National Water Research Institute
BRIEFINGS
VOLUME 13, NUMBER 1 WINTER 2004

NWRI to Hold "Quantum Leap" Membrane Research Symposium

This March, NWRI will hold the first Pacific Rim "Quantum Leap" Membrane Research Symposium to address the needs of one of the most important water treatment technologies.

In the water and wastewater industries, membranes are commonly used to remove contaminants from water. But what is a membrane? A membrane is a thin film of porous material that allows molecules of certain sizes (water, for instance) to pass through, while preventing larger, undesirable molecules — most specifically, viruses, bacteria, salts, and metals — from doing the same. A prime example of a technology that uses membranes is desalination, which filters (or "separates") salt from seawater.

According to NWRI Executive Director Ronald Linsky, the symposium's organizer, membranes are the treatment of choice among utilities; however, the technology — while its use has expanded — has only progressed incrementally over the last 10 years.

"Millions of dollars have been invested in membrane research over the last decade," said Mr. Linsky, "but the technology has not significantly improved. Our concern is that new problems are arising all the time, yet we continue to use nominally improved technology to address them. Unless we make a 'quantum leap' in membrane research and innovation, another decade will pass without major breakthroughs in the technology."

To help move the technology forward, NWRI is collaborating with the nations of Japan, China, Singapore, Australia, and United States to hold the first Pacific Rim "Quantum Leap" Membrane Research Symposium on March 29-31, 2004, at the Hilton Hawaiian Village in Honolulu, Hawaii.

The emphasis on Pacific Rim is due to the fact that membrane technology is growing rapidly in these countries.

- Japan is a leading nation in the development of membrane technology, including reverse osmosis, microfiltration and ultrafiltration, and membrane bioreactors.

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Call for Nominations:

The 2004 Clarke Prize

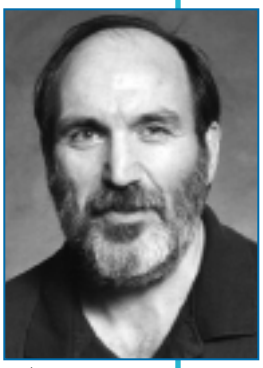
The Athalie Richardson Irvine Clarke Prize is presented annually for demonstrated excellence in the fields of water science and technology. Nomination procedures are now available by emailing Clarke@NWRI-USA.org or by visiting the NWRI website at www.NWRI-USA.org.

Deadline for Nominations: April 1, 2004

Meet Our Research Advisory Board: Robert K. Bastian

It would take an entire concert series to sing the praises of Bob Bastian. His résumé includes over 30 years with the U.S. Environmental Protection Agency (EPA), over 10 years on NWRI's Research Advisory Board (RAB), and a lifetime of interests ranging from wastewater management to award-winning choirs.

Mr. Bastian grew up in northwestern Ohio on a dairy farm that is still owned by his family. In college, he was fascinated by applied biology and became involved with studies about the recycling and treatment of wastewater, rodenticide testing, and animal behavior, as well as a Marshall Islands project monitoring the long-term effects of atomic testing in the South Pacific. He received both a B.S. and M.S. in Biology, Mathematics, and Environmental Sciences from Bowling Green State University in Ohio.



Robert K. Bastian

While on active duty in the U.S. Army Corps of Engineers in 1972, an interagency agreement introduced him to EPA. After nearly three years of doubling as both an Army officer and a member of EPA, he decided to join EPA rather than pursue a career with the Army.

Since then, Mr. Bastian has coordinated the development of numerous agency technical studies and guidance documents dealing with the management of municipal wastewater and biosolids. Some of these include EPA's *Guidelines for Water Reuse;* technology assessments and guiding principles documents associated with constructed wetlands and other innovative technologies; and biosolids management success stories and guidance documents on radioactive materials in biosolids. He has also coordinated a series of Congressionally funded National Demonstration Projects involving such technologies as direct fuel cells, soil aquifer treatment, constructed wetlands, and water reuse, among others.

