The Lipman Log

JULY, 2012

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News from the Chair

RUTGERS
School of Environmental and Biological Sciences

News from the Chair, Max Häggblom

Summer greetings from Lipman Hall! Some of the highlights from the 2011-2012 academic year are included in this issue.

Our scholarly and educational programs in biochemistry and microbiology are flourishing and our core courses continue to be filled to capacity. Our faculty members are leading many exciting new research projects. Please browse through this issue to read more on the various activities and accomplishments of our students and faculty, and the awards that they have received.

The newly established Graduate Program in Microbial Biology is thriving, with a third class of students beginning their studies this fall. Our department provides the leadership for this SEBS-based Graduate Program rooted in the rich traditions of microbiology at Rutgers with over 40 faculty members from over ten departments and institutes across the New Brunswick campus. The program is focused on microbial life processes and their applications, offering advanced study on the biology of microorganisms. Core funding for our entering students comes from two endowed graduate fellowships, The H. Boyd and Jeanette I. Woodruff Microbiology Fellowship in the field of Soil and Environmental Microbiology and the recently established James Macmillan Fellowship in Microbiology.

Our Annual Microbiology Symposium continues to bring together all microbiologists on campus with speakers from SEBS, the School of Arts and Sciences, the Camden and Newark campuses, and also Robert Wood Johnson medical schools (see page 5). In February 2012 we had the pleasure of welcoming back Rutgers alum, Dr. Stephen Picataggio (Ph.D. 1983, Chief Scientific Officer, Verdezyne Inc.), who worked under the direction of Prof. Doug Eveleigh. His keynote presentation was on the applications of synthetic biology for metabolic engineering of industrial microbes.

Rutgers Day-AgField Day continues to be a fun event: "Boisterous biochemistry and marvelous microbiology" is our program theme. As in previous years, the G.H. Cook Biochemistry and Microbiology Undergraduate Student Club coached budding scientists in building their own microbes. We also initiated a straw-poll for the State Microbe that is still continuing - so you can send in your vote. With a State bird, insect, fish, flower and fruit, is it not time for a State Microbe? (see back page).

We welcome three new instructors Drs. Nathan Astrof, Kyle Murphy and Ines Rauschenbach, who join the department as Instructors in Biochemistry and Microbiology with appointments beginning this July.

Some much needed laboratory and office renovations are finally close to completion (for now). There are still many laboratories left in their original 1950s conditions, so there is much left to do. As always, I wish to thank all our donors for your support. We hope that you will continue to show your support for the department in the future.

Inside this issue:

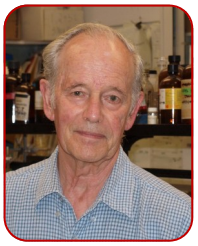
Our Biochemists

Some memories from **Dr. Theo vanEs** as he retires with over 42 years at Rutgers. I was born in Rotterdam, Netherlands in 1932 and lived in Holland until late 1945. As a child I experienced the Second World War first hand: five year occupation by Germans, bombed out of our home by allied strikes and the hunger and deprivation of the last year of the war. My parents and I immigrated in late 1945 to South Africa, at the invitation of my mother's sister who was living in South Africa. I completed high school in Johannesburg and went on to work as a laboratory technician in a petrochemical refinery. After two years of working in the refinery, I enrolled at the University of Witwatersrand (Wits) as a chemistry physics major, on a Johannesburg Municipal Scholarship. I completed my Bachelors of Science and Bachelors of Science honors in Chemistry. I worked as an industrial chemist for two years until I was invited back to Wits Chemistry Department as a lecturer (equivalent to an assistant professor). In addition to my teaching obligations, mainly large freshman chemistry lectures and labs, I was working on my Ph.D research under the guidance of the Head of the Department and Rhodes Scholar, Professor Backeberg.

I obtained my Ph.D after four years of research in the general area of a new synthesis of benzil derivatives. This research led to a number of publications. In 1962 I went on a sabbatical leave to the Biochemistry Department at Purdue University under the auspices of Professor Roy Whistler. It was a difficult year, as our family of five (3 young children) had to live in a small university apartment with limited financial resources!

At this time my research started to divert into the area of synthetic carbohydrate chemistry which persisted for a number of years. After a year at Purdue, I returned to Wits, where I was promoted to Senior Lecturer (equivalent to Associate Professor). I transferred for about two years to the Witwatersrand Medical School in the Department of Biochemistry and Physiology. From Wits, I went to Rutgers College in the Department of Biochemistry and have spent the last forty two (plus) years at Rutgers. I experienced many changes, promotions to Associate Professor to Full Professor with all the attendant heartaches, worries and disappointments. Reorganization which resulted in the formation of Faculty of Arts and Sciences. I was Department Chair for a number of terms as well as Director of the Biochemistry Graduate Program, and a Fulbright Award from Botswana.

Reorganization at Rutgers caused a great deal of disagreements and led eventually after many confrontations about faculty rights and responsibilities, to my removal from FAS to the Department of Biochemistry and Microbiology on the Cook Campus. An enforced move, perhaps, but I have no regrets, only appreciation!
So we have come to a long tale of having taught thousands of students over nearly 55 years, an appreciable amount of research resulting in nearly 75 papers and a patent, the content of which, to this day is producing valuable pharmaceutical products. A full life indeed! Shorty, I will turn 80 years old. My wife and I will move to Knoxville, Tennessee where, hopefully, I will be afforded the opportunity there to interact with students. I will sorely miss Cook College, the Department of Biochemistry and Microbiology and all of you!



"*The world needs new ways to grow food*" is the title of an op-ed published in the Newark Star-Ledger on March 27. It is **by Peter Kahn** and can be found at the url below.

