of Virginia
Ernest F. Couch, Texas Christian University

Leyla deToledo-Morrell, Rush University
Leah Devlin, Penn State Abington College
Thomas K. Duncan, Nichols College

Peggy Edds-Walton, Parmly Hearing Institute, Loyola University
Herman T. Epstein, Brandeis University
Bruce Estrella, Massachusetts Division of Marine Fisheries

Alan Finkelstein, Albert Einstein College of Medicine
Gerald D. Fischbach, Columbia University
Dan Fraenkel, Harvard Medical School
Krystyna Frenkel, New York University School of Medicine

Robert Galatzer-Levy, University of Chicago
Cem Giray, Micro Technologies, Inc.
David L. Glanzman, The University of California, Los Angeles
Moise Goldstein, Johns Hopkins University
Penelope Greene, Harvard School of Public Health
Joanna Groden, University of Cincinnati

Continued...

Library Researchers, cont.

- Harlyn O. Halvorson, MBLWHOI Library
 Moti Harel, Advanced BioNutrition Corporation
 Phil Haring, New England Fishery Management Council
 Robert Haubrich, Denison University
 Peter K. Hepler, University of Massachusetts, Amherst
 Theodore T.Herskovits, Fordham University
 Michael Hickey, Massachusetts Division of Marine Fisheries
 Ann Hochschild, Harvard Medical School
 George Holz, New York University School of Medicine
- Sadayuki Inoue, McGill University
 David Isenberg, MBLWHOI Library
- Allan S. Jacobson, UMass Medical School
 Denise B. Jacobson, University of Massachusetts
 Lionel F. Jaffe, Marine Biological Laboratory
 Robert Jaye, Solomon Schechter Day School of Greater Boston in
 Newton
 Daniel Johnston, University of Texas at Austin
 Robert Josephson, University of California
- Arthur Karlin, Columbia University
 Chris Kellogg, New England Fishery Mgmt.Council
 Robert E. Kelly, Northwestern University
 Robert S. Kennedy, Maria Mitchell Association
 Alexander Keynan, Israel Academy of Sciences and Humanities
 Rita Khanna, Advanced BioNutrition Corporation
 Kenneth King, Woods Hole, MA
 Mary Y. King, Columbia University
 Donald A. Klein, Colorado State University
 Stephen M. Krane, Mass General Hospital-East
 Frank B. Krasne, University of California, Los Angeles
 David Kyle, Advanced BioNutrition Corporation
- Aimlee Laderman, Yale University School of Forestry and
 Environmental Studies
 David Landowne, University of Miami
 Edward Leadbetter, University of Connecticut
 Jared Leadbetter, California Institute of Technology
 Evelyn G. Lipper, New York Presbyterian Hospital
 John Lisman, Brandeis University
 Skip Little, MBLWHOI Library
 Werner R. Loewenstein, Journal of Membrane Biology
 Louise Luckenbill-Edds, Ohio University
- Luisa A. Marcelino, Massachusetts Institute of Technology
 Anne Marfey, MBLWHOI Library
 Charles Mayo, Center for Coastal Studies
 Maryann McEnroe, Purchase College
 Michael E. Mendelsohn, Molecular Cardiology Research Institute
 Anna Menini, SISSA
 Peter L. Merrill, Micro Technologies
 Roger Milkman, Marine Biological Laboratory
 Ralph Mitchell, Harvard University
 Merle Mizell, Tulane University
 Gregg E. Moore, Center for Coastal Studies
 Mark S. Mooseker, Yale University
 Thomas Moth-Poulsen, Massachusetts Division of Marine Fisheries
- Ronald Nagel, Albert Einstein College of Medicine
 Toshio Narahashi, Northwestern University Medical School
 John E. Naugle, National Aeronautics & Space Administration
 Gary Nelson, Massachusetts Division of Marine Fisheries
 Owen Nichols, Center for Coastal Studies
 Tom Nies, New England Fishery Management Council
- Ronald Pethig, University of Wales
 Robert Prendergast, MBLWHOI Library
 Michael B. Rabinowitz, Harvard Medical School
 George Reynolds, Princeton University
 John W. Ripple, Syntnx
 Jooke Robbins, Center for Coastal Studies
 Lawrence Rome, University of Pennsylvania
 Herbert S. Rosenkranz, Florida Atlantic University
 Susan A. Rotenberg, Queens College
 Robert Rudin, Maria Mitchell Society
- Jay M. Schippers, The Housing Resource Foundation
 James O. Schwartz, MBLWHOI Library
 Sheldon Segal, MBLWHOI Library
 Angie L. Senese, Bowdoin College
 Frank C. Shephard, Eppler Lung Research Foundation
 Osamu Shimomura, MBLWHOI Library
 Vivian Siegel, Public Library of Science
 Kathleen Siwicki, Swarthmore College
 Joel Sohn, Pacific Grove, CA
 Stephen Spotte, Mote Marine Lab
 Lori Steele, New England Fishery Management Council
 Frank Striggow, KeyNeurotek
 Ann Stuart, University of North Carolina
 Gerald J. Sullivan, Savio Prep High School
 Eric Sundquist, United States Geological Survey
 Frederick Sweet, Washington University School of Medicine
- Jay Tashiro, Wolfsong Informatics
 Richard R. Taylor, MBLWHOI Library
 Lewis G. Tilney, University of Pennsylvania
 Mark L. Tykocinski, University of Pennsylvania
 Michael Tytell, Wake Forest University School of Medicine
- Deirdre Valentine, New England Fishery Management Council
 Kensal E. Van Holde, Oregon State University
- Alan A. Walton, Cavendish Lab
 Christopher Ward, University of Maryland Baltimore
 Leonard Warren, University of Pennsylvania Medical School
 Nathaniel J. Weiss, MBLWHOI Library
 Gerald Weissmann, New York University School of Medicine
 Jay A. Winsten, Harvard School of Public Health
 Peter Woodhead, Marine Sciences Research Center
 George Woodwell, Woods Hole Research Center
 Lucille Wurtz, MBLWHOI Library
- George J. Yevick, Stevens Institute of Technology

