

This Wormy World

It was 1947. World War II had just ended, and United States soldiers were coming home from engagements in the South Pacific, only to find that they had brought home unexpected passengers: parasitic worms—lots of them. The plight of these soldiers helped bring to American consciousness the debilitating effects of infection by worms. That same year an American parasitologist named Norman Stoll wrote a paper that has become a landmark in the field. Titled *This Wormy World*, the paper was the first systematic attempt to measure the worldwide impact of parasitism by worms, also called helminths. Even as recently as 1947, people in the United States were not exempt from infection by worms. At that time, Stoll estimated that, for example, one in six Americans was infected by *Trichinella spiralis*, the parasitic worm most associated with undercooked pork.

Since then, public health campaigns have vastly reduced the infection rates by worms in developed countries, such as the United States, Japan, and those in Western Europe. However, in many countries of the world parasitic worms continue to pose serious risks to human health, and threaten childhood development. Since 1947, infectious diseases such as malaria have been nearly eradicated

in some areas due to the development of drugs and public awareness campaigns, only to see a resurgence and spread into some new areas, as the malaria parasite developed resistance.

Yet little has changed in the overall impact of parasitic worms on human health.

Part of the reason for this lack of change, says Daniel Colley, Ph.D., director of the Division of Parasitic Diseases at the U.S. Centers for Disease Control and Prevention (CDC), is that parasitic worms have been difficult to manipulate in a laboratory setting. Many have complex life cycles that involve multiple stages and use living animals as hosts. In addition, many of the effects of helminthic infections are chronic and debilitating, rather than acute or directly life threatening. Another factor has been the higher funding priority given to other important infectious diseases such as HIV/AIDS, tuberculosis, and malaria, and the higher

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People laundering their clothes on the banks of an irrigation canal; typical transmission site for schistosomiasis in Egypt.

Photo courtesy of WHO/TDR

The Focus of this Issue...

The Burroughs Wellcome Fund is committed to supporting underfunded areas of science, such as work in parasitic worms. In this issue of *Focus*, we:

- Introduce you to one of our awardees who is working on the blood fluke *Schistosoma mansoni*. p. 4
- Report on a January 2001 Keystone meeting of helminth researchers that was sponsored by BWF. p. 3
- Announce awards for the joint Wellcome Trust-Burroughs Wellcome Fund Infectious Diseases Initiative, which includes three new awards for research on worms. p. 1

Studies of Parasitic Worms Targeted in Joint Funding Program

The Wellcome Trust-Burroughs Wellcome Fund Infectious Diseases Initiative has made six awards to global collaborative research projects in tropical infectious diseases. Awardees will share approximately \$6 million for projects expected to take four to five years to complete. Launched in 1998, the Initiative was established to support trilateral international collaborations between researchers in the United States, the United Kingdom, and developing countries, with the 'center of gravity' of research in the developing world.

In the 2000 round of funding, 51 proposals covering more than 32 topics were received from 26 locations in the developing world. The six awards will support research in countries throughout Africa, India, and South America. Three of the six funded

projects propose to study human parasitic worms, a fourth will target drug-resistant tuberculosis, and the others will study the role of infectious agents in common intestinal and diarrheal diseases in children.

Assessment of the proposals included several criteria: the genuine nature of the collaborative efforts to place the 'center of gravity' of the scientific activities firmly in the developing world, the added value of the collaboration between investigators in the developed and developing world, the public health significance of the subject matter, the scientific merit of the research proposal, and the research training opportunities for young scientists, especially in the developing countries.

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fundability of proposals in such areas, due to the experimental systems that can now be applied. With the possible applications of genomics, cell culture, and other sophisticated molecular techniques, Dr. Colley says it is time to take another serious look at methods to study and control helminthic disease.

