ASP NEWS

Connect

Winter 2015 **vol. 44 (1)**

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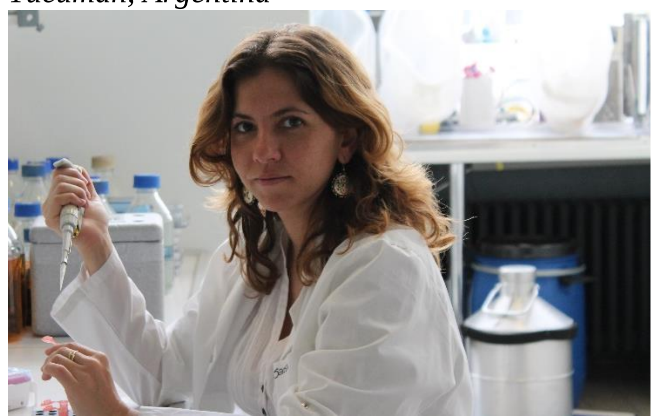
Notes from Winter Council

The ASP executive met for its annual winter council in January. Besides discussions on logistics of ongoing operations, some notable items to highlight include:

- A virtual poster session is planned for June 9th, 2015. **The call for abstracts is now open and will close on March 29, 2015.** Details are at http://photobiology.org/virtual2015/index.php
- An updated and improved ASP website is live.
- The ASP welcomes new treasurer Dr. Theresa Busch and thanks Dr. Bodo Diehn for the time he served in the role.
- High-quality contributions from ASP members are strongly encouraged for Photochemistry and Photobiology.

Meet a Photobiologist:

Virginia Albarracín,
Researcher at PROIMI-CONICET
Tucumán, Argentina



PhD, 2007, National University of Tucumán

Q: *What type of photobiology do you do?*
A: I am a photomicrobiologist. I examine how extremophile bacteria survive while exposed to some of the highest doses of ultraviolet radiation in the world, in high altitudes lakes of Argentina.

Q: *How did you start working in photobiology?*
A: I trained first as a biologist and then specialized in biochemistry. I previously looked at how other types of extremophiles coped with dealing with exposure to high copper exposure. When I returned to Argentina from Germany I began investigating how certain extremophiles cope with high UV levels.

Q: *How do you study UV-resistant bacteria?*
A: We study them in all sorts of ways. In the lab, we have stations with different types of UV light to irradiate the bacteria. We also go to site visits for in

situ measurements, to learn about the conditions there and to collect samples. These trips are challenging since the lakes are very remote and are also quite cold at night. We use biochemical techniques to study the mechanisms of action. However, since these are extremophiles, classical molecular biology techniques sometimes don't work and we need to develop workarounds. This research is interesting since we go from the study of environmental conditions to microbes to molecules.

Q: *How can these bacteria survive despite so much UV irradiation?*
A: That is what we are trying to figure out! With genome sequencing, we have a lot more information at our disposal. But we also have experimental evidence of two main mechanisms behind UV-resistant phenotypes: 1) the ability to withstand outstanding high number of photoproducts on DNA and 2) effective repair mechanisms including direct inactivation of DNA photoproducts. UV light damages DNA by producing mainly pyrimidine dimers. A class of proteins known as photolyases use blue light to specifically deactive those harmful dimers. We are cloning these genes from the extremophiles and seeing how they behave in recombinant systems.

Q: *Where might this research lead to down the line?*
A: Photobiology on extremophiles is a fascinating field with great biotechnological potential. There are possibilities that the proteins from these bacteria could eventually go into new applications for DNA repair or "smart" photoprotection. Another possibility that I am interested in is looking at how these extremophiles evolve and compete against other bacteria in highly stressful conditions. In theory, this might lead to the discovery of totally new natural products for anti-bacterial or anti-cancer applications. But at this point we have a lot of work to do to understand the basics of the systems.

-We reached Dr. Albarracín via Skype.

Photo: Diego Toneatti

We need YOU!