FINANCIALS

REPORT OF THE TREASURER

I am pleased to share with you financial highlights from the year 2004. Once again, the MBL's net assets grew, thanks to continued strong investment returns and judicious "growth by substitution" on the expense side. Although revenues were largely flat in 2004 compared to the previous year, the MBL moved forward with its efforts to implement many of the initiatives recommended by the Strategic Plan.

Balance Sheets

I am especially delighted to report that, for the first time in history, the MBL's total assets exceeded \$100 million. The value of the laboratory's property and equipment increased more than \$4.2 million, a reflection of the improvements we have made to the infrastructure of our campus. Our endowment and similar investments also grew \$3.3 million, thanks to a 12.6% return on the MBL's long-term portfolio. Cash and short-term investments increased as well by more than \$2 million. Although our liabilities increased in 2004, it was largely the result of the purchase of a major piece of equipment, a state-of-the-art confocal microscope of great research value to Whitman Center investigators and other members of the Woods Hole scientific community.

The MBL's total net assets, essentially the equity of the laboratory, increased approximately \$2.8 million. Unrestricted net assets grew for the first time since 2000, and our permanently restricted net assets, the MBL's endowment, grew by more than \$1 million.



Operating History

Support for operations, which includes government grants, private contracts, rental and tuition fees, fell slightly in 2004 because of a number of factors. Although the MBL was awarded a record number of new federal research awards in 2004 totaling \$28.7 million, actual spending on research (from which we draw overhead) showed only marginal growth of 2.6%, the lowest level in a decade. With the exception of a down-turn in tuition, other sources of support grew a modest 2.2% in 2004.

Operating expenses were controlled effectively in 2004, increasing only 2.9% over the previous year. Only subcontracts, utilities, and equipment expenses increased, the latter being the result of the purchase and expensing of four major research instruments totaling \$1.3 million. It is noteworthy that all other expense categories actually declined in 2004, largely due to "belt-tightening" measures implemented by management. In spite of these efforts, the MBL experienced a \$910 thousand (2.5%) decline in net assets before non-operating activity in 2004.

Non-Operating Activities

On a positive note, non-operating activities were strong, assisted by robust investment earnings of \$5.7 million, which more than covered the \$2 million drawn from these earnings to support operations. This helped the laboratory experience a bottom line increase of approximately \$2.8 million in net assets.

In terms of performance benchmarks, the MBL's return on average net assets was an acceptable 3.6% in 2004, and the laboratory's long-term debt to unrestricted and temporarily restricted net assets was a favorable 30%. These numbers show that the MBL accumulated more wealth in 2004 and has leveraged its financial strength at a reasonable level.

