Marine Sciences Research Center

NEWSLETTER

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The Challenge of Living on a Finite Earth

The notion of "sustainable development" and that the world is finite are rising themes heard in many environmental quarters. Recognizing that the Earth has limits in its capacity to support the demands of its inhabitants fits hand-in glove with the notion that human development must proceed at a level that can maintain a healthy environment for future generations.

This past year, MSRC's Dean and Director Jerry Schubel and Assistant Provost Larry Noonan were asked to help the Ben Gurion University of Israel decide its future development, given its desert setting with a large population. As part of that process, the university's president issued a report stating,

> "...Poverty and the population explosion, together with industrial growth are colliding into the physical finiteness of the planet Earth, of its resources, and of its ability to absorb environmental damage inflicted by mankind...
>
> "The moment one has to abandon the assumption that the world is infinite, one is compelled to change one's entire way of thinking about one's relationship with the Earth: from the qualitative to the quantitative."

These concepts are not so new to MSRC. Over the years, its workshops, symposia, and informal

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discussion sessions have been directly or indirectly devoted to these seemingly new concepts. These themes were repeated in the recently completed MSRC Associates' series, "Sunday Seacoast Breakfasts," the April Eutrophication Planning Meeting of the National Research Council's Marine Board held at MSRC, the Environmental Stewardship Workshop for teachers and spiritual leaders, and the Alumni Day "Mission to Planet Earth."

▲ *Associate Director of MSRC Bill Wise demonstrates movements of a contaminant spill in a Long Island groundwater model. Onlookers are Stony Brook alumni and their families attending a special event at MSRC, "Mission to Planet Earth."*

The reality of these two themes is perhaps more clearly drawn for the residents of Long Island's Suffolk County, where the fervid development seen in western Suffolk has not yet taken hold in unspoiled eastern regions. But the need to protect what is left is a priority in MSRC's scientific endeavors, with a close second priority being to rehabilitate those regions already degraded, whenever possible.

The public, as well as scientists and environmental regulators are concerned about leaving Earth healthy enough to support future generations. Often these take the form of green spaces and wetlands protection, usually linked to clean water—drinking water or coastal marine waters—healthy enough to support living resources, including humans.■

Donald Pritchard elected to National Academy of Engineering

Donald W. Pritchard, physical oceanographer and Professor *emeritus* of MSRC, received one of the highest professional honors conferred to engineers, and a distinction only rarely bestowed upon scientists for their contributions to the field of engineering. He is the second Stony Brook professor to be elected to the National Academy of Engineering, and is one of only 73 people nationwide elected this year.

Before coming to Stony Brook in 1978 as MSRC's Associate Director for Research, Pritchard spent nearly 30 years at the Johns Hopkins University. He was the first Director of Hopkins' Chesapeake Bay Institute, serving from 1949 until 1973.■

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related to contaminant transport processes and influence of water circulation, stratification, and mixing on primary production.

KAMAZIMA LWIZA attended a symposium on the International Decade for East African Lakes (IDEAL), held in Jinja, Uganda near the source of the Nile in February. The primary objectives of the symposium, attended by 128 scientists from 27 countries, were to review current knowledge of limnology, climate, and paleoclimate in East Africa; to prepare a monograph on the limnology, climate setting, and sediment records of the East African lakes; and to establish scientific priorities for this program.

AKIRA OKUBO was the featured invited speaker at the workshop, "Biomathematics and Bioengineering '93" held in February at Hofstra University. He presented a lecture on "Fluid mechanical problems in ecology and behavior of marine planktonic organisms: theoretical and mathematical models." Graduate student Melanie Stein gave a talk at the same workshop: "A mathematical model of the copepod feeding current."

MARY SCRANTON and former MSRC postdoctoral fellow **MARIE DE ANGELIS** have received funding from NSF to study methane oxidation near methane seeps in the Gulf of Mexico. For this research, samples will be collected by research submarine vehicles.

Scranton and **CHUCK NITTROUER** participated in a conference devoted to a discussion of the facilities (ships and other platforms) which will be required by coastal oceanographers in the next 10 to 20 years. The conference was held in February in Williamsburg, Virginia.

LARRY SWANSON has been appointed to the Newsprint Recycling Board by Suffolk County Executive Robert J. Gaffney.

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The fourth bioassay is a larval mussel settling bioassay. Larvae close to settling stage are offered both untreated surfaces and surfaces treated with extracts. The team then observes where they do and do not settle and whether they avoid the treated surfaces.