Please submit content (science highlights, suggested links, personal stories, etc) to ASP News. Email: jflovell@buffalo.edu

Historian's Corner:

At this point in the history of ASP, I am moving from Historian to Chair of the Awards Committee. The new Historians are Frances Noonan and David Sliney. This quantum leap provides an excuse to discuss the history of awards in the Society. The new website lists awards made as of 2012, but as often occurs when history is written, some of the really early stuff is missing. Looking closer to the Big Bang, additional details emerge.

The first Historian was John Jagger (1983-87) when there was not much ASP history to plumb. Next came Farrington Daniels, Jr and then James W. Longworth. The purpose of this post is presumably to keep members informed about their past history and perhaps provide a glimmer of continuity. The realm of photobiology has shifted markedly from 1973, when grant applications were often only a formality and it was not uncommon for new PhDs to have multiple job offers: industrial, academic and federal. Those interested in research careers were readily able to find positions. The situation is markedly different now, with academic tenure and long-term NIH support often remote possibilities. The risk of losing a generation of researchers is real and will not, I hope, become a topic for future historians to ponder.

The first ASP award was given in 1974 when President John Spikes presented a plaque to Past-President and Founder Kendric Smith in recognition of his dedication and effort in organizing the Society, promoting membership drives, and organizing the first two meetings. In early records, it is pointed out that the one-time tradition of presenting a bottle of Hankey Bannister Scotch to the incoming President began before ASP was actually organized. During a talk many years later, Tom Coohill pointed out that Makers Mark had a much more elegant Presentation Package than the Hankey which was, more often than not, a paper bag.

The ASP Research award was established by the 32nd Council: a plaque + $1000 to be awarded to a scientist in the 'early stages' of his/her career. This award was initially to be given to awardees within 10 years of a PhD award, but this restriction was later removed. In those days, NIH support was such that one might have reliable grant support before Social Security payments began to arrive. The first recipient was Barry Rosenstein (1986) who studies interactions between photons and tissues. The second award (1987) went to Thomas Dougherty, one of the founders of the modern era of photodynamic therapy.

We now have a larger variety of awards for which nominations are being solicited. See http://photobiology.org/wp/awards for details. The language is being clarified, so check to see if there is an update. The careful reader will note that the Journal Editor deals with the PhotoCites, the President and Past-President find candidates for the Lifetime Achievement and Photon awards, but anyone can nominate candidates for the Research, New Investigator and Light Path awards. These should be forwarded to me: dhkessel@med.wayne.edu

-David Kessel

Photochemistry: How humans can see infrared light

Scientists have known since the 1940s that some people can see near-infrared light as if it were visible light. But the mechanism of IR vision has remained uncertain. Now, Krzysztof Palczewski of Case Western Reserve University and an international team report that human IR vision probably works via a mechanism in which two-photon absorption activates the light-sensitive protein rhodopsin within the eye (*Proc. Natl. Acad. Sci. USA* 2014, DOI: 10.1073/pnas.1410162111).

The team performed color-matching tests on 30 human participants. The subjects perceived wavelengths longer than 950 nm to have a color that matches a wavelength slightly longer than half the original IR—a greenish hue. This phenomenon, the team concluded, could be caused by either of two optical phenomena: second-harmonic generation or two-photon absorption.

To distinguish between the two possibilities, the researchers exposed isolated intact mouse retinas to IR laser light. The retinas responded to the IR wavelengths in a nonlinear fashion, suggesting that second-harmonic generation was probably not at play. The team also observed that the IR light triggered isomerization of the chromophore within crystallized rhodopsin, and they followed up by computationally modeling the process with a two-photon mechanism.

"The evidence from these different experiments suggests that the likelihood of a significant contribution from second harmonics and single-photon absorption is low," Palczewski says.

Jason B. Shear, an expert on multiphoton excitation at the University of Texas, Austin, says: "Until fairly recently, two-photon excitation was perceived as a phenomenon that would probably have little relevance outside a few specialized applications. Many will find it eye-opening that two-photon excitation can be exploited by humans to perceive their surroundings."