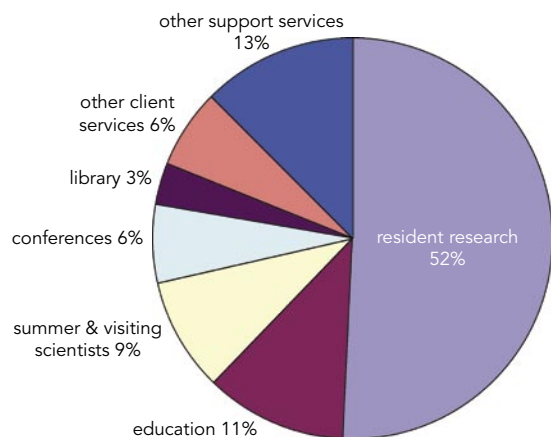
Conclusion

The MBL continues to work towards overcoming operating losses and building revenues to be able to fund depreciation accrual. Management continues to seek ways to enhance revenues and build research programs while implementing cost-saving measures whenever prudent. We expect that such measures will ensure the healthy growth of this institution and the successful implementation of the Strategic Plan.

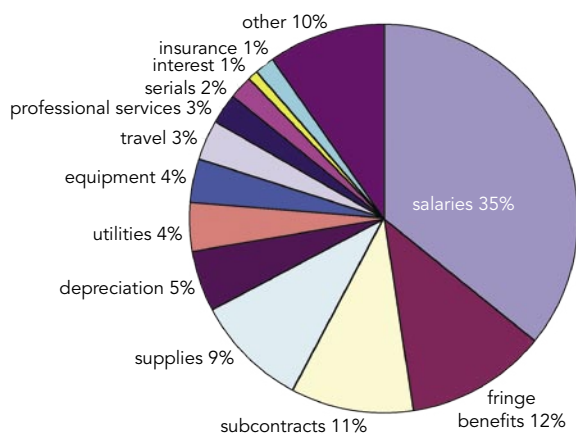
— Mary B. Conrad

FINANCIAL STATEMENTS

SOURCES OF \$35.8 MILLION IN OPERATING SUPPORT



USES OF \$36.7 MILLION IN EXPENSES



The financial statements of the Marine Biological Laboratory for the fiscal year ending December 31, 2004, were audited by KPMG.

Complete financial statements are available upon request from:

Homer Lane
Chief Financial Officer
Marine Biological Laboratory
7 MBL Street
Woods Hole, MA 02543

The Operating and Balance Sheet numbers shown here are unaudited.

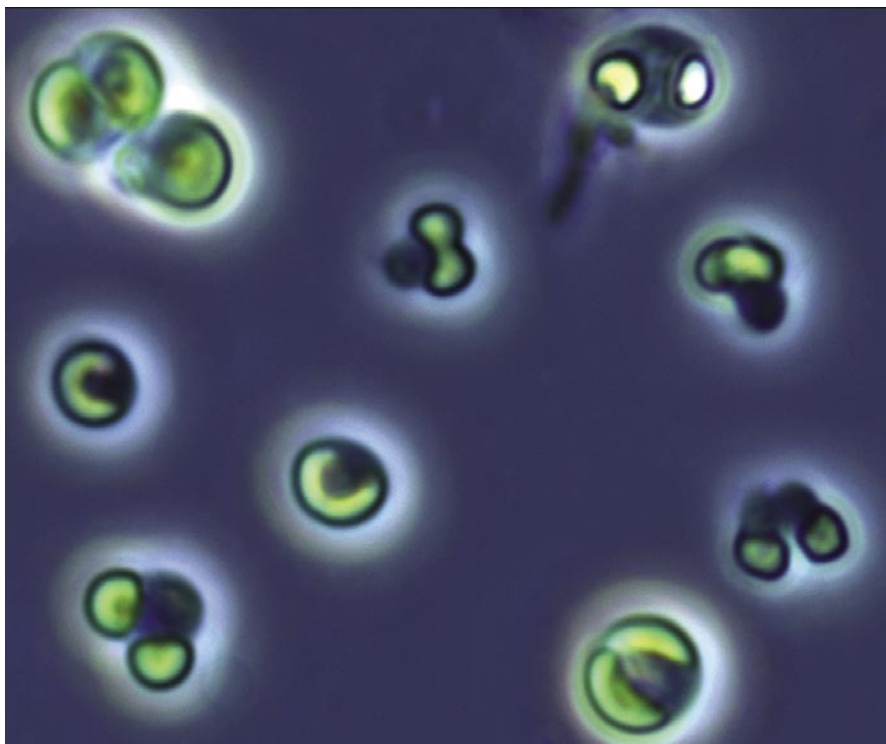
Operating History and Balance Sheet
as of December 31, 2004 and 2003