"I think there is a parallel between worm research now and where tuberculosis research was 15 years ago," Dr. Colley says. "*Mycobacterium tuberculosis* (the organism that causes tuberculosis) is slow to grow and hard to manipulate. Very few people worked on it. Then about 10 to 12 years ago multi-drug resistant tuberculosis started showing up. In response, the National Institutes of Health created an 'affirmative action' program for tuberculosis to induce people to tackle these thorny problems. It worked. People came up with tools to experimentally manipulate *M. tuberculosis* in the laboratory and work has really taken off. From my perspective, the world of worms is now in need of this approach."

Fortunately, many helminthic infections can now be controlled through mass drug treatment campaigns. However, most of these programs have only a single drug

available to them, and the lessons of the past should warn us of the potential dangers ahead when we depend on single interventions in mass programs, Dr. Colley says. In the veterinary world, drug resistance by parasitic worms is already a major problem.

"We should be pushing ahead on the basic science now, while effective drugs are still

available," says Dr. Colley, a member of BWF's infectious diseases advisory committee. "We are sitting on a slowly ticking time bomb, but if we put in an effort at this point to develop the necessary fundamental biology and train the investigators, we can develop new drugs and find vaccines, so we may still be able to defuse it."

Estimates of Global Morbidity and Mortality Due to Major Human Helminth Infections

	Number of infections (in millions)	Morbidity/ illness (in millions)	Mortality/ death (annual)
Ascariasis (intestinal roundworm)	1,472	335	60,000
Hookworm	1,298	159	65,000
Lymphatic filariasis (elephantiasis)	120	44	(not reported)
Onchocerciasis (river blindness)	18	0.27	45,000
Schistosomiasis (blood fluke)	200	20	20,000
Trichuriasis (whipworm)	1,049	220	10,000
TOTAL	4,157	778	200,000

Source: Crompton, D. W. T. 1999. How much human helminthiasis is there in the world? *J. Parasitol.* 85(3): 397-403.

Joint Funding (Continued from page 1)

Awards were made to the following institutions, represented here by the researcher who submitted the grant.

Jerrold Ellner, M.D.

Department of Infectious Diseases, University of Medicine and Dentistry of New Jersey, and colleagues at the London School of Hygiene and Tropical Medicine and Makerere University Medical School, Kampala, Uganda, for work in Uganda. Strategies for the management of multi-drug resistant tuberculosis in Kampala, Uganda.

Mary K. Estes, Ph.D.

Department of Molecular Virology, Baylor College of Medicine, and colleagues at the London School of Hygiene and Tropical Medicine and Christian Medical College and Hospital, Vellore, India, for work in India. Correlates of protection against rotaviral gastroenteritis in children in Vellore, India.

Robert H. Gilman, M.D.

Department of International Health, John Hopkins University School of Hygiene and Public Health, and colleagues at the University of Salford, Manchester, U.K., and the Universidad de San Marcos, Lima, Peru, for work in Peru. New insights in the epidemiology and control of *Taenia solium* taeniasis/cysticercosis.

B. Siddartha Ramakrishna, M.D., Ph.D.

Department of Gastroenterology, Christian Medical College and Hospital, Vellore, India, and colleagues at Yale University and the University of Glasgow, for work in India.

Comprehensive studies of a new improved oral rehydration solution for diarrheal disease: Physiological and molecular studies, clinical trials, and acceptability and efficacy studies in a rural south Indian community.

Mathuram Santosham

Department of International Health, John Hopkins University School of Hygiene and Public Health, and colleagues at Oxford University and the International Center for Diarrheal Diseases Research-Bangladesh, for work in Bangladesh.

Etiology, prevention, and treatment of neonatal infections in the community.

Rebecca J Stoltzfus, Ph.D.

Department of International Health, Johns Hopkins University School of Hygiene and Public Health, and colleagues at the London School of Hygiene and Tropical Medicine and Pemba Public Health Laboratory, Zanzibar, for work in rural Tanzania.

Effects of intestinal helminth infections in early childhood on immune response, inflammation, anemia, and malnutrition.

Scientists Seek Research Agenda for Parasitic Worms

In an effort to support researchers who study parasitic worms (helminths), BWF sponsored a workshop, "Molecular Helminthology: An Integrated Approach," at a January 2001 Keystone Symposium in Taos, New Mexico.