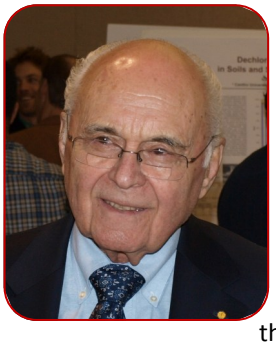
http://blog.nj.com/njv_guest_blog/2012/03/the_world_needs_new_ways_to_gr.html

The op-ed arose from a paper, *"Investing in Perennial Crops to Sustainably Feed the World"* which appeared in the Summer, 2011, issue of Issues in Science and Technology, a quarterly journal published jointly by the National Academies of Science, Engineering and Medicine. The paper was coauthored by Kahn, Thomas Molnar, C. Reed Funk and Gengyun Zhang. Dr. Molnar is a colleague in the department of Plant Biology & Pathology, Dr. Funk is Professor Emeritus in the same department, while Dr Zhang earned his doctorate with Dr. Funk and also studied with Kahn.

The project is a proposal to set up perennial plant research stations all around the world to reclaim damaged land, especially sloping land which erodes when annual crops are planted on it. The plants would include many kinds of trees to provide food, woody biomass for construction and fuel, oil and other products. The stations would also develop grasses and other plants to be planted in mixed cultures among trees and on land presently unable to sustain trees. In combination the plants in each region would stabilize and enrich soil, increase water percolation into aquifers used for irrigation, reduce or prevent mud slides, and absorb large amounts of carbon dioxide. There would be 3-5 stations each in China, South Asia, Africa, South America, North America, the Middle East, Australia and Japan Each would be endowed with $20-$40 million dollars, which at 5%-7% average annual income, would yield enough to run the stations. The funds would be raised privately, as governmental and commercial support is short term, while perennial plant development is longer term.

These ideas arose because Dr. Funk, a plant breeder with encyclopedic knowledge of plants worldwide, had his office directly above Dr. Kahn's. They found themselves going to lunch together frequently, and the conversations led to the collaboration. Many of the ideas have their origin in J. Russell Smith's book, Tree Crops: A Perennial Agriculture, which was first published in 1929 and in revised form in 1950.

David Pramer- The ASM Founders Distinguished Service Award

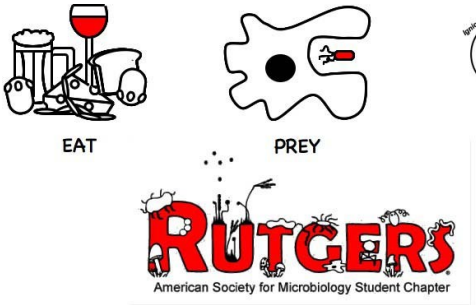


David Pramer was recently asked by the American Society for Microbiology to reflect on his being awarded the ASM Founders Distinguished Service Award. For perspective, David was the first Chair of the Department of Biochemistry and Microbiology [newly formed from the Departments of Ag Biochemistry and Ag Microbiology on Dr. Starkey's retirement] and Past Director of the Waksman Institute. He also served the University as Director of Biological Sciences, Director of University Research, Associate Vice President for Research and Sponsored Programs, and Associate Vice President for Corporate Liaison. David has kindly shared his thoughts.

When returning home unharmed from World War II, and being fortunate enough to enroll in college under the G.I. Bill, I promised myself to pursue a career that would enable me to contribute to making this a better world while doing work that would provide me with personal satisfaction as well. I was admitted to Graduate Study in Microbiology at Rutgers University. The Department Chair was Dr. Selman A. Waksman [Nobel Laureate]. Dr. Robert L. Starkey was my Thesis Advisor. Both men were Past-Presidents of the American Society of Microbiology [ASM] and they made clear to their students that the ASM was our "Professional Voice", and that membership in the Society was obligatory, as was participation in the Society's Meetings. I did as I was taught. I have been an ASM member since 1950, I attended meetings regularly and I have had the privilege of serving on various ASM Committees and Boards. Moreover, as Professor of Microbiology, Chairman of the Department of Microbiology and Director of the Waksman Institute of Microbiology at Rutgers University, I have attempted to convey to my students and faculty associates an understanding of the importance of the ASM, not only for their welfare and the welfare of their chosen profession, but also for the well-being of the Country in which we live. In 2002, some 50 years after I committed myself to pursuing a career in Microbiology as an avenue to making this a better world, while providing opportunity for personnel satisfaction as well, I was awarded the ASM Founders Distinguished Service Award. The Award brought many expressions of congratulations and best wishes, and it and no doubt facilitated my future professional endeavors. To me, however, the Award was most important because it represented tangible evidence that I had, indeed, realized the goal that I had set out to accomplish some 50 years earlier. David Pramer, Distinguished Professor Emeritus of Microbiology.

ASM—Student Chapter

The Rutgers' American Society for Microbiology (ASM) Student Chapter is a graduate student organization (GSO) that is open to all students at Rutgers, including undergraduates, that are interested in the wonderful field of microbiology. This GSO has recently begun ramping up its activities and are more actively encouraging new membership in the group. This spring four new officers began their tenure with the organization: Nick Rose, President; Tiffany Louie, Vice President; Pooja Mishra, Treasurer; and Tong Liu Secretary. In their first semester, the new officers have held three GSO meetings, setup a social hour for members of the club, designed new Rutgers ASM T-shirts (see below). They also organized a student poster and oral presentation session for the Theobald Smith Society's Meeting in Miniature on April 30, 2012. The Theobald Smith Society (TSS) is the New Jersey ASM branch. In addition to that, the group is in the process of inviting a speaker who will give a talk on their research and have a sit down lunch discussion with microbiology students at Rutgers.