Currently, he serves as Senior Environmental Scientist with the Municipal Technology Branch of the Office of Wastewater Management, where he deals with a wide range of wastewater treatment related issues such as wastewater reuse and disinfection, natural biological waste treatment technologies, and on-site/decentralized treatment technologies. He also represents EPA on several interagency and advisory groups, such as the National Research Council and National Academy of Sciences' Water Science and Technology Board, the interagency Joint Aquaculture Subcommittee, and the Sewage Sludge Subcommittee of the Interagency Steering Committee on Radiation Standards.

"It's been a lot of fun," he said of his 30-plus years with EPA. "I go to work early in the morning and have trouble leaving at night. I get to work with the best people in the country on a wide range of subjects. Eventually, you learn that every program in the agency has some link back to wastewater."

When he does leave at night, Mr. Bastian heads to Falls Church in northern Virginia, where he lives with his wife, Carroll. His daughter, Meredith, attends Duke University, where she is working on a Ph.D. in Physical Anthropology and is focusing on great apes. "She has always had a strong interest in animal behavior and biological sciences," said her proud father, "probably something that she picked up from her Dad!" During his free time, Mr. Bastian enjoys gardening, hiking, fishing, and visiting the family farm in Ohio. "Basically, I like outdoor stuff," he said.

But his most impressive and time-consuming hobby is not "outdoor stuff" at all. Mr. Bastian is a singer. He is involved in several choirs, including The Washington Chorus, "the only Grammy-winning chorus in the Washington, D.C., area," he said. To be precise, The Washington Chorus was the winner of the 2000 Grammy Award for Best Choral Performance for its live-performance CD of Benjamin Britten's *War Requiem*. Mr. Bastian decided to audition for the celebrated chorus after joining and enjoying his church choir and a smaller local group, The Alban Chorale.

"Basically, I found another chorus that held practice on a night I had free," he explained. The annual auditions for all 200-plus members are intense. But the pay-off is tremendous: the chorus has its own subscription series at the Kennedy Center, frequently sings with the National Symphony Orchestra, and performs regularly at Wolf Trap National Park of the Performing Arts in Vienna, Virginia, and other venues, including international tours.

"We're thinking about touring in China next year," said Mr. Bastian. This would not be his first concert tour: "I just got back from a tour in Italy with The Alban Chorale. We performed at St. Mark's Basilica in Venice, the Vatican, and a number of other places in northern Italy."

This diversity of talent makes Mr. Bastian a key figure in NWRI's RAB. As a founding member, he has served on the board since 1992 and has participated in numerous committees and events, including the Water Quality Subcommittee and the 1992 Planning Conference, which helped to establish the overall direction of NWRI's research, education, and public information programs.

"The RAB involves folks from all across the country," he said. "It's a great opportunity to keep up to speed with all of these high-rate people. I've learned a lot, and hopefully I've contributed a little something."

Article written by Kristin Wehner

Groundwater Replenishment System Gearing Up to Make More Water

It has been lauded as the "the ultimate water recycling project." Its construction alone will cost $453 million. Considered the largest project of its kind in the nation, the Groundwater Replenishment System will go online in 2007 to create a new, safe, and reliable water supply for Orange County, California — using highly treated sewer water as its source.

Currently under construction, the Groundwater Replenishment System — referred to as the "GWR System" — is the brainchild of two Orange County utilities: the Orange County Water District and Orange County Sanitation District.

World renown as a leader among water utilities, the Orange County Water District is located in Fountain Valley, California, a coastal city about 30 minutes south of Los Angeles. The water district is responsible for protecting Orange County's rights to the Santa Ana River and for managing a groundwater basin that supplies more than 20 cities and water agencies in the region with water.

Located just next door, the Orange County Sanitation District is the sixth largest wastewater treatment agency in the nation. It treats 234-million gallons of wastewater a day, discharging most of it into the Pacific Ocean.

Together, these districts are leading the way in developing a system that will purify and reuse wastewater to near-distilled quality to provide a reliable source of water for 2.3-million residents of Orange County.

Why Does Orange County Need the GWR System?

Orange County is investing in the GWR System for two main reasons: to decrease its dependence on imported water supplies and to help protect it from future droughts.

More than half of all water used in Orange County is groundwater pumped from the groundwater basin; the rest is imported from Northern California and the Colorado River.