The workshop focused on five questions:

- How big a problem is drug resistance in the medically important helminths?
- What are the biological endpoints for measuring drug resistance?
- How can medical helminthologists capitalize on model systems work?
- How applicable are current model systems, and what others are needed?
- Understanding vs. tools: what is the capability and where is the balance?

Following is a summary of the discussion held at that meeting, as reported by BWF infectious diseases program officer, Victoria McGovern, Ph.D.

Scientists who attended the meeting agreed that drug resistance problems are on the horizon in a number of important human helminth diseases, including onchocerciasis (river blindness), lymphatic filariasis, and schistosomiasis. Drug resistance is already a major problem in dealing with many helminth parasites of livestock. However, it is difficult to identify and quantitate low levels of drug resistance in the field. Often, by the time drug resistance is identified, the prevalence of resistance has already escalated to high levels, making available drugs less and less useful. Relatively few drugs are available to combat parasitic worms, and fewer still are currently in the drug development pipeline.

Sequencing of the *Caenorhabditis elegans* genome has provided an important resource for studying worm biology. However, *C. elegans* is a free-living worm, quite different in its life style from parasitic worms. The *C. elegans* genome may thus be of limited use in understanding the biology of disease-causing parasitic worms. Attracting researchers trained in *C. elegans* to work on human and veterinary pathogens will be an important step in bringing insights from *C. elegans* genetics, genomics, and biochemistry to the relatively under-studied disease-causing worms.

The human pathogen helminths can be difficult to study, in many cases because the worm's normal life cycle can not be reproduced in a laboratory setting. For this reason, development of alternative worm models for human diseases is important. Some animal pathogens, as well as plant pathogens, may be easier to study in the laboratory. However, it is difficult to obtain funding for work to systematically establish new model systems, or to improve current models. Since worms are multicellular organisms, development of cell culture, cultivating layers of single cells rather than the more complex whole parasites, may be a way forward.

Necessary steps toward a better understanding of helminth pathogens mentioned at the meeting include: improvement of genetic tools for the parasitic helminths; development of new gene expression systems to produce parasite proteins in organisms that are easier to handle in the laboratory; and innovative new basic biological, pharmacological, and chemotherapeutic approaches.

Finally, it was suggested that the public health response to helminth parasites should move forward, but that it must be accompanied by stronger research efforts. The current and proposed global elimination and control programs against helminthic infections rely on mass drug treatment programs, often with the only applicable drug available. Such large-scale distribution systems, driven by public health needs of countries immediately affected by these diseases, clearly helps people in need, but at the same time puts tremendous drug pressure on the parasites to adapt by developing resistance.

The group concluded that more effective public health surveillance to define the scope and magnitude of emerging drug resistance would make efforts to control drug resistance more fruitful. Using the limited number of existing drugs prudently, and on the research side, developing the means to monitor the development of drug resistance, and new drugs against the parasites, are critical to lessening the global impact of diseases caused by worms.

Web Resources

For more information on parasitic worms, their biology, and their effects on human health:

- The Special Program for Research and Training in Tropical Diseases (TDR), a collaborative group co-sponsored by the United Nations Development Program (UNDP), the World Bank, and the World Health Organization (WHO), maintains an extensive Web site of information about neglected infectious diseases that disproportionately affect the poor, particularly in underdeveloped countries. Visit them at www.who.int/tdr/about/mission.htm
- General information about prevention of parasitic diseases may be found at the U.S. Centers for Disease Control and Prevention at www.cdc.gov/ncidod/dpd/default.htm
- The College of Biological Sciences at Ohio State University maintains a Web site dedicated to parasites and parasitology that contains images of more than 180 species of parasites, as well as information about the biology of many parasitic species. Visit them at www.biosci.ohio-state.edu/~parasite/home.html
- The Schistosomiasis Research Group at the University of Cambridge maintains a Web site that covers research done by that group, but also general information on all aspects of schistosomiasis as a tropical parasitic disease. Visit them at www.path.cam.ac.uk/~tjs16/home-page.html
- To learn more about the research of BWF awardee Dr. Edward Pearce, profiled on pp. 4-5, visit his Web site: web.vet.cornell.edu/public/microbiology/pearce%20new.htm