Such two-photon IR-triggered isomerization could have applications in optogenetics, Palczewski says. In optogenetics, scientists use light-activated proteins, typically engineered bacterial rhodopsins, to study neuronal responses in the brain.

“There’s no reason that bacteriorhodopsin can’t be isomerized by two-photon absorption,” he says. If that’s the case, he adds, the penetration of light into tissue could be much deeper using IR light rather than the visible light typically used in optogenetics.

-source: Chemical & Engineering News

Photobiology: Giant clams use ‘gems’ to harvest sunlight

Scientists say they’ve uncovered the utility of the amazing iridescent structures on giant clams.

The structures, known as iridocytes, filter sunlight. That sunlight feeds the symbiotic algae that grow inside clams.

“Many mollusks, like squid, octopuses, snails, and cuttlefish have iridescent structures, but almost all use them for camouflage or for signaling to mates. We knew giant clams weren’t doing either of those things, so we wanted to know what they were using them for,” says Alison Sweeney, an assistant professor at the University of Pennsylvania.

These algae convert the abundant sunlight of the clams’ equatorial home into a source of nutrition but are not particularly efficient in the intense sunlight found on tropical reefs; sunlight at the latitude where these clams live is so intense that it can disrupt the algae’s photosynthesis, paradoxically reducing their ability to generate energy. The team members began their study hypothesizing that the clams’ iridocytes were being used to maximize the usefulness of the light that reaches the algae within their bodies. They were first confounded by the relationship between these iridescent structures and the single-celled plants, until they realized that they had an incomplete picture of their geometry.

When they made more precise cross sections of the clams, they found that the algae were organized into pillars, with a layer of iridocytes at the top.

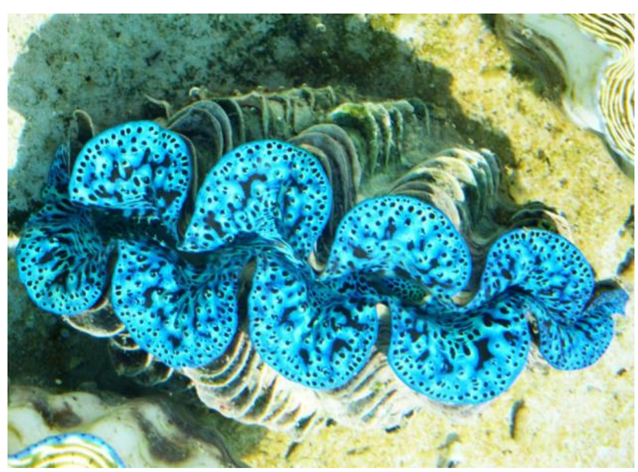
“When we saw the complete picture, we understood that the pillars are oriented exactly the wrong way if you want to catch sunlight,” Sweeney says. “That’s where the iridocytes come into play.”

The team relied on Penn’s Amanda Holt, a postdoctoral researcher formerly at the University of California, Santa Barbara, as well as Sanaz Vahidinia, of NASA’s Ames Research Center, to model exactly what was happening to the light once it passed through the iridocytes; the degree of disorder within these cells bore a resemblance to structures Vahidinia studies at NASA: the dust of Saturn’s rings.

Their analysis suggested that the iridocytes would scatter many wavelengths of light in a cone-like distribution pointing deeper into the clam.

Red and blue wavelengths, the most useful to the algae, spread the widest, impacting the sides of the pillars in which the single-celled plants were stacked.

To test this model, the team constructed fiber optic probes with spherical tips the size of an individual alga. Threaded through a section of clam flesh alongside the native algae, this spherical probe was



able to detect the angled light scattered by the iridocytes, whereas a flat-tipped probe, only able to sense light shining straight down, detected nothing.

“We see that, at any vertical position within the clam tissue, the light comes in at just about the highest rate at which these algae can make use of photons most efficiently,” Sweeney says. “The entire system is scaled so the algae absorb light exactly at the rate where they are happiest.”