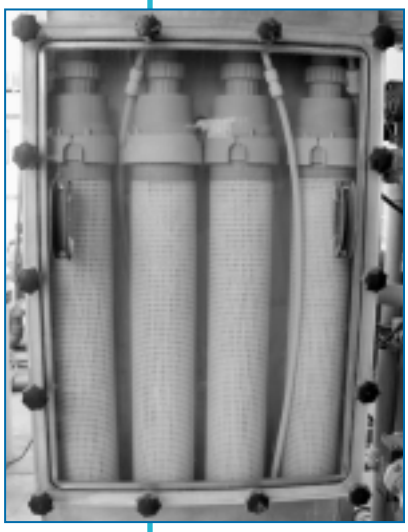
At present, about 250 wells within the water district's service area pump 270,000 acre-feet of drinking water from the basin each year. Just one acre-foot of water amounts to 326,000 gallons, which is enough water to supply the needs of two families of four for a year.

To ensure the basin is not over pumped, the water district refills (or "recharges") it with both Santa Ana River water and imported water. This water seeps into the ground, like rain, to blend with the groundwater.

But the future availability of imported water is uncertain. The county cannot continue to rely on imported water from Northern California or the Colorado River, as both sources are being divvied up to support the west's booming population. Eventually, it will become too expensive and unreliable to continue using imported water.

At the same time, Orange County's population is steadily growing. It is anticipated that an additional 300,000 to 500,000 people (requiring 60- to 100-million gallons of new water a day) will live in the county by the year 2020. By then, if the county does not find additional sources of water, it will experience severe water shortages.

Another threat to Orange County's water is seawater intrusion. When water is pumped from the groundwater basin, the basin's water levels fall below sea level. Because the basin has an underground connection to the Pacific Ocean, seawater flows into it, contaminating the groundwater supply.



Here are four microfiltration modules used in the US Filter CMF-S microfiltration system chosen for the GWR System. Each module contains 14,000 hollow fibers that reject anything over 0.2 micrometers in diameter. The GWR System will have a CMF-S microfiltration system consisting of a total of over 15,000 membrane modules — the largest ever installed by US Filter.

Orange County is investing in GWRS for two main reasons: to decrease its dependence on imported water supplies and to help protect it from future droughts.

To combat seawater intrusion, the water district operates Water Factory 21, a 30-year old world-famous water purification plant that takes treated wastewater diverted from the sanitation district, purifies it to drinking water standards, and then injects it into the basin near the coast to form an underwater dam, blocking out seawater. The treated water eventually becomes a part of the groundwater supply.

Under the GWR System, Water Factory 21 will be replaced with new technology that is even more efficient in treating greater volumes of wastewater for reuse in the groundwater basin. Where Water Factory 21 can only produce up to 15 million gallons per day, the GWR System will produce 72 million gallons of reusable water per day.

How Will the GWR System Work?

The GWR System is the ultimate recycler. It will function exactly like Water Factory 21 did, treating wastewater diverted from the sanitation district. The big difference, however, is while Water Factory 21 used older technology like flocculation and coagulation in front of reverse osmosis to purify water to

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GWR System Slated to Go Online in 2007

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drinking-water standards, the GWR System will use a faster, more efficient process to do the same *with five times more water*. There are three steps to the GWR System's purification process:

Step 1) *Microfiltration:* A low-pressure membrane filtration process, microfiltration forces water through membranes — imagine them as hollow straws with microscopic holes in the side — to sieve small particles and bacteria from the water. Microfiltration is used in commercial industries to process food, fruit juices, and soda beverages, as well as to sterilize medicines that cannot be heated.

Construction of the Phox advanced oxidation ultraviolet (UV) system by Trojan Technologies began in summer 2003. The GWR System will contain nine UV Phox systems, and each system will treat up to 8.75 million gallons of wastewater per day. When complete, it will be the largest UV treatment system designed for NDMA removal in the world.

Step 2) *Reverse osmosis:* Reverse osmosis is a high-pressure membrane filtration process that sieves much smaller contaminants like minerals, viruses, and pharmaceuticals, from water. The reverse osmosis process forces water through a sheet of plastic membrane at the molecular level, and the contaminants stay behind. Many bottled water companies use reverse osmosis to purify water.

Step 3) *Ultraviolet light and hydrogen peroxide advanced oxidation treatment:* As its name implies, ultraviolet light uses high levels of radiation to disinfect water. Ultraviolet light used in combination with hydrogen peroxide creates an advanced oxidation reaction that breaks down any remaining compounds — like organic compounds that bacteria can grow on — to create ultra-pure water.