Profile: Dr. Edward Pearce

No one likes to think about parasitic worms living inside them, draining away nutrients and wreaking havoc with tissues and organs, but in many parts of the tropical world, living with parasitic worms, also called helminthes, is a fact of life. Infections by helminthes rank second only to malaria in terms of negative health effects of parasitism. One in four people world wide, many of them children, are estimated to be infected.

Worms are particularly clever parasites in that they have developed ingenious ways of hiding from the human immune system, allowing them to escape an all out assault that could eliminate them from the body. But how do they do it?

Edward Pearce, Ph.D., a BWF scholar in molecular parasitology and associate professor of parasitology at Cornell University College of Veterinary Medicine, is studying how a particular parasitic worm called *Schistosoma mansoni* is able to set up residence in the veins leading from the intestine to the liver, living there for five to 10 years and sometimes longer. Long-term exposure to the parasite can cause serious liver, intestinal, and bladder damage. In children, infection stunts growth, and some studies have shown damage to learning ability.

Ever since he was a college student, Dr. Pearce has been fascinated with the effectiveness of the worms' strategy and their ability to evade the human immune system.

"Just think," he says, "what it would mean to transplantation if we could understand how whole, living animals like these worms manage to live inside us for so long." Currently, the field of organ transplantation is severely limited by immune system's reaction and even eventual rejection of "foreign" organs implanted into people to replace failing ones. Only daily regimens immune-suppressing drugs stop transplant patients from rejecting their new organs. Parasitic worms have a lot to teach us about evading the immune system.

And by understanding how worms thwart the immune system, says Dr. Pearce, we

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Questions for Edward J. Pearce, Ph.D.



BWF award: 2000 Scholar in Molecular Parasitology; 1994 New Investigator in Molecular Parasitology

Academic title: associate professor of parasitology, Department of Microbiology and Immunology

Affiliation: Cornell University College of Veterinary Medicine

How did you first discover you wanted to be a scientist?

I never remember *not* wanting to be a biologist of some sort or another.

Why did you choose to enter your particular field of study?

My parasitology professor at the University of Wales Aberystwyth, John Barrett, made the whole story of how parasites are able to avoid the immune response and survive in their hosts so intriguing that I became hooked. It was a choice of trying to work on African trypanosomes or schistosomes and I had an opportunity to do the latter.

What has your BWF grant meant for your research?

The chance to invest more resources into the issue of how schistosomes receive environmental cues; it has not been easy to obtain funds for this area of research.

What is the best thing about your job?

The intellectual challenge, the opportunity to work with some very smart people, and the freedom to more or less set my own timetable.

What is your philosophy with respect to your research?

Don't do "me too" research. In other words, don't get trapped into doing mundane research. Maintain originality in what you do.

What kind of advice would you give a scientist just entering academic research?

Focus on the question, do your experiments as carefully as you can with a view to making as few errors as possible, and publish. Collaborations can be great, but remember to keep adding to the list of publications on which you are first or last author. If you don't get your grant first time, keep trying. When you get your own laboratory, make sure you spend as much time as possible in there rather than in your office.

What area of science needs new researchers?

There is a very real need for more scientists to study helminths. There are very few young scientists choosing to stay in this field.

If you had unlimited resources, what one big scientific question would you pursue?

Probably the same ones that I am pursuing now.

What do you do for fun?

Watch films, watch wildlife, read and travel.

What do you plan to do when you retire?

As little as possible.

What is your favorite book?

One of them is: "The Spy Who Came in From the Cold," by John LeCarre.

Dr. Pearce (Continued from page 5)

can begin to think about developing a vaccine to stop infection.