Please stop by and see any of the officers to purchase a tee shirt or tote bag ($10 each). Contact: tslouie@eden.rutgers.edu

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Pictured: **Costa Vetriani** collects chemosynthetic bacteria from the vents in the Aegean Sea, Milos

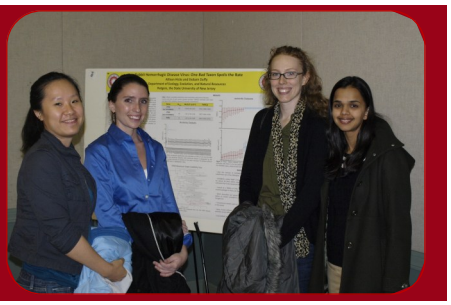
Symposium - Microbiology at Rutgers University

Cultivating Traditions, Current Strength and Future Frontiers

Thursday, February 2 & Friday, February 3, 2012

School of Environmental and Biological Sciences (SEBS)

Steve Picataggio and Douglas Eveleigh



YM. Seah, A. Hicks, J. McConnell, P. Gadkari

Stephen Picataggio, Chief Scientific Officer of Verdezyne Inc. Carlsbad, CA, was the keynote speaker. His talk **"Applications of Synthetic Biology for Metabolic Engineering of Industrial Microbes"** presented an overview of over 25 years of experience in metabolic engineering of industrial microorganisms and development of fermentation processes for production of renewable fuels and chemicals. Some of the products highlighted included biobased feedstocks as alternatives to petrochemicals such as adipic acid, a precursor of Nylon, coatings and even automobile parts, in addition to renewable fuels. The neutraceutical New Harvest (polyunsaturated omega-3 fatty acids) had been brought to commercialization based on the non-conventional yeast *Yarrowia lipolytica.* Dr. Picataggio earned his Ph.D. in 1983 from the Rutgers Graduate program in Microbiology with Doug Eveleigh.

The symposium featured speakers from ten departments and institutes at Rutgers and the University of Medicine and Dentistry of New Jersey:

Kay Bidle (Institute of Marine and Coastal Sciences) "A host-virus chemical arms race at sea: placing subcellular controls of cell fate into an ecological and biogeochemical context"

Nathan Yee (Department of Environmental Sciences) "Evolution of metalloid respiring bacteria over Geologic Time"

Costantino Vetriani (Dept. Biochemistry and Microbiology and Institute of Marine and Coastal Sciences) "Chemosynthetic microbial biofilms at post eruptive vents on the East Pacific Rise at 9°N"

Ann Stock (Center for Advanced Biotechnology and Medicine-UMDNJ) "Targeting two-component regulation of virulence in *Staphylococcus aureus* for inhibitor development"

Nihal Altan-Bonnet (Federated Department of Biological Sciences – Rutgers Newark/NJIT) "Viral intracellular rewiring to generate organelle platforms for replication"

Richard Ebright (Waksman Institute) "Structural basis of bacterial transcription initiation"

Nancy Woychik (Department of Molecular Genetics, Microbiology & Immunology – UMDNJ) "Bacterial persistence, pathogenesis and toxin-antitoxin systems"

Robert Goodman (Executive Dean of Agriculture and Natural Resources) "Environmental genomics: Looking back and looking ahead--some personal reflections"

Jeferson Gross (Department of Ecology, Evolution, and Natural Resources) "One year of experimental epigenomic evolution with microalgae"

Don Kobayashi (Department of Plant Biology & Pathology) "Role of pathogenicity mechanisms during interactions between the bacterial biocontrol agent Lysobacter enzymogenes and fungal hosts"

Jim Polashock (Philip E. Marucci Center for Blueberry and Cranberry Research and Extension) "Solving the nearly 100-year-old mystery of fairy ring disease of cranberry"

Over 50 posters were presented bringing together over 200 students, postdocs and faculty for insightful discussions on a diverse set of studies in microbiology.

Please mark your calendars for our 2013 Microbiology Symposium on February 1 and 2, 2013

Our Faculty

Gerben Zylstra assumed the chairman position of American Society for Microbiology Division Q (Environmental and General Applied Microbiology) July 2011– July 2012.

One of **Gerben Zylstra's** published papers recently made the list of the 20 Most-Frequently Cited Articles of all time in Applied and Environmental Microbiology. This paper, coauthored with then postdoctoral associate Jonathan Dennis in 1998, is entitled "Plasposons: Modular Self-Cloning Minitransposon Derivatives for Rapid Genetic Analysis of Gram-Negative Bacterial Genomes."

Jeff Boyd presented a talk entitled: Iron-Sulfur Cluster Metabolism in *Staphylococcus aureus*, at the 55th Annual Wind River conference on Prokaryotic Biology, June 8th to 12th, in Colorado.

In January **Prof. Max Häggblom** visited Vietnam and China. He was invited to give a talk on microbial respiration of selenium and arsenic at the University of Hong Kong while visiting the group of Prof. Ji-Dong Gu in the School of Biological Sciences. He then continued to Cantho University in Vietnam to teach a 1-week short course on environmental microbiology to a group of Ph.D. and M.S. students. At Cantho he also worked with Dr. Vien Minh Duong and his students on joint projects on biodegradation of pesticides and dioxins. From Vietnam Dr. Häggblom continued to China, to the Institute of Urban Environment at the Chinese Academy of Sciences in Xiamen, where he also taught a short course on environmental microbiology to graduate students and Post-Doctoral scientists of the institute. At IUE Dr. Häggblom is collaborating on research projects on the fate of pollutants in sediments and on microbial reduction of selenium oxyanions.

In January **Max Häggblom** served as the external examiner of the Ph.D. thesis of Mr. Sivaraman at the Birla Institute of Technology, KK Birla Goa Campus. (The examination was conducted via Skype, while Max was in Xiamen, China). Mr. Sivaraman's study on the biodegradation of hydrocarbons was supervised by Dr. M. Srikanth, who in 2011 visited Rutgers on a American Society for Microbiology Indo-US fellowship.