"Roughly one-fourth of the 60-plus crude extracts assayed were biologically active," said Taylor. In the next phase of the study, he will be trying to purify the most promising of these candidate crude extracts, and once again, screen for antifouling activity. In the final phase, he will characterize the chemically active component to see if it can be synthesized or bioengineered or even harvested from a special mariculture crop. However produced, the compound may prove to be one of the hottest new products on the marine market, with other such applications as boat hull and pier antifouling ■

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▲ *MSRC's Vincent Breslin shows Governor Mario Cuomo how he measures samples for trace metals using the polarized atomic absorption spectrophotomer and furnace autosampler, donated to the State of New York by Hitachi Instruments, Inc. of Japan. Governor Cuomo and Dr. H. Graham Jones, Executive Director of NY State Science and Technology Foundation, selected MSRC to receive this gift. This instrumentation is available to faculty and students from the campus and off-campus environmental and research groups.*

Conference to design future of Long Island coasts

Through a technique called "scenario planning," participants at a conference planned for June 16 and 17 will attempt to predict the future of Long Island's coastal environment. "Preserving Long Island's Critical Coastal Resources," sponsored by the MSRC, the Long Island Association, Nassau and Suffolk Counties, and the NY State Office of Parks, Recreation and Historic Preservation, will be held at the Marriott Uniondale and Jones Beach.

For further information, call Patricia Hall at Long Island Association (516) 499-4400■

"The best way to predict the future is to create it."

— John Scully
CEO of Apple

FACULTY AND ALUMNI NOTES

MARVIN GELLER attended the National Academy of Sciences Committee in February at NASA's Lewis Research Center, Cleveland, Ohio, to assess environmental impacts of High Speed Civil Transports.

In March he attended a meeting of the Joint Steering Committee of the World Climate Research Program as co-chair of Stratospheric Processes And their Relation to Climate (SPARC). The meeting was held in Bermuda.

CINDY LEE participated in a 28-day U.S. Joint Global Ocean Flux Study (JGOFS) sediment-trap pick-up cruise in the South Pacific during January and February.

Her graduate student, Silvio Pantoja received the best M.S. Thesis award, and Mingyi Sun (co-advised by Lee and Robert Aller) received the best Ph.D. Thesis award.

DARCY LONSDALE, MALCOLM BOWMAN, KIRK COCHRAN, AND HENRY BOKUNIEWICZ organized a workshop for MSRC on current research in the Hudson River in late February. Papers and discussions

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Researcher uses natural products to combat biofouling of seawater intake systems

Marine microbial ecologist Gordon Taylor is working to solve a problem common to oysters and water intake systems of power plants used for heat exchange. That problem is biofouling—the colonization on surfaces by marine organism, and the surfaces include the shells of mussels, oysters, and crabs and the blades of seagrasses, as well as the pipes of the intake systems.

Biofouling organisms range from the smallest marine microorganisms, such as bacteria, to the larger biofoulers, like barnacles and blue mussels. Although often relatively harmless, their settlement on plant or animal surfaces can restrict gas and nutrient exchange through the outer cell layer. In power plant intake systems, biofoulers can constrict pipes, reduce water flow rates, and ultimately, cause expenditure of more energy to move the water through the system, as well as expenditure of time and money to clean the surfaces.

Taylor is currently looking at marine organisms' own natural defenses against biofouling to provide some answers for the Long Island Lighting Company, which is funding this research. Many sedentary benthic animals and plants produce their own chemicals as a defense against the biofoulers. Taylor's research objective is to isolate a variety of these naturally occurring antifouling extracts, test them for bioactivity, and once biologically active candidates are found, purify and characterize the active component for production.

The crude extracts are subjected to four different types of bioassay. First, Taylor and his students look for antimicrobial activity, an assay similar to that used by pharmaceutical companies to screen for antibiotics. A second test is a bacterial antisettling test: observing the response of fouling bacteria to alternative surfaces coated with extract to see if they do or do not settle.

The third assay is the mussel-attachment survey. Juvenile mussels are cemented to a glass slide in close proximity to an area treated with a bioactive substance. "We monitor the orientation of their byssal threads [the hair-like strands used for attachment to surfaces] over time, and if the substance has antifouling properties, the byssal threads will not attach to the treated area [see figure a]. If the extract has no antifouling activity, the byssal attachment will be random [figure b]," said Taylor.