Scientists know that in an elaborate life cycle, worm eggs hatch in the water and seek out a specific fresh water snail, which serves as a type of incubator for the developing worm. When it's ready, the worm leaves the snail and enters the water, where it attaches to unsuspecting bathers, burrowing into the skin and entering the blood stream. Somehow, the tiny worms are able to travel throughout the body riding along in the bloodstream for two to three weeks, until they reach their destination: the veins leading from the intestine to the liver. Here they set up residence and begin mating and producing new eggs, which are swept through the intestines and deposited with feces to begin the cycle anew.

Dr. Pearce began about six years ago to study how the worms know when they have reached their destination. He reasoned that they must have some kind of signaling system that lets them know when they are in the right veins. He began looking for signaling receptors on the surface of the worm's body.

What he found was that the worms have a chemical receptor on their bodies that is in the same family as a human receptor called transforming growth factor-beta (TGFb) receptor 1. These receptors are used by cells throughout the body to regulate growth, proliferation of new cells, and development into specialized cell types. There are dozens of members in the TGFb family that bind to this type of receptor. Dr. Pearce is using his BWF Scholar Award to fully investigate his discovery. He isolated the receptor and cloned it so he could study it further. But he realized he needed to find out what human protein was the target for this receptor.

"We really needed to identify the human ligand to understand the consequences of this discovery," he said. Recently he and his colleagues identified at least one target as bona fide TGFb and showed the worm receptor can bind it and initiate a signaling process. "That may sound obvious," he said. "But there are many, many related proteins that it could have been. The challenge now is to establish the consequences to the parasite."



Photo courtesy of WHO/TDR

The Biomphalaria snail transmits *Schistosoma mansoni*.

Who gets worms?

Anyone can become infected with schistosomes when they swim or bathe in fresh water lakes and streams that contain the tiny parasitic worm. They are found in wide areas of 74 tropical countries in Africa, South America, and Asia. More than 200 million people are infected, many of whom are children. Anyone traveling to these areas is at risk of infection if they come in contact with infected water.

What are the symptoms of infection?

For travelers, the symptoms are nausea, fever, malaise, abdominal pain, and sometimes bloody stools. These symptoms of early infection are not common in people who live in endemic areas, who have gained some tolerance to initial infection by living in close contact with the parasites over many generations. Chronic infection can lead to life threatening complications associated with liver fibrosis. Definitive diagnosis requires finding eggs in the feces.

Can people be cured?

Effective drug treatments for schistosome infection exist. A drug called praziquantel can rid the body of the worms after a one- or two-day treatment. However, it is currently the only generally accepted treatment and resistance to the drug has been detected in some worms. New medicines and a vaccine are in various stages of research. In endemic areas, only major public health campaigns in places such as China have reduced long-term infection. In most areas, treatment is limited.

Dr. Pearce is beginning experiments using mice that don't make TGFb. He wants to find out if the worms will be able to localize and function properly without TGFb present. If not, he may have discovered a key element to the worms' localization strategy—using proteins within the human body to help guide themselves.

He acknowledges that working on these parasites is not easy and requires a lot of patience. For one thing, the parasites won't

grow in culture—they are dependent on their hosts for survival. And they take a long time to mature.

"There are a lot of important molecular tools—like knock-out mutants and gene expression mutants—that have not been developed for worms," he said. "Development of tools for work on these parasites is key to moving this field along."

Clinical Research Professional Groups Plan Unprecedented Joint Meeting

For the first time in their histories, three professional societies whose missions are to support clinical research will meet together to discuss pressing issues in the field and to showcase the very best in clinical research. The Association for Patient-Oriented Research (APOR), the American Federation for Medical Research (AFMR), and the General Clinical Research Center (GCRC) Directors Association will meet for Clinical Research 2001, March 8-11, 2001, in Arlington, Virginia.

The meeting will include four new elements specifically designed to enhance professional development of clinical research professionals: a joint scientific session, a session designed to encourage and assist trainees with career advice, a new clinical research trainees award for best abstract, and a session devoted to policy issues in clinical research.