BALANCE SHEET (In Thousands)	2004	2003
ASSETS:		
Cash and Short-Term Investments	\$3,345	\$1,330
Pledges and Other Receivables	9,381	10,868
Assets held by bond trustee	6	3,536
Other Assets	704	778
Endowment and Similar Investments	50,957	47,627
Property and Equipment, net	36,902	32,671
Total Assets:	101,295	96,810
LIABILITIES:		
Accounts Payable	4,183	2,532
Annuities and Unitrusts Payable	592	470
Deferred Revenue and Other Liabilities	3,178	3,242
Long-Term Debt	15,200	15,200
Total Liabilities:	23,153	21,444
NET ASSETS:		
Unrestricted	19,628	19,184
Temporarily Restricted	31,171	29,901
Permanently Restricted	27,343	26,281
Total Net Assets:	78,142	75,366
TOTAL LIABILITIES AND NET ASSETS	\$101,295	\$96,810

OPERATING HISTORY (In Thousands)

OPERATING SUPPORT:		
Government Grants	\$17,629	\$17,190
Private Contracts	1,265	1,503
Laboratory rental and Net Tuition	2,238	2,260
Fees for Conferences and Services	5,225	5,126
Contributions	6,897	7,357
Investment and Other Revenue	2,526	2,395
Total Operating Support:	35,780	35,831
EXPENSES:		
Research	24,510	23,750
Instruction	6,496	6,245
Conferences and services	2,129	2,126
Other programs	3,555	3,525
Total Expenses:	36,690	35,646
CHANGES IN NET ASSETS BEFORE NON-OPERATING ACTIVITY:	(910)	185
Non-Operating Activities:		
Contributions to Plant and Other Expenses, net	(31)	(758)
Total Investment Income and Earnings	5,716	6,201
Less Investment Earnings Used for Operations	(1,999)	(1,974)
Reinvested Investment Earnings	3,717	4,227
TOTAL CHANGE IN NET ASSETS:	\$2,776	\$3,654

GIFTS



REPORT OF THE DEVELOPMENT COMMITTEE

The MBL's recent strategic planning initiative calls for ensuring that the laboratory continues to have a disproportionate impact on the advancement of biological sciences by building upon the strengths of its three core programs: a world-renowned education program; highly regarded resident research programs in the biological, biomedical, and environmental sciences; and an unparalleled summer and visiting science program.

To implement the plan fully, it is clear that the laboratory must take aggressive steps towards acquiring resources and endowment funds to enhance and expand these core programs and provide sustainable support for institutional priorities in perpetuity.

We have already begun taking steps towards meeting these goals and are pleased to acknowledge an ever-broadening community of donors to the laboratory this year. Under the leadership of new annual giving chair Tom Pollard, the Annual Fund had a strong year in 2004 with a record \$664,784 raised from 880 donors, an 8.8% increase over 2003. A record number of donors also joined the Director's

Circle by making gifts of \$10,000 or more. In addition, one-third of our annual donors in 2004 were alumni, a figure that has grown steadily over the past few years as a result of enhanced outreach efforts.

Special gifts contributed significantly to the MBL's education endowment. Seventy-eight new individual donors made gifts to named endowed funds in honor of fellow scientists, educators, friends, and mentors. These funds support such events as lectureships and symposia, which complement other programs at the MBL. Also in 2004, the laboratory instituted a "legacy" program intended to acquire critically important and highly valued unrestricted endowment funds that provide flexible support to meet the MBL's needs. An unrestricted gift reflects a trust in the institution and the administration's discretion to direct funds where they are most needed and will have the greatest impact. The New Century Society, the MBL's planned giving program, also continued to grow, proving an attractive giving option for ten donors who expressed their bequest intentions during the year.



Also in 2004, the MBL launched a \$20 million fundraising drive in support of the renovation of the Whitman building. The Whitman project is a cornerstone of the strategic plan and is crucial to the continued success of the MBL's renowned summer and visiting science program. As of winter 2005, the MBL has raised \$3,800,000 in gifts and pledges towards this goal. The initial fundraising efforts for this project were further energized by a \$500,000 challenge grant from the G. Unger Vetlesen Foundation.