After undergoing these three processes, the treated water — which will exceed all state and federal drinking water standards — will then be used to for two purposes: to provide water for the seawater intrusion barrier and to directly recharge the groundwater basin.

In essence, the GWR System is a grander and newer version of Water Factory 21, but with better technology and the ability to reuse approximately 72,000 acre-feet of water per year.

Where Is the GWR System Now?

Although it will not be ready for another 3 years, the GWR System has hit several milestones in its construction and is already receiving accolades and awards.

The water district broke ground on the initial microfiltration facility (IMF) in June 2003, which will be needed to treat water from the sanitation district once the existing Water Factory 21 plant is taken off-line and demolished. Once the GWR System is complete, the IMF will be incorporated into the larger plant.

In addition, the California Department of Health Services, which provides regulatory oversight of California's public drinking-water system, filed a report in July 2003 declaring that GWR System's water purification processes are acceptable for producing water to recharge the groundwater basin. This vote of confidence was a significant achievement for both the water and sanitation districts, which have invested nearly a decade's worth of research and data into developing the GWR System.

As for awards, the Orange County chapter of the Public Relations Society of America gave top honors to the public information program for the GWR System, which was designed to communicate with all 783,000 households in the service area, and included access to minorities, the media, government, and business and development.

The GWR System is also already being recognized as an innovative and outstanding project in the water industry. Among its honors, it received the 2003 Award of Excellence from the Orange County chapter of the Consulting Engineers and Land Surveyors of California, as well as the 2003 Drought Proofing Award from the Santa Ana Watershed Project Authority.

What Is the Value of the GWR System?

The GWR System is a massive project with a massive budget. Yet, its cost to Orange County residents is negligible, and it is the least expensive new water source. The value of the project, however, cannot be measured by money alone. The GWR System has multiple benefits. In addition to drought-proofing the region, protecting the groundwater basin from seawater, and providing a dependable water supply, the GWR System will also:

- *Reduce mineral levels in Orange County's groundwater.* At present, more minerals (such as salts) enter the groundwater basin than come out, thanks to the high mineral content of the river waters used to recharge it. In the future, when the mineral-free water produced from the GWR System is blended with groundwater in the basin, it will help prevent mineral build-up. This will lessen the cost of treatment, as well as protect the health of both the public and the environment.
- *Decrease the amount of wastewater released into the ocean.* The sanitation district currently releases treated wastewater into the Pacific Ocean through a 5-mile long offshore pipeline. By diverting more wastewater to the water district for GWR System purposes, the sanitation district avoids having to build a second pipeline to discharge increased wastewater flows during peak storm events.
- *Conserve the most important and most limited resource of all — water — through recycling.* When less water is taken from the natural environment to recharge the groundwater basin, more water is available in the rivers for wildlife habitat, as well as for human recreation and use.

Upcoming Events in the World of Water

Symposium on Aquifer Recharge

The Berlin Centre of Competence for Water is pleased to present:

Fifth International Symposium on Management of Aquifer Recharge:

"Recharge Systems for Protecting and Enhancing Groundwater Resources"

June 12-17, 2005

Berlin, Germany

The symposium will focus on bank filtration, artificial recharge, and groundwater resource protection.

Conference topics will include:

- Geochemical processes.
- Microbiological aspects.
- Removal of pollutants.
- Managing aquifer recharge.
- Recharge with treated wastewater.
- Hydraulic aspects.
- Modeling.
- Case studies.
- Regional experience.

Sponsored by:

- Berlin Centre of Competence for Water (KompetenzZentrum Wasser Berlin)
- Berlin Wasser
- UNESCO
- UNESCO's International Hydrological Programme
- Veolia Water
- American Society of Civil Engineers
- IAH-AIH

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Additional information on the symposium may be found at www.kompetenz-wasser.de.

Workshop for Water Officials

NWRI and the Association for Environmental Health and Sciences are pleased to present:

The NWRI Workshop for Elected and Appointed Water Officials

March 18, 2004
8:00 am to 12:00 pm

San Diego, California

Satellite view of San Diego, California, courtesy of NASA.