"One of the cardinal advantages of such an event will be the opportunity to expose interested students, residents, and junior faculty members to the entire continuum of the clinical research community at a single place and time," said Richard Galbraith, M.D., Ph.D., director of the clinical research center at the University of Vermont College of Medicine and one of the meeting's organizers.

The stage was set for the meeting in April 2000, when the Burroughs Wellcome Fund, the Doris Duke Charitable Trust, the Robert Wood Johnson Foundation, and

the Damon Runyon Cancer Research Fund held a meeting with the presidents of the various professional groups that support clinical research to talk about challenges to the field. In addition to the groups named above, two other clinical research societies were represented: the American Society for Clinical Investigation and the Association of American Physicians.

"At that meeting, it became apparent that improving the climate for clinical research will require the united effort of all of the various players in the arena," says Nancy Sung, Ph.D., BWF program officer and one of the April meeting's organizers.

After several hours of fruitful discussion, three of the groups shared their plan to organize a joint meeting for clinical research professionals and put forth an agenda to reinvigorate academic clinical research on a national level. The four private foundations have since been joined by a fifth (the Juvenile Diabetes Research Foundation), and have jointly provided support for Clinical Research 2001.

This loosely federated group, whose members include presidents of the five clinical research societies and representatives of the five foundations, calls itself the Clinical Research Alliance. The group recognizes that reversing the downtrend in physician-scientists entering careers in patient-oriented research will require more than just a big meeting. Under discussion are items such as a career development Web site for clinical

researchers, additional support for mentors and trainees, and further integration of the activities of the societies dedicated to clinical research to maximize their impact.

For more information about Clinical Research 2001, see www.mpi-evv.com/CR2001/Clinical_Research_2001.htm

To learn more about the Clinical Research Alliance contact: Nancy Sung, Ph.D., nsung@bwfund.org

New Board Members

Burroughs Wellcome Fund welcomes two members to its board of directors:

Peter Doherty, Ph.D., F.R.S., chairman, Department of Immunology, St. Jude Children's Research Hospital and **Philip R. Tracy**, former president and chief executive officer, Burroughs Wellcome Co.

Dr. Doherty received his undergraduate degree in veterinary science from the University of Queensland, Australia, and his Ph.D. in pathology from the University of Edinburgh, Scotland. He is a Nobel laureate in physiology or medicine (1996), a foreign associate of the National Academy of Sciences, and a fellow of the Royal Society of London. He has won numerous honors for his research on the human T cell response to infection, viral immunology, and immune memory, including the Albert Lasker Basic Medical Research Award and the Gairdner International Award for Medical Science.

Mr. Tracy received his undergraduate degree from the University of Nebraska and law degree from George Washington University. He joined Burroughs Wellcome Co. in 1974 as assistant general counsel, and he served as the company's president and chief executive officer from 1989 until its acquisition by Glaxo Inc. in 1995. Mr. Tracy currently is associated with the North Carolina-based law firm of Smith, Anderson, Blount, Dorsett, Mitchell & Jernigan, L.L.P. Among other business interests, he serves on the board of directors of numerous organizations, and he chairs the board of Xanthon, Inc., a drug-development company. Mr. Tracy first served on the BWF board in 1989, and he rejoined the board in 2001.



www.bwfund.org

VISIT BWF'S WEB SITE:

- NEW! Directory of current awardees
- 2000 annual report
- 2002 Career Awards at the Scientific Interface brochure
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- Interactive on-line application forms
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\$9.25 Million Awarded to Encourage Interdisciplinary Training in the Physical and Biological Sciences

In an effort to bring fresh perspectives into biomedical research, the Burroughs Wellcome Fund (BWF) has awarded \$9.25 million to four universities to foster graduate and postdoctoral training at the interface between the physical and biological sciences. In addition, BWF is launching a new career development program to assist interdisciplinary scientists launching academic careers.