The laboratory's research and education programs also benefited from the generosity of corporate and foundation support. The Dart Neuroscience Limited Partnership awarded a \$1,000,000 grant to support a summer research fellowship program focused on learning and memory. In addition, grants from The Ellison Medical Foundation and The Grass Foundation provided more than \$1,000,000 combined in support of the MBL's celebrated summer courses.

We are also pleased to report that the MBL's development team is again fully staffed. Wendy King joined the staff in April as director of foundation relations.

On behalf of the Board of Trustees, and especially the scientists and the students who were afforded the unique opportunity to pursue curiosity-driven research and unprecedented peer-to-peer collaborations at the MBL, we extend our sincerest appreciation to those whose names appear on the following pages, and also to those who requested anonymity. Your investment in the laboratory directly contributes to the advancement of biological, biomedical, and environmental science and helps fuel new discoveries leading to a healthier world.

— M Howard Jacobson
and William I. Huyett
Co-chairs



MAJOR GIFTS

We gratefully acknowledge the important support provided by the following foundations and individuals for our research and education programs.



Highlights

The Dart Neuroscience Limited Partnership awarded a grant of \$1,000,000 in support of the Dart Scholars summer research program in learning and memory for the years 2004 through 2008.

Alfred P. Sloan Foundation awarded a grant of \$900,000 to Mitchell Sogin and the Josephine Bay Paul Center to support the organization and commencement of the International Census of Marine Microbes, a component of the Census of Marine Life.

The G. Unger Vetlesen Foundation made a challenge grant of \$500,000 for the renovation of the Whitman building. This grant is a capacity building grant and contingent on successfully raising 30% of the \$20 million to complete the project. The Foundation also renewed its grant of \$350,000 in support of the Josephine Bay Paul Center for Comparative Molecular Biology and Evolution; for the program to develop marine models for biomedical research in the MRC; and, to support veterinary services at the MBL.

The Ellison Medical Foundation awarded \$739,453 for the continued support of the Molecular Biology of Aging course from 2005 through 2007. They also contributed additional support in the amount of \$89,542 for the Biology of Parasitism course, the Molecular Biology of Aging course, and the Global Infectious Diseases Colloquium.

Allen Whitehill Clowes Charitable Foundation, Inc. awarded \$819,702 to support the renovation of real estate bequeathed to the MBL by Allen Clowes.

The Estate of Octavia C. Clement bequeathed \$300,000 to the MBL General Endowment in memory of Octavia C. and Anthony C. Clement.

The Grass Foundation awarded two grants totaling \$255,000. A grant of \$135,000 will support the Neural Systems and Behavior course for the years 2005 through 2007. A grant of \$120,000 will support the Neurobiology course for the years 2005 through 2007. The Foundation also contributed \$10,000 for the purchase of a Leica vibratome for the Grass Laboratory.

The Gruss Lipper Family Foundation renewed funding in the amount of \$226,953 for the Gruss Lipper Research and Educational Fund for support of Israeli scientists over a period of three years.

The Andrew W. Mellon Foundation awarded \$166,000 to support the MBLWHOI Library uBio Project, specifically the development of NameBank, which promises to be an outstanding resource to scientists, libraries, and other information centers.

Mr. William Golden made a challenge grant in the amount of \$200,000 in support of endowing the Science Journalism Program. This grant is contingent on the MBL successfully raising \$2,000,000 for this endowment.