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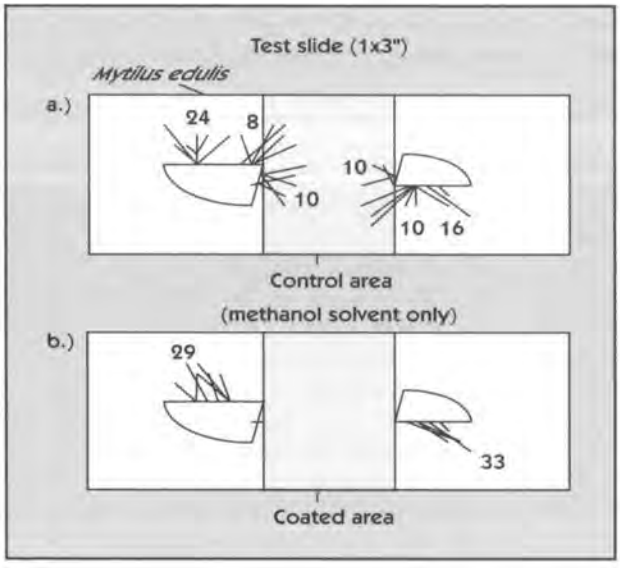
Mussel Attachment Survey
Mussels either attach (a) or avoid attaching (b) to test slides, depending on surface coating.
▼



Dong-Ping Wang

Movement Across Oceanic Fronts

Oceanic fronts are the sharp boundaries formed where two different types of water masses come together. Just as weather fronts are places where warm air and cold air meet and form storms, oceanic fronts are boundaries where cold and warm water come together, or where high salinity and low salinity water masses come together, and result in eddies and turbulence.

Fronts are everywhere, forming boundaries that define different regions of the ocean, such as continental shelf water, slope water, or open Gulf Stream water, where fresh water from land and salty water from the ocean meet. They are important places because they are ubiquitous and because many floating materials—from spilled oil and floatable wastes to plankton and seaweed—get stuck at their long, invisible boundary lines and can't seem to move across. And fronts are important places because they hold answers to basic physics questions which consume much time of computers and physical oceanographers around the world.

One such basic question, and one that MSRC physical oceanographer Dong-Ping Wang is working to answer is, Why is the boundary so sharply formed? Despite the sharp boundary, however, organisms and particles do pass across the front. Fresh and saline water mixes together on the continental shelf, pollution from the coasts moves out into open water, and pelagic larvae move into estuaries from the open ocean. So another basic question Wang asks is, How do these organisms and materials get across?

Fronts are very important biologically because they are typically very productive regions. They can be responsible for moving migrating fish larvae from one place to another. Turbulence brings up nutrients with planktonic organisms following, then fish and seabirds. But why they are there is still being debated. "If you're a physical oceanographer, you might think the fish are there because they get stuck there, but if you're a fisheries biologist, you might think they are there because they swim there to feed," said Wang.

Physical oceanographers know that movement across a front is carried out in both horizontal and vertical planes. The faster, horizontal circulation moves materials along the invisible line of the boundary. It is the slower, vertical movement that is important for moving materials across the front, yet this circulation is so slow it is very difficult to measure. "We can make measurements of the water movements indirectly with isotopic tracers or by measuring distribution of organisms such as plankton across the front," said Wang. Radioisotopes are taken up by particles and their location can then be traced.

Materials move vertically through either upwelling or subduction—if upwelling, materials from below, such as nutrients, are drawn upward; if subduction, floating particles are drawn down under the water mass on the other side of the front. Wang tries to predict vertical movement by use of computer models using data sets taken from all over the world's oceans. If he can predict movement across fronts accurately, companies involved in oil spills should be very grateful, because it will allow them to move quickly to the fronts where the oil will get stuck to remove it. And fisheries biologists may better understand transport of larvae.

"In physical oceanography, modeling is a very powerful tool," said Wang. There are two problems in making a model, according to him. "Our knowledge of nature is always limited—we don't know everything about it. So, any credible model must be verified." To verify the model, Wang compares the data generated by the model against several parameters that he can measure directly, such as temperature or salinity. The other problem is the limit on computer resources needed to test the models. "The more sophistication we need to define the system, the more powerful computer resources we need."

To develop his models, Wang needs a highly technical computer with a large amount of memory—one that can digest large amounts of data and process it fast. A supercomputer, the fastest available today, can take large amounts of data and process it fast. "But we always push very quickly to the limit of what is available today," said Wang. He would like something 100 times bigger, so he is tied into massively parallel computers located at Cornell University and University of California at San Diego. "It's like putting 100 supercomputers in parallel." And it is a first step in the formation of the national information super highways talked about by President Clinton.

But despite the technological orientation of this type of work, Wang's research ultimately depends on the art involved. "In principle, the model is trivial, but in practice, it requires a judgement call on how to handle the information," said Wang." And how good his model really is depends a great deal on whether his insight is correct and judgement good.