"These awards provide an opportunity for outstanding graduate and postdoctoral students from the physical, chemical, and computational sciences to apply their knowledge and talents to biological problems," says BWF President Enriqueta C. Bond, Ph.D. "The awards help fill the gap left by federal funding efforts that are discipline specific. Through these award programs, the Fund is trying to jump-start a new type of training to meet the quantitative challenges emerging in biology."

The Interfaces in Science institutional award program is not intended to introduce more graduate students into the research system, but rather to promote a different kind of training and a change in institutional behavior.

The four award recipients are Boston University, which received \$1.75 million, and Princeton University, the University of Chicago, and the University of California-San Francisco, which each received \$2.5 million. BWF selected the awardees with the guidance of an advisory committee composed of scientists who are leaders in this type of interdisciplinary research.

The University of Chicago program is directed by Stephen Kron, M.D., Ph.D., assistant professor of molecular genetics and cell biology, and Norbert Scherer, Ph.D., professor of chemistry.

The program's goal, say its directors, is to bring talented physical sciences graduate students into biological laboratories and provide dual mentorship for each student. BWF fellows will participate in core courses and select additional coursework tailored to their research goals. In addition, they will participate in a weekly seminar-discussion group.

"No amount of reading or coursework can replace working side-by-side with biologists," Dr. Kron says. "We believe that these young

physical scientists will bring an important, rigorous perspective with them that will enrich the experience for the biologists in training beside them. This is a clear win-win situation for the students and for their mentors."

The Program in Mathematical and Computational Neuroscience at Boston University is directed by Howard Eichenbaum, Ph.D., professor of psychology, and Nancy Kopell, Ph.D., William Goodwin Aurelio Professor of Mathematics and Science.

"Although neurobiology remains one of the great frontiers of science, with questions needing new mathematical and modeling skills, there are still very few training opportunities for those in the physical sciences to use their skills in neuroscience," Dr. Kopell said. "Our program is motivated by the conviction that the transition is done most efficiently and effectively when there is a community of scientists addressing a variety of related problems."

The training program in biological dynamics at Princeton University is directed by John Hopfield, Ph.D., professor of molecular biology, and Simon Levin, Ph.D., George M. Moffett Professor of Biology.

The Princeton program will challenge physical scientists to apply their training in complex system modeling to understand the behavior of biological systems. The program

will offer graduate students the opportunity to receive training in the emerging field of biological dynamics.

The University of California-San Francisco's graduate program in quantitative biology is directed by David Agard, Ph.D., professor of biochemistry and biophysics, and Ken Dill, Ph.D., professor of pharmaceutical chemistry.

The new program will complement the university's existing interdisciplinary program between chemistry, physics, and biology by incorporating mathematics and computer science into the mix.

"Recent scientific advances make it possible to analyze complex biological phenomena, including disease processes, in terms of basic physical and chemical interactions of molecules," Dr. Bond says. "Indeed, some of the most promising recent discoveries in biomedicine now result from the insights and skills of investigators who have strong backgrounds in physics, chemistry, or mathematics."

Examples of such interdisciplinary research include development of novel imaging tools and biosensors, application of nanotechnology to manipulate cellular systems, and the use of mathematical techniques to decipher biologically meaningful information encoded in the human genome.

New Career Development Program for Physical Scientists Entering Biology

Burroughs Wellcome Fund has launched a new award program: Career Awards at the Scientific Interface. This new program is designed to complement BWF's Institutional Awards at the Scientific Interface program. Each award will provide up to \$538,000 over five years to support advanced postdoctoral training and the first three years of a faculty appointment. Applicants must not have accepted a faculty position at the time of application. The goal of these new awards is to foster the early career development of researchers with backgrounds in the physical/computational sciences whose work addresses biological questions. The deadline for application is May 1, 2001.