The 112th ASM annual meeting San Francisco, 2012 inspired a departmental get together of the older timers (1970s-1980s) through the invitation of Judy Wilber and Bob Miller in Oakland. The old department events were laid bare yet with witticism and frivolity. Water pouring forth from the back door and the subsequent visit from the Dean of Water - at that time all microbiology labs were on the third floor. The requirement to remove "static" producing nylon underwear in order to get the pH meter to work. The removal of the amino-acid analyzer via the third floor window, and of course rapid pipetting to recover purified enzyme from the laboratory floor – is that where the "5 second food rule" came from (safe if only there for 5 seconds). Indeed there were so many stories of note, especially the revised geriatric versions, that Linda and Dennis Fenton invited all to sally forth for a second evening of tall stories The coach trip to ASM in Chicago with the vast stock of beer virtually gone by the outskirts of New Brunswick though this inspired singing for the next 20 hours, the washing of one's arms with ninhydrin to clean the skin, the drinking of the buffer to assess which contained salt. Sheer delight as the old grey cells were revived and remembrances were relived. Indeed send Kathy Maguire your own remembrances which she has offered to give editorial spacing for publication in the Log. You may go to our home page and fill out the "alumni form" to add a remembrance!

Pictured: Left to right, front row: Linda Sherwood, Linda Fenton, Anne Nakas, Doug Eveleigh, Laura Macmillan, Judy Wilber. Back row: JP, Bob Miller, Jim Nakas, John Sherwood, Jim Macmillan, Christine Rotgers; Dennis Fenton. Tim and Pam Bartley, Peggy Souser Woehleke and Tom Kelleher were unable to be present for the second evening of conviviality.

Faculty (continued)

Tamar Barkay attended The 11th International Conference on Thermophiles Research. Big Sky, Montana, Sept. 11-16, 2011 where she gave an invited talk "*The origin, evolution, and distribution of the mercury resistance (mer) system in geothermal environments",* and presented a poster by Zac Freedman and Tamar Barkay: Mercury resistance among thermophilic Aqificales.

Max Häggblom chaired the 2011 Gordon Research Conference on Applied and Environmental Microbiology, held at Mt. Holyoke College, MA, July 10-15. The AEM is one of the longest running of the Gordon Conferences, being held every two years since 1950. The theme of the 2011 conference was "Functional Interactions from Molecules to Biomes". Over 170 scientists from more than 25 countries participated in the conference to discuss cutting-edge research in the field of applied and environmental microbiology, with a focus on understanding the functional interactions between microorganisms and their environment at levels ranging from molecules to biomes. The Conference will feature a wide range of topics, such as how microbes interface with each other and with "macrobes", the evolution of microbial species and their genomes, the role of small molecules in "microbial conversations", microbial metal interactions and redox processes, as well as applications of biodegradation, bioremediation and bioenergy. **Lee Kerkhof** (IMCS) served as one of the Discussion Leaders while **Doug Eveleigh** (Biochemistry and Microbiology) gave the concluding talk. The conference received support from the Office of Naval Research, Department of Energy, National Science Foundation and Rutgers School of Environmental and Biological Sciences. More information is available at: http://grc.org/programs.aspx?year=2011&program=applied

Max Häggblom was an invited speaker at the Society for Industrial Microbiology Annual Meeting, July 24-28, 2011 in New Orleans, LA. His presentation on Microbial Respiration of Selenium Oxyanions was part of a special session on Microbial transformation of arsenic and selenium for bioremediation.

The research article by Jessica M. McCormick, Theo Van Es, Keith R. Cooper, Lori A. White, and Max M. Häggblom, Microbially Mediated O-Methylation of Bisphenol a Results in Metabolites with Increased Toxicity to the Developing Zebrafish (*Danio rerio*) Embryo, published in Environmental Science and Technology (DOI: 10.1021/es200588w) was highlighted Chemical & Engineering News (June 23, 2011 DOI:10.1021/CEN062311292128 A New Hazard From Bisphenol A?). The study led by **Max Häggblom** and **Lori White** (Biochemistry and Microbiology) found that certain bacteria turn BPA into compounds more toxic to fish than BPA itself. BPA, which is produced by the millions of tons each year by industry, mimics the female sex hormone, estrogen. Bacteria were shown to O-methylate BPA to its mono- and dimethyl ether derivatives, with increased toxicity to developing zebrafish embryos. This transformation of BPA could occur in the environment, and warrants further study.

Max Häggblom (Biochemistry & Microbiology) was the lead instructor for the Rutgers Study Abroad course on the Microbiology and Culture of Cheese and Wine, held in Burgundy, France, June 13-26, 2011. Drs. Catherine Healey (Resident Director for Rutgers Study Abroad Programs in France) and Stephen Reinert (Dean of Rutgers Study Abroad) also participated in the two-week intensive course. Nine students had the opportunity to explore the microbiology and culture of cheese in Burgundy, discover how milk is curdled and processed into cheese, learn about the history and practice of viticulture and savor the culinary heritage and produits de terroir. One of the highlights was the visit to Pasteur's home and laboratory in Arbois**.**

On December 5-7, 2011, **Costantino Vetriani** taught in the training course "Extreme environments and deep-sea ecosystems" at the Universite` Pierre et Marie Curie, Observatoire Oceanologique de Banyuls-sur-Mer, Banyuls-sur-Mer, France, on the themes: 1) "Molecular tools in microbial oceanography", and 2) "Microbiology of deep-sea hydrothermal vents: Microbial colonization, biofilms, thermophiles".

On December 1, 2011, **Costantino Vetriani** gave an invited seminar entitled: "Chemosynthetic microbial biofilms: Understanding the foundation of deep-sea hydrothermal vent ecosystems" at IFM-GEOMAR, Kiel, Germany. .

On November 9, 2011, **Costantino Vetriani** gave an invited seminar entitled: "Chemosynthetic microbial biofilms from deep-sea hydrothermal vents: insight from laboratory and in situ studies" at Queens College, New York, NY.

Expeditions:

Donato Giovannelli, a graduate student in **Costa Vetriani's** laboratory, participated in an oceanographic expedition aboard the French Navire Oceanographique L'Atalante on March 11-26, 2012. He collected samples from the deep-sea vents located on the East Pacific Rise at 9° and conducted shipboard experiments on chemosynthetic microbial communities.