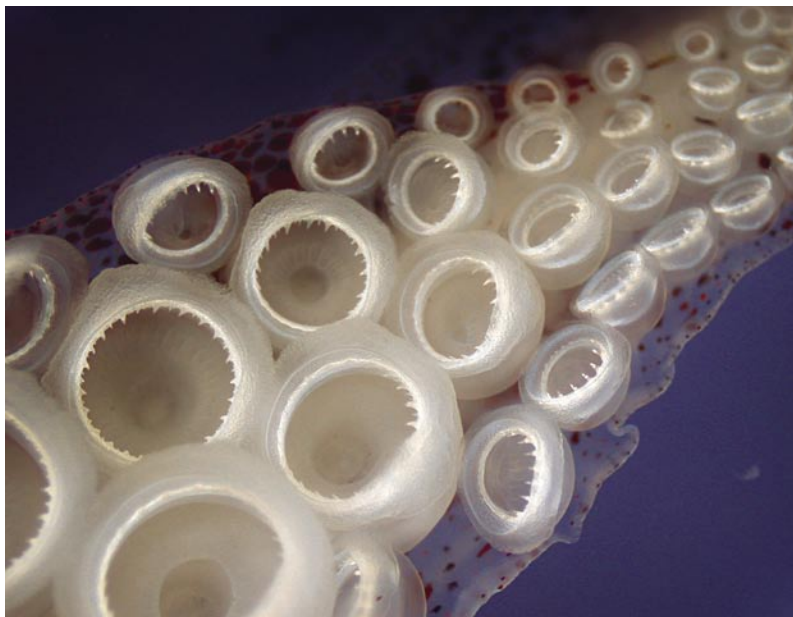
The Foundation for Research in Cell Biology and Cancer made a commitment of \$100,000 in support of the Whitman building renovation. The foundation also contributed \$20,000 to the MBL Annual Fund.

Mrs. Freda Kaminer contributed \$100,000 to support the Benjamin Kaminer Endowed Scholarship in Physiology. An additional \$1,850 was contributed to the Annual Fund and the Associates Program.

The Estate of Edward F. MacNichol, Jr. bequeathed \$100,000 to support the H. Keffer Hartline and Edward F. MacNichol Fellowship for Research.

The Keith R. Porter Endowment for Cell Biology awarded \$100,000 to endow the Keith Porter Lecture Fund for lectures to be given in conjunction with the MBL Friday Evening Lecture series.

Arthur Ross Foundation made a challenge grant in the amount of \$100,000 in support of endowing the Science Journalism Program. This grant is contingent on the MBL successfully raising \$2,000,000 for this endowment.



Gifts \$10,000 to \$99,999

Allen Foundation, Inc.
 American Society for Reproductive Medicine
 Dr. Porter W. Anderson, Jr.
 Anderson-Rogers Foundation, Inc.
 Dr. and Mrs. Francis P. Bowles
 Dr. Lawrence B. Cohen
 Friendship Fund
 Global Biodiversity Information Facility
 Green Family Fund
 John E. Fetzer Institute, Inc.
 The Hyde & Watson Foundation
 International Brain Research Organization
 Drs. Raymond Keller and Ann Sutherland
 Dr. Richard G. Kessel
 The Kohlberg Foundation, Inc.
 Massachusetts Environmental Trust
 Merck Research Laboratories
 Gordon and Betty Moore Foundation
 Nikon Instruments Inc.
 Optical Imaging Association
 William Townsend Porter Foundation
 Mr. Marius A. Robinson
 Sholley Foundation, Inc.
 Drs. Albert Stunkard and Margaret Maurin
 The Foundation for Sustainability and Innovation
 Waksman Foundation for Microbiology
 Dr. J. Richard Whittaker
 World Precision Instruments