Decision makers are key to guiding and expanding the nation's water industry. The purpose of this workshop is to offer decision makers an opportunity to strengthen their knowledge and understanding of the challenges facing water and wastewater utilities.

The 4-hour workshop will cover topics such as creating stakeholder interest, dealing with risk, building public acceptance and trust, planning for the impacts of population growth, and enhancing inter-organization communication, among others.

Invited guest speakers include:

DIANA GALE, PH.D.,
Director, Office of Executive Education, University of Washington

RONALD B. LINSKY, *Executive Director, National Water Research Institute*

GARRETT P. WESTERHOFF, P.E., DEE,
Senior Vice President and Director, Red Oak Consulting

JOHN B. WITHERS,
Member of the Board of Directors, Irvine Ranch Water District

Seating is limited to 30, and there are no registration fees. To reserve a seat at the workshop, please call (714) 378-3278 or register at www.NWRI-USA.org.

The NWRI Workshop for Elected and Appointed Water Officials will be held in conjunction with the *Fourteenth Annual West Coast Conference on Soils, Sediments, and Water,* sponsored by the Association for Environmental Health and Sciences and the Naval Facilities Engineering Service Center. Further information about the conference can be found at www.aehs.com.

Location:
Marriot Mission Valley
8757 Rio San Diego Drive
San Diego, CA 92108
Phone: (800) 842-5329 *or* (619) 692-3800

Attendees are responsible for their own hotel arrangements. The room rate is $135 for single/double per night. For more information about the Marriot Mission Valley, please visit www.marriott.com.

Texas Student Receives NWRI Fellowship for Soil Physics Research

Mikhail Gladkikh is not your average Texan. First of all, he speaks with a Russian accent. Second, his favorite sport is not football, but *futbol*. And third, he spends most of his time in front of the computer — simulating soil processes.

For 25 year old Mikhail, a second-year doctoral student at the University of Texas at Austin, physics has been a lifelong passion. Growing up, he was always interested in physics. He especially liked how it explained the world around him.

That love led him to study Applied Mathematics and Physics for 6 years at the Moscow Institute of Physics and Technology, which is about 200 kilometers from his hometown, the City of Tula in Russia.

Mikhail Gladkikh

Physics also brought him together with his wife, Larisa Branets, who was studying in the same department at the Moscow Institute. When it was time to earn their Ph.D.s, they both applied to the University of Texas at Austin — and both were accepted into the Computational and Applied Mathematics program at the university's Institute for Computational and Engineering Sciences.

A graduate research assistant, Mikhail spends his time at the university conducting research. "It's like a job," he says — but it's definitely not the routine 9 to 5.

Mikhail is conducting cutting-edge research on developing a model to simulate — and, ultimately — predict the behavior of soil, especially as it relates to the movement of contaminants and water underground.

Specifically, his graduate research is based on modeling soil on the microscopic level (soil being defined as little spheres that are equal in size and randomly lumped together). Since the spatial coordinates of these spheres have been measured in advance, Mikhail already knows the exact soil geometry (namely, the positions of soil grains and pore space). Combining this knowledge with modeling can, for instance, be used to determine how quickly and where surface water can infiltrate through the soil, or in which direction a contaminant, like gasoline, might flow through the earth.

Or, as Mikhail put it, "If we have a complete geometric description of soil, we can model any physical process that can occur, such as contaminant transport."

His research has direct and substantial application to the water industry, especially in the field of riverbank filtration, which uses wells located along riverbanks to force surface water through the ground and effectively filter out contaminants.

Because of the potential of his research, NWRI awarded Mikhail an NWRI Fellowship in the amount of $15,000. He was among three new students nationwide to receive the award this year.

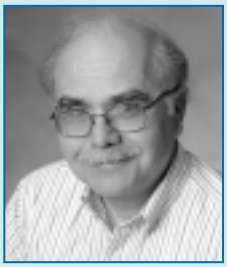
According to his graduate advisor, Dr. Steven Bryant of the Department of Petroleum and Geosystems Engineering at the University of Texas at Austin, Mikhail — already a published author — has "a rare gift: an extraordinary physical insight combined with computational expertise."

"His research contributions will be useful for understanding and quantifying problems associated with freshwater environments," Dr. Bryant added.