Donato Giovannelli swims above a field of vents that release carbon dioxide

Ph.D Theses-2011-2012

Ines Rauschenbach Graduate Program in Microbiology and Molecular Genetics

Growth, Genes, Genomes- Insights Into Microbial Respiration of Arsenic and Selenium.
Advisor: Max Häggblom

Arsenic (As) and selenium (Se) are a naturally occurring, metalloid elements which are ubiquitously found in nature. High concentrations of As and Se oxyanions in the environment have been shown to be toxic to the animals that inhabit these contaminated areas. The global As and Se cycles are greatly influenced by microorganisms. Even though concerted efforts have been made to isolate and characterize new species, only a few organisms have been identified that utilize dissimilatory As and Se reduction to reduce selenate to selenite and selenium. Despite identification of many new isolates and ongoing research on the reduction and oxidation of As and Se-oxyanions has taken place, we still do not know much about the physiology and ecology of the diverse group of bacteria that mediate this process. We isolated two novel arsenate and selenate-respiring bacteria, strain S4T and Desulfurispirillum indicum strain S5T from two diverse environments. The annotation of the whole genome sequence of D. indicum enabled us to identify and characterize the reductases and molybdoenzymes involved in arsenate and nitrate respiration. Genome analysis uncovered five sequences carrying the signatures of molybdoenzymes. Three of the molybdoenzyme sequences were found to cluster with the respiratory arsenate reductase Arr, the alpha subunit of the membrane-bound nitrate reductase Nar, and the periplasmic nitrate reductase subunit NapA, respectively. Further analysis of the genome context revealed the presence of additional sequences encoding operons of each enzyme, and a gene organization resembling typical arr, nar, and nap operons. Expression studies showed that arr was the only gene highly expressed during arsenate respiration, verifying its annotation as the respiratory arsenate reductase in D. indicum. The results of this genomic analysis provide insights into the metabolic pathways for energy production in contaminated environments, and how these pathways are regulated depending on the availability of oxyanions.

Sean Bugel: Graduate Program in Environmental Sciences

Contaminant effects on vitellogenesis and oogenesis in zebrafish (*Danio rerio*), and killifish (*Fundulus heteroclitus*) from the chemically impacted Newark Bay, NJ.
Advisor: Keith R. Cooper

The studies in this Dissertation tested the general hypothesis that contaminants in Newark Bay, NJ (specifically the aryl hydrocarbon receptor agonists) alter the gene–regulation of hepatic vitellogenin and down–regulate the pathway, resulting in inhibition of oogenesis and reproductive failure in a population of killifish from Newark Bay, NJ. Vitellogenin proteins are large glycolipoproteins that are precursors to yolk–proteins in developing oocytes of nearly all oviparous organisms (e.g. birds, amphibians, reptiles, fish, insects). Vitellogenins are synthesized exclusively in the liver of teleosts and are used to transport vital biomolecules (amino acids, lipids, sugars, minerals) into the egg–yolk to act as growth substrate during early development. I demonstrated Newark Bay killifish exhibited reproductive failure due to inhibition of oocyte yolk–development, which resulted in decreased egg production, decreased embryo mass and reduced yolk–volume. The mode of toxicity for these impacts is shown to be the down–regulation of vitellogenesis in the liver. Decreased vitellogenin expression during spawning is demonstrated to be due to deficient levels of circulating 17β–estradiol, and a decreased sensitivity of the vitellogenin pathway to induction (protein and mRNA levels) by physiological doses of 17β–estradiol. In the Newark Bay population, vitellogenin expression was inversely correlated with CYP1A, a biomarker for aryl hydrocarbon receptor 2 (AhR) activity. I therefore propose that the down–regulation of the vitellogenin pathway is phenotypic of aryl hydrocarbon receptor (AhR) mediated cross–talk inhibition of the estrogen receptor (ER). To further examine the role of AhR2 in mediating AhR–ER cross–talk inhibition of vitellogenin, the zebrafish model was developed as a comparative tool to demonstrate the mechanism of action. Findings demonstrated that the potent AhR agonists 2,3,7,8–tetrachlorodibenzo–p–dioxin and 1,2,3,7,8–pentachlorodibenzo–p–dioxin inhibit the induction of vitellogenins 1, 2 and 3 by 17α–ethynylestradiol in zebrafish. To determine the role of the AhR2, an AhR2 splice–variant morpholino was used to transiently knock–down AhR2 levels during development. These data showed that knockdown of AhR2 activity reduced inhibition of vitellogenesis by 2,3,7,8–tetrachlorodibenzo–p–dioxin, demonstrating that AhR2 activation mediates AhR–ER cross–talk inhibition of vitellogenesis**.** Taken together, these studies demonstrate that contaminants that down–regulate vitellogenesis in the liver can manifest reproductive failure in the ovary and indicate that the mechanism of these effects are mediated through AhR2–ER signaling pathways.

Aspa Chatziefthimiou, Ecology & Evolution Graduate Program

The Effect of Long-Term Mercury Contamination on the Composition and Diversity of Soil Bacterial Communities in Riverine Ecosystems.
Advisor: Tamar Barkay

Hg contamination in riverine ecosystems is a persistent problem and clean-up efforts are a priority for EPA and local federal governments as potential methylation of Hg increases its toxicity due its bioaccumulation and biomagnification in aquatic food chains. Understanding the microbial contribution to Hg contamination is of particular importance as microbial communities occupy the base of the food chain and the way they transform Hg has bottom-up effects to all trophic levels. The broad objective of this thesis was to investigate the role of abiotic factors in shaping the composition, diversity and distribution of bacterial communities inhabiting floodplain soils of the East Fork Poplar Creek (EFPC), TN, and South River (SR), VA, chronically contaminated with Hg as a result of industrial processes. Analysis of soil samples from the EFPC by direct cultivation and isolation, revealed a metabolic-dependent effect of Hg-stress on bacterial populations, with copiotrophs exhibiting higher mercury reduction potentials, as well as phylogenetic and functional diversity, than oligotrophs. As the great majority of the strains contained a *merA* gene in their genome, Hg-resistance in these isolates may have been conferred by the functions of the mercury resistance (*mer*) system.

