**We spoke with microbial ecologist Ronald Oremland, author of 'Got Selenium?' for *FEMS Microbiology Ecology*, to talk about career choices, serendipity and perseverance in science, the fun of doing research, and the value of collaborators.**

**This interview was run for the #FEMSmicroBlog in the section #MicrobiologyIsFun**

**You can read the interview "Successful collaborations enable to delve into new realms of research" on the #FEMSmicroBlog. The whole interview is given below.**

*Illustrations for the #FEMSmicroBlog by Eliza Wolfson (FEMS and Eliza Wolfson/CC-BY-NC-SA).*

**In your retrospective article 'Got Selenium?' for *FEMS Microbiology Ecology* you present your work on microbial metabolism regarding Group 15 and 16 elements in the periodic table. If you would start your career today, would you focus on the same or on different elements, and why?**

"Boy, that's one ringer of a question! Something akin to going back 45 years ago and asking if I would have forsaken a scientific career and gone into: 1) medicine; 2) my family's business or 3) remained in the navy and made a career out of it? Definitely not number 3, unless I knew *a priori* that I would eventually become a Vice Admiral, emphasis on the "Vice" part. Let's repose this a little differently for practical purposes, OK?

"Let's go back > 35 years ago and say that John Conomos never came down that hall and hence, that I never had an incentive to work on selenium. I probably would not have taken this path that led to Group 15 & 16 elements. I would have continued to work on the methane cycle, but emphasizing Mono and Big Soda Lakes. This would have encompassed isolations of novel haloalkaliphilic methanogens and methanotrophs, delineating which substrates were preferred in these locations, and likely stronger collaborations with the late Dave Boone and the late Ron

Kiene in pursuing the conversion of alkylated sulfides to methane and higher alkanes. If I was starting out my career today, I wouldn't get into this field either because of all the great work done by those active all these years, especially a guy named "Overlamb" or "Oberland" or "Oremlump" or something sounding very similar to Oremland, and hence a likely relative. There wouldn't be much room to strike out on my own, unless I joined forces with one of those people and married the boss' daughter.

"Seriously, there are many other chemical elements out there to test, like redox reactions of iodine and other halogens that one could have made some inroads on. But most likely, I would have stuck with methane, since after all that's what I knew best and where all my friends at the time were active."

**From your writing emerges not only a passion for microbiology, but also an adventurous spirit in the field and in the lab, and a general fun in doing research. Is there a piece of experience you can pass over to early career scientists who need to endure a particular difficult situation, like a grant rejection or an important experiment who would not work?**

"Hmmm.

"Well, maybe we should start with deep philosophical but uplifting melodic insights from the likes of Fred Astaire and Ginger Rogers or perhaps Peter Boyle and Gene Wilder would be appropriate. Disaster struck the characters of both movies but it was eventually was overcome through character building perseverance and introspective insights. Young scientists are particularly frail when it comes to setbacks, and I can recall two instructive incidents of my own. When I was a grad student, I was trying to extract dissolved methane from seawater in a contraption modeled after that used by the folks at the Naval Research Labs (NRL), only the NRL model had fancy 8 port switching valves and cryo-traps, while mine was a much more modest array made of purloined Swagelok fittings, switches, and scavenged old copper tubing, all held together with spit and bubble gum. It should've worked, but it didn't. When I injected the extracted methane sample onto the GC, the instrument's chart recorder pegged and never came down. When rebuilding the apparatus with new copper tubing, I was told to first clean the tubing using organic solvents of increasing polarity. A light bulb went on in my head: the copper tubing apparently contains a thin layer of applied hydrocarbons to preserve its metallic "freshness" and what I was doing without prior cleaning was injecting those coating hydrocarbons onto the GC. No wonder it pegged. Hence, these must be removed in order to see anything isolated from the environment as a discrete peak. After that it worked like a charm, but I had wasted some 6 months tearing my hair out. Another stupid mistake came as a cocky know-it-all postdoc when I was trying to run

proteins using a simple tried and true Lowry method. For the life of me I could not get a reasonable standard curve with BSA protein. It turned out that the test tubes in the lab were rather short, and so to prevent spillage upon vortexing I capped them with rubber stoppers. The standards came in contact with the stoppers, and the stoppers all give off a variety of reactive volatiles that screw up the color change of the assay. A simple switch to taller test tubes purloined from another lab made everything workable, but I had wasted some 6 weeks, and was beset with self-doubts. In both cases outlined above, I was able to step back, think, and figure out what it was that I was doing wrong, sometimes with the helpful advice of a colleague.