Gifts up to \$9,999

Anonymous
 American Jewish World Service, Inc.
 Ms. Susan M. Barnes
 Dr. Sangeeta Bhargava
 Dr. and Mrs. Thomas A. Borgese
 Dr. Nadiya V. Boyko
 Dr. and Mrs. Frank M. Child
 Dr. Kai-Ping Chow
 The Company of Biologists Limited
 Mrs. Neal Cornell
 Drs. Susan and Nessly Craig
 Mrs. Sally Cross
 Drs. Christopher Cuff and Rosana Schafer
 Mr. and Mrs. David Dearborn
 Ms. Suzanne Donovan
 Dr. Richard E. Ecker
 Dr. Michael A. Edidin
 Dr. Toby Eisenstein
 Drs. Lyman and Rebecca Emmons
 Endeavour Foundation
 ExxonMobil Foundation, Inc.
 Dr. Marcus Fechheimer and Ms. Ruth Furukawa
 Ms. Elizabeth J. Forrer
 Ms. Edith Frankel
 Dr. Harold E. Froehlich
 Dr. Patricia Gearhart
 Drs. Bryan and Paula Gebhardt
 Estate of Donald R. Griffin
 Dr. and Mrs. John F. Halsey
 Mr. and Mrs. Buzz Harvey
 Ms. Kelly R. Holzworth
 Dr. Ru-Chih C. Huang
 Mrs. Carmela J. Huettner
 Dr. Julia Lea Hurwitz
 Dr. Henri Jaquet
 Dr. Hanqing Jiang
 Dr. Patricia P. Jones
 Mrs. Freda Kaminer
 Dr. Peter Koo
 Dr. Debra Kotloff
 Drs. Andrew Kropinski and Peggy Pritchard
 Dr. Natasha Kushnir
 Dr. Ming-Zong Lai
 Dr. Hans Laufer
 Dr. and Mrs. Stephen B. Leighton
 Dr. Sammy Liu
 Drs. Steven and Lucille London