Mikhail defended his research dissertation, "*A Priori* Predictions of Macroscopic Behavior of Fluids in Simple Porous Media," this fall and expects to graduate in May 2005. He's not sure if he will stay in Texas — where the air conditioning is always on at home — or if he will return to Russia. His hope is to become a researcher at an institute, where he can continue to pursue his interests in the physics of soil.

RESEARCH IN PROGRESS

Does Bromate Break Down in the Human Stomach?



Joseph A. Cotruvo

Bromate — a potential human carcinogen — is formed in water during the ozonation of bromide-containing water, and added as a contaminant of chlorine during the disinfection of water. To protect the public, regulations require that water bottlers and utilities remove bromate to below 10 parts per billion, which requires additional and costly treatment steps; however, it is possible that for many people, bromate can be naturally broken down by gastric juices in the stomach or by chemical reactions in the blood before it can reach target organs and potentially affect human health. Principal Investigator Joseph A. Cotruvo, Ph.D., of Joseph Cotruvo Associates and his team are examining the fate of low levels of bromate in the stomach under a range of typical conditions and are also looking at blood to determine if the consumption of water with low levels of bromate constitutes a likely health risk.

Supporting Students of Science: NWRI Success Stories

NWRI prides itself on its interest and support of students in science. From presenting awards to junior high and high school students at science fairs to holding Water Camp, a weeklong summer program for kids interested in science, NWRI has always incorporated the younger generation into its research agenda. After all, these students are the scientists of the future — supporting them can only ensure clean, safe sources of water in the years to come.

That is why NWRI is dedicated to supporting graduate students conducting research related to water science. Since 1991, NWRI has funded the work of over 30 graduate researchers, 12 of which directly received NWRI Fellowships.

Here is an update on the careers of three outstanding recipients of the NWRI Fellowship:

Joon Ha Kim, Ph.D.

Congratulations are in order for Joon Ha Kim, a native of Korea, who recently graduated from the University of California, Irvine (UCI), with a Ph.D. in Chemical and Biochemical Engineering in September 2003.

Joon Ha Kim, Ph.D.

Joon received an NWRI Fellowship in 2001 for his research on characterizing the fate and transport of biological pollutants — specifically, fecal indicator bacteria — in coastal waters, as well as means to forecast coastal pollution.

Four studies that he worked on as a graduate researcher have already been published, and another three studies are currently being submitted to environmental journals. These studies range in topics from variations in surf-zone water quality to public mis-notification of water quality to the impacts of tides on coastal pollution.

Joon is now employed as a postdoctoral researcher in the Environmental Biotechnology Laboratory at UCI, where he is developing "now-casts" (a short-term forecast, generally about 6 hours or less) of both surf-zone and coastal wetland water quality. He hopes that these now-cast models will be "useful management tools" that can help "coastal managers make cost-effective and scientifically justifiable decisions" in determining when to close a beach to protect public health and in better managing coastal urban wetlands.

An avid golfer and racquetball player, Joon plans on staying in the U.S. "as long as research needs me." He credits the NWRI Fellowship with helping him achieve success — and not just in science.

"It was an honor to become an NWRI Graduate Fellow," said Joon. "The status of Fellow brought in good support, and that helped me in developing my ability and creativeness for research, as well as for life."

Stephen Lyon, Ph.D.

Another UCI alumni, Stephen Lyon received an NWRI Fellowship in 1994 for his doctoral research on the microbial ecology of bacterial communities in chemically stressed soils. At that time, he was a graduate researcher in UCI's Department of Environmental Analysis and Design. With help from the Fellowship, he completed his research and graduated in 2000.

Stephen Lyon, Ph.D.

Four years later, he is now a Senior Scientist at the Orange County Water District, where he developed and runs the Field Research Laboratory in Anaheim, California.

"My job," said Stephen, "is to investigate a variety of approaches that improve the quantity and quality of water that is used to recharge the aquifer in Orange County."

Some of these approaches include developing constructed wetlands for treating surface water prior to recharge, developing a limnological database on all the major water bodies in the 1,000-acre recharge system, and studying the various processes that influence percolation and clogging in the recharge basins.