Ph.D Theses-2011-2012

A total of 27 phylogenetic incongruencies were observed between this and the 16S rRNA genes of the isolates, suggesting that horizontal gene transfer may play a role in Hg adaptation. The culture-independent method of 16S rRNA-fingerprinting was used to assess spatial distribution and diversity of bacterial communities along the Hg-contamination gradient in SR. Higher levels of diversity were obtained in communities that experience low as compared to high soil Hg levels. The best predictors of community diversity were pH, moisture and soil texture, whereas THg and geography were poor predictors. In this study a new *merA*-based t-RFLP method was designed to assess distribution and diversity of *merA* genes. Results show high levels of diversity for this gene and clustering based on geographical proximity. These findings highlight the impact of long-term Hg-stress on microbial communities in riverine ecosystems and provide a micro-ecological framework for future remedial actions in Hg contaminated sites.

Zachary Freedman, Ecology & Evolution Graduate Program

Microbially Mediated Mercury Detoxification in Geothermal Environments: Interactions of Aquificae with Mercury, and Evidence for Phylogenetic Niche Conservatism in Yellowstone National Park Hot Springs.
Advisor: Tamar Barkay

Geothermal features are noted by leaching of minerals and metals as superheated water flows through cracks and fissures in Earth's crust. As this water reaches the surface, chemical, pH, and temperature gradients are created that drive life in these diverse environments. Geothermal environments are often enriched with toxic metals, e.g. mercury (Hg), the focus of this dissertation. Resistance to toxic Hg(II) is controlled by the enzyme mercuric reductase (MR), which catalyzes Hg(II) reduction to Hg(0). The gene encoding MR, merA, is part of the mercury resistance (mer) operon, which at minimum includes genes encoding transport, enzymatic, and regulatory functions. The primary objective of my research was to achieve better understanding of biotic transformations that modulate Hg toxicity in geothermal environments. I characterized Hg-resistance in Aquificae, dominant primary producers in geothermal environments, and investigated the diversity and distribution of Hg-resistance genes in geochemically diverse hot springs in Yellowstone National Park (YNP), and 23 assemblages on a global scale.

Two strains of Aquificae were obtained; Hydrogenobaculum sp. Y04AAS1 (AAS1) and Hydrogenivirga sp. 128-5-R1-1 (R1-1). Genome sequencing revealed homologous sequences to merA, and alignment of putative Hg-resistance genes, MerA, MerT (Hg(II) transporter) and MerP (periplasmic scavenger), reveal homology with the mer system of Tn501. Characterization of mer in AAS1 and R1-1 include growth in Hg concentrations >10 _M Hg(II), loss of Hg(II) from the growth medium, validation of Hg(0) production, and MR enzyme activity; mer induction was not observed, suggesting lack of regulatory function.

Microbial mat biomass was collected from Bijah and Succession Springs, YNP, and environmental merA sequences were obtained from GenBank to determine the ecological controls on Hg-resistant communities in YNP hot springs, and on a global scale. merA assemblages exhibited grouping within the community, and total sequence pool, as indicated by positive net relatedness index and nearest taxon index values, respectively. Cluster analyses reveal different clustering patterns of 16S rRNA and merA gene assemblages from YNP, suggesting unique controls on 16S rRNA and merA gene community structure. Meta-analysis of merA communities from 23 assemblages encompassing 782 environmental sequences reveal clustering based on sample location, suggesting that geography structures Hg-resistant communities.

I'leana Pérez-Rodríguez, Ecology & Evolution Graduate Program

Microbial ecology of deep-sea hydrothermal vents: physiology and cell-to-cell communication in anaerobic chemosynthetic bacteria.
Advisor: Costantino Vetriani

The global influence of mid-oceanic ridges (MOR) first became apparent through continental drifting– its immanent force easily appreciated in today's resulting continents. The role of MORs as a source of global-ocean chemistry is less apparent but equally immense. Key to these processes is fluid-rock reactions between circulating seawater and hot new basalt. With the discovery of hydrothermal vent ecosystems in the 1970's, yet another important consequence of rock-fluid interaction was established in chemosynthesis. Early photographic descriptions of "frosted white and yellow precipitates" covering basalt rocks close to discharged hydrothermal fluids, with benthic communities emerging from them, referred to the now known chemosynthetic biofilms that interact with hydrothermal fluids. These microorganisms have a pivotal role in transforming the geochemistry of Earth's oceans.

The main objectives of this dissertation are to study anaerobic chemosynthetic vent microorganisms, and to explore the molecular ecology of these biofilm communities. Initial approaches included isolation of anaerobic chemosynthetic microorganisms resulting in the description of two novel bacterial species: the epsilonproteobacterium *Nautilia nitratireducens* strain MB-1T, and *Phorcys thermohydrogeniphilus* strain HB-8T, a new genus in the Aquificales. Both bacteria are obligate thermophilic anaerobes, capable of hydrogen oxidation coupled to sulfur- and nitrate-reduction.

Further investigation focused on mechanisms regulating vent biofilms, the dominant growth strategy in vent microbial communities. Quorum-sensing (QS), a mechanism relying on cell density and the production of extracellular signals for cell-cell communication, is used by many microbial species to regulate biofilm formation. One QS signal is Autoinducer-2, whose precursor is synthesized by the LuxS enzyme. To study QS in vent environments, Caminibacter mediatlanticus and Sulfurovum lithotrophicum, cultured members of the well-represented Epsilonproteobacteria, were used as model systems. The luxS gene and transcripts were detected in their genomes and during growth, respectively; these luxS-expressing cultures induced bioluminescence, a QS response, in a *Vibrio harveyi* reporter strain. Detection of luxS transcripts in-situ, also indicated that QS is likely occurring in natural vent biofilms. This data demonstrates that vent Epsilonproteobacteria posses the luxS/AI-2 system for cell-cell communication. This work is relevant to our overall understanding of microbial phenotypic plasticity in response to environmental factors.