“This provides a gentle, uniform illumination to the vertical pillars consisting of the millions of symbiotic algae that provide nutrients to their animal host by photosynthesis,” adds Morse. “The combined effect of the deeper penetration of sunlight—reaching more algae that grow densely in the 3-dimensional volume of tissue—and the “step-down” reduction in light intensity—preventing the inhibition of photosynthesis from excessive irradiation—enables the host to support a much larger population of active algae producing food than possible without the reflective cells.”

Mimicking the micron-scale structures within the clam’s iridocytes and algal pillars could lead to new approaches for boosting the efficiency of photovoltaic cells without having to precisely engineer structures on the nanoscale.

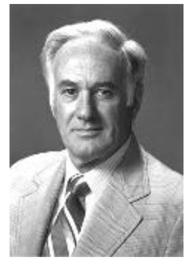
Other alternative energy strategies might adopt lessons from the clams in a more direct way: current bioreactors are inefficient because they must constantly stir the algae to keep them exposed to light as they grow and take up more and more space. Adopting the geometry of the iridocytes and algal pillars within the clams would be a way of circumventing that issue.

“The clam has to make every square inch count when it comes to efficiency,” Sweeney says. “Likewise, all of our alternatives are very expensive when it comes to surface area, so it makes sense to try to solve that problem the way evolution has.”

The study was published in the *Journal of the Royal Society Interface*.

-source: UCSB

In memorandum



John Jagger, peacefully on December 27th, 2014. He was born in New Haven CT in 1924 and got his PhD in Biophysics from Yale in 1954. He did post-doctoral research at the Radium Institute in Paris, and then worked nine years in the Biology Division of the Oak Ridge National Laboratory. In 1965, he moved to Texas where he was Professor of Biology at the University of Texas at Dallas for 21 years. He retired from UT-Dallas in 1986 to work and write on problems of science and society.

John was a biophysicist and photobiologist. He worked primarily on effects of ultraviolet light on bacteria. At UT-Dallas, working with a graduate student, they discovered the mechanism of growth delay induced by sunlight in bacteria. He was editor of Photochemistry and Photobiology for three years, and president of the ASP (1983-84) which honored him in 1991 with a Lifetime Achievement Award. He was also the first Historian of the ASP.

He wrote about 70 scientific papers and 4 scientific books, including The Nuclear Lion: What every Citizen should know about Nuclear Power and Nuclear War (1991) and Science and the Religious Right: What Americans should know about Both (2010). He also published personal Books including From Sea to Prairie : A Lifetime of Poems (2003).

In 1956 in Oak Ridge he married Mary Esther Gaulden, radiation geneticist, who passed away in 2007. They had two children, and three grandchildren.

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www.photobiology.org

Contact

Jonathan F Lovell

E-mail: jflovell@buffalo.edu

Upcoming Photobiology Events

ASP 38: May 21-25, 2016, Tampa Bay

The time and place has been set! Mark your calendar and plan on joining ASP for the next conference.

7th-12th February 2015
Photonics West
San Francisco, California, USA
http://spie.org/photonics-west.xml/

12th-14th March 2015
3rd International Conference on Photonics, Optics and Laser Technology
Berlin, Germany
http://www.photoptics.org/

22nd-26th April, 2015
ASLMS 2015 Annual Conference
Kissimmee, Florida, USA
http://aslms.org/

March 19, 2015
Annual Meeting of The Photomedicine Society
San Francisco, California, USA
http://www.photomedicine.org/

22-26 May, 2015
International Photodynamic Association Congress
Rio de Janeiro, Brazil
http://meetings.cepof.ifsc.usp.br/ipa-spie-2015

June 28-July 3, 2015
The 27th International Conference on Photochemistry
Jeju, Korea
http://www.icp2015.org/

9th-11th September, 2015
Japanese Photochemistry Association. Annual Meeting
Osaka, Japan
http://photochemistry.jp/2015/en/index.html

Other Event Calendars

SPIE Events: http://spie.org/x1375.xml
Plant Biology Events: http://aspb.org/calendar
Chemistry Events: http://www.chemistry.org
Gordon Conferences: http://www.grc.org
Nature Events Directory:
www.nature.com/natureevents/science