Stephen's work isn't just limited to aquifers — he is also interested in "encouraging the next generation of environmental scientists." Not only does he teach Environmental Chemistry in the Engineering Department at UCI, but he also works with the water division of the Southern California Science Olympiad, as well as the Orange County Science and Engineering Fair.

For Stephen, encouragement — especially in the form of a fellowship — is the key to success.

"My Ph.D. dissertation research was one of the main reasons why I was hired by the Orange County Water District," he said. "At a time when my current funding had run out, the NWRI Fellowship provided the support needed to get me through a critical period in my research. I am greatly indebted to NWRI for its caring and generosity."

Sharon Walker, Ph.D. Candidate

When Sharon Walker was an undergraduate in Environmental Engineering at the University of Southern California, her professor encouraged her to attend the Athalie Richardson Irvine Clarke Prize

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Fellowship Helped Budding Scientists

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Award Ceremony and Lecture — which is where she first learned about NWRI and its graduate Fellowship.

Sharon Walker

Several years later, after she was accepted as a doctoral student in the Environmental Engineering Program in the Department of Chemical Engineering at Yale University, Sharon immediately submitted a proposal to NWRI and was awarded a Fellowship for her doctoral research on bacteria in groundwater environments.

Specifically, she is looking at how the surface characteristics of bacteria, the chemical solution of groundwater, and the geology of the subsurface all affect the transport of bacteria in groundwater during bioremediation, the process of using microorganisms, like bacteria, to break down or immobilize contaminants.

The Fellowship has been a boon to her research. "Unlike other graduate students," she said, "I've had the freedom to decide which symposiums to attend, and I've been lucky enough to meet so many experts in my field. Not only that, but the Fellowship funding has allowed me to develop my research without worrying about the costs, which is a luxury not many students have."

For instance, the Fellowship money held her to purchase a Zeiss inverted fluorescence microscope, which Sharon says is the "Rolls Royce of microscopes." It is the primary piece of equipment for her research and allows her to see bacteria in an aquatic environment.

Sharon plans on graduating with her Ph.D. in summer 2004. In the meantime, she is working on her dissertation, which will be a compilation of all her published papers. So far, she has one published piece, two in the process of publication, and another that she has just started writing.

She also squeezes in time as a mentor to women undergraduates as a part of the "Women in Science" program at Yale University. As one of the few female engineers at Yale, Sharon has spent the last few years introducing other young women to the laboratories and graduate research in the environmental engineering program. "It's a satisfying outlet," she said. "I'm able to give these undergrads a different perspective on engineering."

Ultimately, her goal is to become a professor at a research university. At present, she is applying for postdoctoral positions in the United States and abroad. NWRI wishes her the best of luck!

Collaboration on Membrane Research Needed

Continued from Page 1

- China is a burgeoning market for membrane equipment and is pioneering new areas of membrane research, including the development of new membrane materials.
- Singapore is now a world leader in the use of membrane technology for water reuse, specifically in indirect potable reuse (its "NEWater Project" is a prime example).
- Australia has several universities — including the University of New South Wales — that have exhibited world-renowned expertise in membranes, and is now using the technology to solve critical water problems across the nation.
- The United States has over 30 year's worth of history and experience in membrane research and development, more than any other nation in the world — in fact, membranes were first developed here.

Delegates from these nations have been invited to the symposium to address the following topics:

- What is the current state-of-the-art in membrane research?
- What are the most important challenges facing membrane research efforts?
- What future research is needed to move the technology forward by magnitudes, not increments?
- What novel and/or unconventional methods and applications need to be considered by the research community?

The purpose of the symposium is to exchange ideas and information on membrane technology, with the ultimate goal of collaborating on future membrane research.

"Each of these countries have something to share," said Head of the United States Delegation David Furukawa, P.E., Ch.E., of Separations Consultants, Inc. in California. "Together, it may be possible to engage in cooperative and multi-disciplinary research that may, indeed, spawn a 'quantum leap' in membrane development."

For it is this research that may, in fact, best serve the water supply of future generations.

"With the limited supply of fresh water on this planet," said Mr. Furukawa, "the available supply must be conserved, municipal and industrial wastewater must be reused, and saline and impaired sources must be treated to keep up with the growing demand caused by an expanding population. Membranes provide the opportunity to accomplish these tasks as the most efficient and cost-effective of separation processes."

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