Our Department

Ameya Mashruwala (Boyd lab) was awarded best student presentation at the 2011 Theobald Smith Society, New Jersey branch of the American Society of Microbiology. His talk entitled Environmental sensing in *Staphylococus aureus*: sense, survive, stealth and subvert. Also, congratulations to **Ameya** the Admissions and Academic Standards Committee has nominated him for a $1,000 **Hachnasarian Fellowship.**

Sean Bugel (Cooper Lab) was awarded 3rd Place for his presentation at the Mid-Atlantic Society of Toxicology Annual Meeting Iselin, New Jersey.

Kimberly Cruz

Madhavi Parikh

We are pleased to announce that **Kimberly Cruz** (Graduate Program in Toxicology) and **Madhavi Parikh (**Graduate program in Microbial Biology) have been selected as the recipients of the **Robert S. and Eileen A. Robison Scholarship Award for 2011**.

The Robert S. and Eileen A. Robison Scholarship Award for Excellence in Graduate Studies was established in 2003 and is supported by the Robison family. This year we also have additional support from the Linda and Dennis Fenton Fund. The scholarship is awarded to a graduate student who has demonstrated tremendous competence and accomplishment in their academic and research program while at Rutgers University, has shown an active participation in or a leadership role in the activities of the department, college, university or community, and is motivated to help and improve the human condition at this time and upon graduation. Dr. Robert Robison earned his BS and MS degrees at Cornell University and a PhD degree at Rutgers University in Microbiology in 1954. His research at Rutgers was in soil microbiology and streptomycin synthesis in actinomycetes under the supervision of Selman Waksman, Robert Starkey and Walter Nickerson. The award presentation took place on March 30.

Congratulations to the following students for their excellence and achievements:

Preshita Gadkari received the 2012 Selman A. Waksman Award for Academic Excellence in Microbiology. Preshita is a double major in Microbiology and Biotechnology. The 2012 David H. Strumeyer Award for Academic Excellence in Biochemistry went to **Ekta Makwana.** Ekta majored in Biochemistry and will be graduating with a 4.0.

Peng Wai Tham, Umut Turkdogan, Guadalupe Cruz, Yung Chan and **Chris Choi** received the Dr. Theodore Chase 2012 Distinguished Scholar Award for Biochemistry majors.

The 19th Annual Celebration of Excellence-April 25, 2012. Congratulations to **Peter Anderson** (pictured right with Dean Robert Goodman) on his much deserved Staff Excellence Award. Peter, who has worked at Cook College and now the School of Environmental and Biological Sciences for nearly 25 years, excels in all criteria of this award. In his position at Information Technology Services he provides superior and sustained support as the computing specialist for the departments of **Biochemistry & Microbiology**, of Entomology, and of Ecology, Evolution, & Natural Resources. His activities and support, however, go far beyond his specific information technology duties: He is a polymath of operations. He greases current systems to ensure smooth operation. He visualizes potential problems. He is renowned for his help coordinating operations between the various offices and between departments.

He continually contributes to a positive, collaborative work environment. In delivering exemplary service to others, Peter continues to exhibit exceptional resourcefulness, innovation, and creativity. He has demonstrated excellence in his job performance and beyond. And is thus truly worthy of a 2012 Staff Excellence Award!

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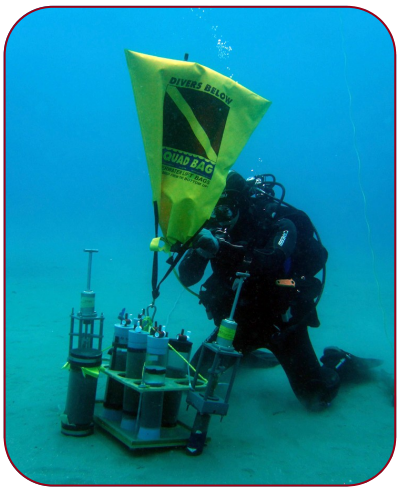


In May, 2012, **Costa Vetriani** was one of the leading scientists, along with Stefan Sievert (WHOI) and Dionysis Foustoukos (Carnegie Institution), that participated in an expedition to study the shallow-water hydrothermal system of Paleochori Bay in the island of Milos, Aegean Sea, Greece. During the course of the expedition, Costa Vetriani and Donato Giovannelli (a graduate student in Costa's lab) collected sediment and biomass samples by SCUBA diving (see photos). This NSF-sponsored project employs a powerful combination of cutting-edge research tools aiming to improve our understanding of autotrophic carbon fixation and its chemical and isotopic signature along environmental gradients in the shallow water hydrothermal system of Milos island.

What' Shaking

Congratulations to **Kyle Murphy** and Erica Murphy the new parents of twins— Two new babies entered the world on May 11th at 1:53 am. Kayla Elizabeth Murphy 14.45g (3lbs 3oz) 41.5cm (16.3") and Donovan Andrew Murphy 14.75g (3lbs 4oz) 41cm (16.1") Both babies, Mom and Dad are doing fine.

The **2012 NEMPET** meeting (NorthEastern Microbiologists—Physiology, Ecology, Taxonomy) meeting at Blue Mountain Lake, the Adirondacks, June 29-July 1, 2012.

(Left to right). KD Terza, S Rawat, D Eveleigh, M Deshpande, R Pineda, K Haas (UMASS), C Phelps, T Barkay, P Gadkari, S Kannepali, T Liu, H Dam and B Subramaniam. (P Mishra: photographer).