"But now and then one really needs to take a break and have a little fun to lighten the mood. I recall an incident from grad school around the winter holidays (circa 1973) when 4 of us were in the lab (University of Miami's marine lab: RSMAS) one weekend working on our different thesis projects. It seemed we had each been at it 24/7 since the last Ice Age and were doing our best to ignore the festiveness of the outside world and soldier on, metaphorically with blinders fastened to our eyes. The bulk population of RSMAS itself was greatly diminished owing to the holidays and it being a weekend to boot, while we remained behind as castaways, in dour moods of unabashed self-imposed sacrifice, drudgery, and toil. At around noontime, Jorge Corredor (from Columbia) let out a loud sigh followed by an oral rejoinder: "What the ---- are we doing here?!?!" The 4 of us took a collective break (and a half empty jug of cheap wine from the 'fridge) and headed out to the pier to commiserate. We needed something to lift our spirits, and Jorge suggested we throw a dinner party for all our grad school friends still around, and that we make paella as the centerpiece with him as the chef. We pooled our meager financial resources for Jorge to procure and cook the needed rice, pimentos, saffron and some shellfish, while I went snorkeling off the pier and contributed the necessary fish. Steve Langley, my roommate, had acquired a talent for making passable (to impoverished grad student tastes) "wines" from discarded fruit and contributed several vintage bottles (> 1 month old) from his "cellar." That night we had about 30 people over to our Coconut Grove cabin for the feast and had a blast. The next day found us all back at our laboratory posts, but now we were smiling and could mentally perceive a light at the end of the tunnel from which we would eventually emerge from this sub-tropical purgatory with our advanced degrees clenched in hand."

**You said before that collaborators are crucial for a career in microbiology. Are colleagues serendipitous companions that share the same passion? What is the best way to approach a colleague who shares same interests but might also be competing on a similar project?**

"I can only respond by saying close collaborations have worked out very well for me. It might not be a panacea for everyone, and there are colleagues with whom I have avoided collaboration

with because the interpersonal chemistry did not feel right. Successful collaboration has enabled me to delve into realms of research in which I lacked technical competence, but nonetheless understood the importance and need for such a path to add complexity and detail to what we had previously only scratched the surface. In most cases these collaborations, especially if fieldwork was involved, evolved into close personal friendships.

"The hardest part of successful collaborations is to subsume your ego and the inherent psychological need to be the center of attention. This is a leadership skill one acquires with time, and it is not easy to develop. Your collaborators deserve their shot as well to be in the limelight (i.e., the lead author of a key paper). This is particularly difficult with competitors and may be facilitated by mentally figuring out beforehand who would be the lead author, a facet that could be aided by trying to come up with two papers rather than just one. That would give each of you a crack at such name recognition. Successful collaborations breed trust and friendships amongst those involved, and over time it gets easier to do, and is a very pleasant, long-lived experience."

**Isaac Asimov is quoted with *"The most exciting phrase to hear in science, the one that heralds new discoveries, is not 'Eureka!' but 'That's funny …'"* What is the most funny outcome of an experiment you remember? Was it worth of a new discovery?**

"I can recall an instance where both terms were applicable. It occurred in the course of our selenium work. I was carrying out a series of experiments with anoxic sediment slurries which I amended with selenate [Se(VI)] and a variety of electron donors to speed up the dissimilatory reduction of Se(VI) to Se(0). So I was already at the "eureka!" phase in as much as we had a lot of good evidence that Se(VI) was a novel, bona-fide e-acceptor for certain anaerobes. I was doing follow-up experiments testing out a variety of e-donors that would work, and it involved sub-sampling the slurries by centrifuging them down and pouring off the supernatant for later analysis of the Se-oxyanions. I used sizeable plastic, capped centrifuge tubes, about 50 mL total volume. I had uncapped one of the tubes and was about to decant it when instead I turned my head to answer a phone call to my lab. While on the phone I noted that the hand holding the centrifuge tube was growing hot, and when I turned back to look, the tube had turned a bright orange (from a dull grey) indicating the formation of copious Se(0). Yet this didn't conform to the "eureka" paradigm we were trying to prove. So I thought "that's funny" and filed it away for a later time to pursue. We were eventually able to show that if given an excess of electron donor over the Se(VI) acceptor, the selenotrophs would carry out a further dissimilatory reduction of accumulated Se(0) to Se(-II). The Se(-II) would autoxidize to Se(0) when exposed to air. Hence, when I uncapped the centrifuge tube air rushed in and there was an exothermic chemical reaction of Se(-II) with $O_2$ to generate Se(0). But it took another 14 years after my hand turned

hot to get to the stage where the problem would prove tractable and would provide a clear answer to the phenomenon. And that we could publish it (Herbel *et al.* 2003)."

Herbel MJ, Switzer Blum J, Borglin S, Oremland RS. Reduction of elemental selenium to selenide: Experiments with anoxic sediments and bacteria that respire Se-oxyanions. *Geomicrobiol J* 2003 **20**:587 - 602.

**What is in your opinion the most curious and yet unexplained phenomenon in microbiology?**

"Gosh, I would have to posit the age-old question of just how did microbial life on Earth get started from all the precursor material present in that pre-biotic, primordial soup? There has been a lot of experimentation and theoretical ruminations of how it may have occurred and what sequence of reactions likely manifested themselves some 4 billion years ago, but nobody really knows as yet. And no one has been able to synthesize a recognizable microbial life form from purely inorganic starting materials as a theoretical experimental guide. Such a result would be a fantastic event and shed light upon which planetary bodies, including exoplanets, would likely host the appropriate conditions for life to initiate if it wasn't already present."



**The article 'Got Selenium?' for *FEMS Microbiology Ecology* is part of the *Thematic Issue Microbes vs. Metals: Harvest and Recycle*. You can read the interview for the #FEMSmicroBlog here.**