"Competition for tenure-track positions is fierce. By providing financial support and career development assistance, we hope to highlight to potential employers the value these cross-trained individuals bring to biomedical science," says Nancy Sung, Ph.D., program officer for Interfaces in Science. Information about the new Career Awards at the Scientific Interface is available on BWF's Web site at www.bwffund.org/interfaces_program.htm



BWF Awardees Honored at White House

Career awardee **Charles Murry, M.D., Ph.D.**, former career awardee **Jeffrey Diamond, Ph.D.**, and new investigator in molecular parasitology **Theresa Gaasterland, Ph.D.**, were among the 59 recipients of the Presidential Early Career Awards for Scientists and Engineers (PECASE) announced in late 2000. All recipients were honored at a White House ceremony.

Dr. Murry, who is a 1995 career award recipient, is an associate professor in the Department of Pathology at the University of Washington School of Medicine. His BWF-supported work focuses on gene therapy for muscle regeneration following heart attack.

Dr. Diamond, an investigator in the Synaptic Physiology Unit at the National Institute of Neurological Disorders and Stroke, received a 1998 career award for his work on nerve cell connections in the hippocampus region of the brain. Because BWF awards are restricted to degree-granting institutions, Dr. Diamond gave up his career award when he joined NINDS.

Dr. Gaasterland, a 2000 new investigator who also served on the Fund's functional genomics advisory committee in 1999-2000, is an assistant professor at Rockefeller University and head of Rockefeller's Laboratory of Computational Genomics. Her BWF-sponsored research focuses on designing a comprehensive annotation of genomic sequence data for three unicellular, protozoan human pathogens: *Plasmodium falciparum*, *Leishmania major*, and *Typanosoma brucei*.

The PECASE program recognizes demonstrated excellence and promise of future success in scientific or engineering research, and the potential for eventual leadership of the recipients in their respective fields. Eight federal agencies nominated top young scientists from within their funding area for this five-year research grant. Drs. Diamond and Murry were nominated by the National Institutes of Health and Dr. Gaasterland by the National Science Foundation.

So What's New?

BWF wants to expand communications about the research conducted by the scientists we support.

We therefore encourage award recipients to notify us of papers you are about to publish, major lectures you will make, patents you will receive, or any other notable achievements that have resulted, totally or in part, from BWF-funded research. We would like to hear about such items as early as possible.

Also, if your institution's public-information officer has reported on your work, or if it has been described in a local publication, please send us copies of the articles.

Spreading the word about your work, through FOCUS and other media outlets, is one way BWF can help make the case for supporting basic medical research. We'd like your assistance in this important task. We will, of course, check with you before releasing any information.

Send the information to the FOCUS editor at the address below.

News Notes

- A history of medicine paper published by **Victoria Sweet, M.D.**, assistant professor of clinical medicine at the University of California-San Francisco School of Medicine and 1998 research travel grant awardee, has received two prestigious scholarly awards. The article, "Hildegard of Bingen and the Greening of Medieval Medicine," published in the Fall 1999 issue of the *Bulletin of the History of Medicine*, (73:381-403), received the 2000 Estes Award for the best published paper in the history of pharmacology for 1998 and 1999, and the Jerry Stannard Memorial Award for 2000, which is awarded for the best paper published on the topic of pre-18th century medical history.
- **Hongtao Yu, Ph.D.**, a BWF new investigator in pharmacology and assistant professor at the University of Texas Southwestern Medical Center-Dallas, and **Hiten Madhani, M.D., Ph.D.**, a BWF career awardee and assistant professor at the University of California-San Francisco School of Medicine, were among 24 researchers who received fellowships for science and engineering from the David and Lucile Packard Foundation. The five-year, \$625,000 unrestricted grants support faculty members who are early in their careers.
- **Martin Ionescu-Pioggia, Ph.D.**, BWF senior program officer has received the 2001 Beacon Award from the faculty of the Frontiers in Reproduction training course held at the Marine Biological Laboratory, Woods Hole, Mass. The award is given annually to an individual who represents a source of guidance for young scientists in the field of reproductive science.

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This newsletter is published quarterly by the Burroughs Wellcome Fund, an independent private foundation dedicated to advancing the medical sciences by supporting research and other scientific and educational activities.

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