Several microbiologists from the Department and others also from the Ag. School (SEBS) escaped from a searing NJ heat wave heat to attend the annual NEMPET NorthEastern Microbiologists—Physiology, Ecology, Taxonomy meeting at Blue Mountain Lake, the Adirondacks. The lead talk was by our guest, Mukund Deshpande, (National Chemical Laboratory, Pune, India) "Biopesticides: an alternative to chemical insecticides". This brought back memories of David Pramer's research with the dastardly nematode trapping fungi. The diversity of the SEBS programs was manifest with studies on the bovine rumen virome (Prisheta Gadkari), magnificent microbes that dechlorinated dioxins (Hang Dam), ripped apart methyl tert-butyl ether (MTBE)(Tong Liu), considered clever little devils that could mobilize arsenate (Pooja Mishra,) and even respire arsenate and selenite (Bavani Subramaniam), how Acidobacteria dominate the microbial activities in the Arctic tundra (Suman Rawat); microbial foods such as wood mulch leachate (Sarat Kannepalli), "negative log hydrogen concentration" loving, flashy methanogens (Katherine Della Terza), salty, mercury loving, stinking reducers (Rainier Pineda and Tamar Barkay), Craig Phelps illustrating basics of biochemistry using soil rather than mushy chicken liver, and even history "Star Wars: the Selman Waksman and Albert Schatz debate" (Doug Eveleigh). The meeting attracts undergrads to crusty old professors – a marvelous rambunctious mix evident during the microbial nature-walk when leghemoglobin in legume nodules, mycorrhizal roots, edible mushrooms (free for dinner), flammable gas, and leprechaun lichens are revealed. Make plans for next years "Must attend event".

GRANTS:

Tamar Barkay was awarded a $1,099,555 grant from the Office of Biological and Environmental Research – Dept. of Energy for "Microbial Oxidation of Hg(O): Its effect on Hg stable isotope fractionation and Methylmercury Production."

Tamar Barkay PI was awarded a grant from the Department of Energy SBR Program. "*Microbial Oxidation of Hg(0): Its Effect on Hg Stable Isotope Fractionation and Methylmercury Production*" (with **Nathan Yee** and **John Reinfelder**) total award $1,099,555 through August 2014.

Tamar Barkay PI was awarded a grant from the Dept. of Environmental Resources, Utah "*Mercury Biogeochemistry in Great Salt Lake: The Role of Microorganisms in Methylation*". Co-PI (with Bonnie Baxter [Westminster Collage] and Eric Boyd [Montana State University]). $62,082. Through Aug. 2012.

Max Häggblom is the Principal Investigator on a new 4-year project funded (640,000 Euro) by the Academy of Finland on "The ecological role of Acidobacteria in carbon cycling in Arctic tundra soil ecosystems". The research will primarily be done at the Finnish Forest Research Institute with close collaboration with the Häggblom Lab at Rutgers.

Costantino Vetriani PI was awarded a three-year, $420,434 NSF Dimensions of Biodiversity collaborative grant with colleagues at the Woods Hole Oceanographic Institution, Carnegie Institution of Washington and Bigelow Laboratory for Ocean Sciences (total award granted: $1,918,359) through September 30, 2014. The collaborative research is titled "*An integrated study of energy metabolism, carbon fixation, and colonization mechanisms in chemosynthetic microbial communities at deep-sea vents*".

Costantino Vetriani PI was awarded a two-year, $196,655 NSF Biological Oceanography collaborative grant with colleagues at the Woods Hole Oceanographic Institution, and Carnegie Institution of Washington (total award granted: $432,033) through September 30, 2014. The collaborative research is titled *"Autotrophic carbon fixation at a shallow-water hydrothermal system: Constraining microbial activity, isotopic and geochemical regimes".*

VOTE VOTE VOTE

for New Jersey STATE MICROBE

State Bird – Eastern Goldfinch

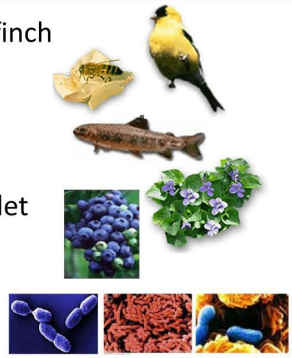
State Insect – Honeybee

State Fish – Brook trout

State Flower – Purple Violet

State Fruit – Blueberry

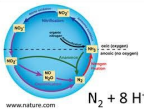
State Microbe – ???



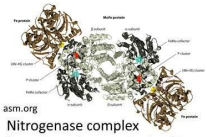
Candidate for NJ State Microbe

Azotobacter vinelandii

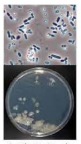
Jacob Lipman



$$N_2 + 8\,H^+ + 8\,e^- \longrightarrow 2\,NH_3 + H_2$$



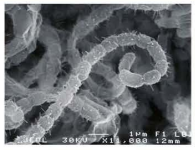
Nitrogenase complex from *Azotobacter vinelandii*



- Soil-dwelling bacterium
- Converts atmospheric nitrogen to ammonia (as a fertilizer)
- First isolated by Jacob Lipman, 1903, and named after Vineland, NJ
- Plays an important role in the Nature's nitrogen cycle
- A model microbe to study the process of nitrogen fixation

Candidate for NJ State Microbe

Streptomyces griseus



Streptomycin

A. Schatz and S. Waksman

- **Soil filamentous bacterium**
- **Gives soil its "earthy" smell by producing "Geosmin"**
- **Selman Waksman and Albert Schatz, 1944 discovered that it produces "Streptomycin", the first cure for tuberculosis**
- **Produces several antibiotics and pharmaceuticals**
- ***Out of the Soil Came Goodness***

Candidate for NJ State Microbe

Acidithiobacillus thiooxidans

- Used to recover metals from ores - bioleaching oxidation
- Cause of acid mine drainage
- Produces sulfuric acid from sulfur waste residues
- First described by Waksman and Joffe, 1922
- An autotrophic, acid-loving bacterium
- Previously known as *Thiobacillus thiooxidans*

Thanks to all who assisted in writing, assembling, editing, nudging, preparing, critiquing (always constructively), and producing this newsletter. Please feel free to email corrections, complaints, submissions to: maguire@aesop.rutgers.edu

Editors: Douglas E. Eveleigh, Max M. Häggblom and Kathy Maguire

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