 Dr. Zana L. Lummus
 Dr. Manu M. Manohar
 Microbia
 Nashua Christian Academy
 National Academy of Sciences
 Northeast Fisheries Science Center
 Novartis
 Dr. Jose A. O'Daley
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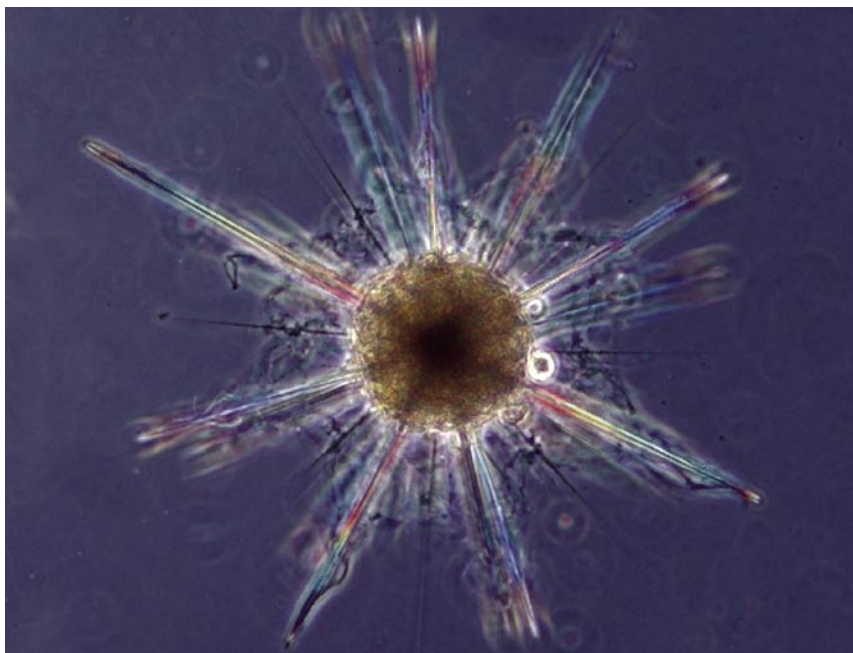
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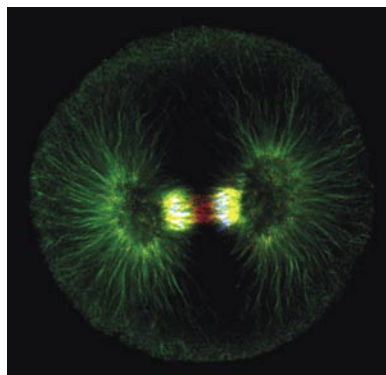
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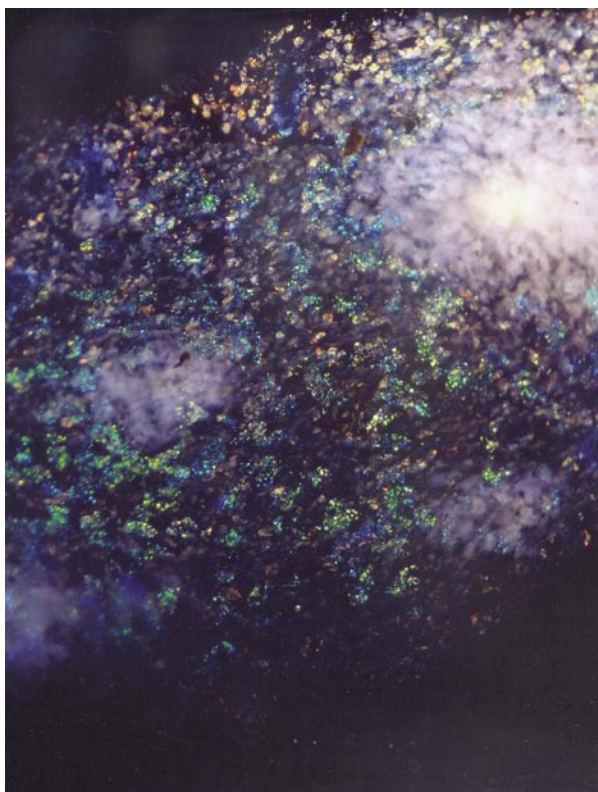
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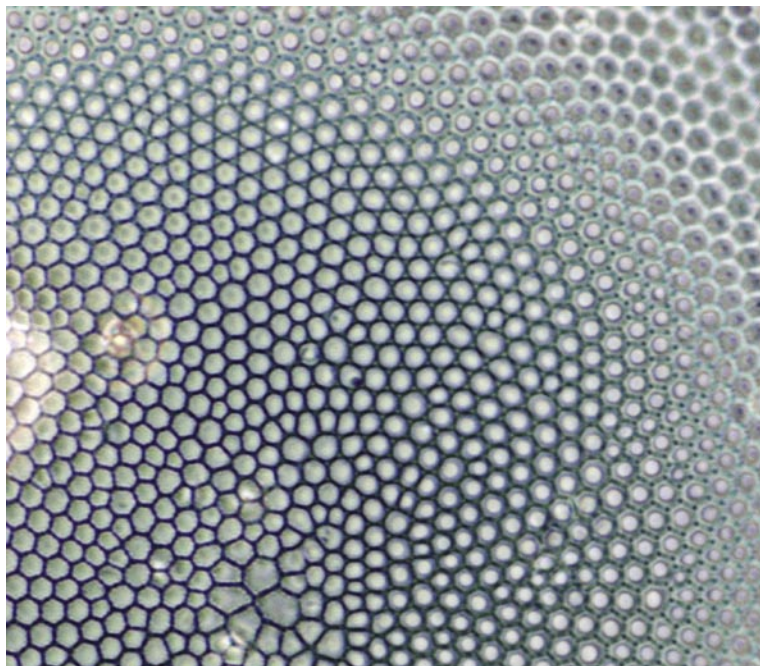
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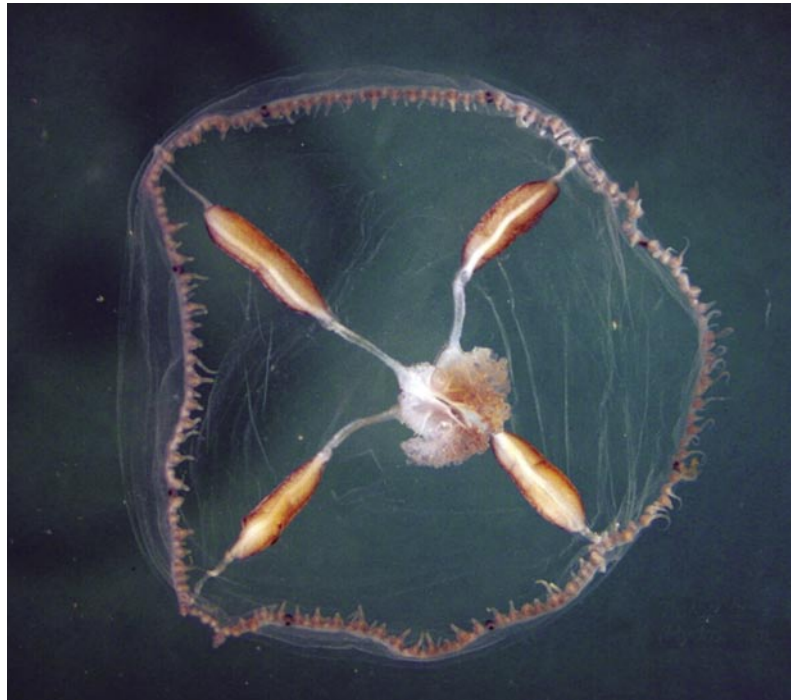
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THE SCIENCE OF MEMORY

Dr. David Glanzman, University of California, Los Angeles,
moderator

"From Genes To Drugs For Cognitive Dysfunction"
Dr. Tim Tully, Cold Spring Harbor Laboratory

"Memory Formation: An Interplay of Genes and Environment"
Dr. John David Sweatt, Baylor College of Medicine

*"The Neurobiology of Vocal Learning: What Songbirds
Can Tell Us About Human Speech"*
Dr. Richard D. Mooney, Duke University Medical Center

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