Photobiology News (2004)

by Peter A. Ensminger

December 17, 2004
New Meeting on Ozone Depletion

Substantial evidence shows that man-made chlorofluorocarbons deplete ozone in the earth's stratosphere and thereby increase the level of terrestrial UV radiation. In 1987, many nations adopted "The Montreal Protocol on Substances that Deplete the Ozone" (MOP) to phase out the use of ozone-depleting chemicals. On November 22-26, 2004, the parties to the MOP held its 16th meeting Prague, Czech Republic [1]. There was continuing disagreement about the scheduled phase out of methyl bromide, a pesticide widely used in the US for cultivation of strawberries, tomatoes, and other crops. Methyl bromide is considered a "Class-I Ozone Depleter," and is believed to be responsible for 5-10% percent of worldwide ozone depletion [2].

1. Barros, P et al, 2004, Summary of the Sixteenth Meeting of the Parties to the Montreal Protocol: 22-26 November 2004. *Earth Negotiations Bulletin*
2. Colman JJ, Blake DR, Rowland FS, 1998, Atmospheric residence time of CH3Br estimated from the junge spatial variability relation. *Science* 281: 392-6. [PubMed]

Recombinational Repair of DNA

Cells have numerous mechanisms for repair of DNA that has been damaged by UV radiation or by other means. Recent research shows that the RecA protein plays a role in trans-lesion synthesis during replication restart. In the recent issue of *BioEssays*, Kendric Smith (Stanford University), founder and first President of the **ASP**, reviews the literature on recombinational DNA repair [1]. He shows that many studies in the older literature clearly demonstrate an important role for recA-dependent recombinational DNA repair, but that much of the recent literature ignores this repair system. Moreover, much of the recent literature has ignored the distinction between repair to parts of the chromosome that has replicated before and after DNA damage.

1. Smith KC, 2004, Recombinational DNA repair: the ignored repair systems. *BioEssays* 26: 1322-6. [PubMed]

December 3, 2004
Evolution of Dinoflagellate Luciferase

An enzyme with multiple catalytic sites represents an evolutionary elaboration of an enzyme with a single catalytic site. One example is the luciferase of dinoflagellates, which has three homologous catalytic domains. This enzyme catalyzes bioluminescence in the presence of luciferin and oxygen and is regulated by a circadian clock. In a recent issue of *Proceedings of the National Academy of Sciences*, **ASP** member Woody Hastings (Harvard University) and colleagues present their study of the catalytic sites of the luciferase from seven dinoflagellate species [1]. Their study elucidates the relationships and evolutionary significance of the different catalytic domains.

1. Liu L, Wilson T, Hastings JW, 2004, Molecular evolution of dinoflagellate luciferases, enzymes with three catalytic domains in a single polypeptide. *Proc Natl Acad Sci* 101: 16555-60. [PubMed]

Fluorescent Phytochrome

Phytochrome is a pigment that regulates growth and development of plants. It is also present in cyanobacteria. In a recent issue of *Proceedings of the National Academy of Sciences*, Amanda Fischer and **ASP** member Clark Lagarias (University of California, Davis) report their studies of the directed evolution of a cyanobacterial phytochrome [1]. They identify a specific region of the apoprotein that is important in regulating the spectroscopic properties of phytochrome. They also show that a specific tyrosine-to-histidine mutation transforms phytochrome into a red fluorescent protein. Such mutants may have an application as far-red light fluorescent reporter genes.

1. Fischer AJ, Lagarias JC, 2004, Harnessing phytochrome's glowing potential. *Proc Natl Acad Sci* Nov 17; [Epub ahead of print] [PubMed]

November 12, 2004
Review of the Phototropins

The phototropins are blue light-absorbing pigments that regulate phototropism in higher plants. In the forthcoming issue of *Photochemistry and Photobiology*, R. Brandon Celaya and **ASP** member Emmanuel Liscum (University of Missouri) review recent studies of the phototropins [1]. Their review includes detailed discussion of phototropin photochemistry and of the alterations in chromophore and peptide structure that follow light absorption. They also discuss the roles of phototropins in controlling stomatal opening and chloroplast movements.

1. Celaya RB, Liscum E, 2004, Phototropins and associated signaling: Providing the power of movement in higher plants. *Photochem Photobiol* Aug 1 [Epub ahead of print] [PubMed]

Genetic Basis of UV-sensitive Syndrome

The UV-sensitive syndrome (UVsS) is a rare heritable disorder that is characterized by skin photosensitivity and freckling. In the recent issue of *Proceedings of the National Academy of Sciences*, **ASP** members Masamitsu Ichihashi (Kobe University School of Medicine), Yoshihisa Iwamoto (University of Shizuoka), and colleagues present the results of their studies of the genetics of UVsS [1]. Their results show that a mutation in the CSB gene, previously associated with Cockayne syndrome (a disease characterized by skin photosensitivity and neurological problems), can give rise to UVsS.

1. Horibata K, Iwamoto Y, Kuraoka I, Jaspers NG, Kurimasa A, Oshimura M, Ichihashi M, Tanaka K, 2004, Complete absence of Cockayne syndrome group B gene product gives rise to UV-sensitive syndrome but not Cockayne syndrome. *Proc Natl Acad Sci* 101: 15410-5. [PubMed]

October 22, 2004
Ultraviolet Radiation and Melanoma

In the United States, melanoma accounts for 3.5% of skin cancers, but 80% of skin cancer deaths, or ~8000 people per year [1]. Sunlight exposure is implicated in initiating melanoma, but there is controversy about the relative importance of UV-A (320-400 nm) and UV-B radiation (280-320 nm). A recent study by **ASP** members Edward De Fabo, Frances Noonan (George Washington University Medical Center) and colleagues [2] shows that only UVB-containing sources initiated melanoma in a transgenic mouse model that recapitulates human melanoma. These results have important implications for risk assessment from exposure to solar and artificial UV radiation, and to the development of effective UV radiation protection strategies.

1. Armstrong BK, Dallas DR, 1996, Cutaneous malignant melanoma, pp 212-31 in *Cancer Epidemiology and Prevention* (D Schottenfeld and JF Fraumeni, eds) Oxford Univ Press.
2. De Fabo EC, Noonan FP, Fears T, Merlino G, 2004, Ultraviolet B but not ultraviolet A radiation initiates melanoma. *Cancer Res* 64: 6372-6. [PubMed]

Melanin Acts as a Potent UV-B Photosensitizer

Light-skinned people are more prone to UV-induced skin damage, such as melanoma, than dark-skinned people. It is believed that melanin filters out UV radiation and scavenges reactive oxygen species, thereby reducing UV damage. However, irradiation of melanin also generates reactive oxygen species that can damage DNA. In the recent issue of *Proceedings of the National Academy of Sciences*, **ASP** members Douglas Brash (Yale School of Medicine), Kenneth Kraemer (National Cancer Institute), and colleagues report on their studies of melanin as a photosensitizer in mouse skin [1]. They conclude that melanin-induced apoptosis may contribute to the increased sensitivity of light-skinned individuals to melanoma and other types of skin damage.

1. Takeuchi S, Zhang W, Wakamatsu K, Ito S, Hearing VJ, Kraemer KH, Brash DE, 2004, Melanin acts as a potent UVB photosensitizer to cause an atypical mode of cell death in murine skin. *Proc Natl Acad Sci* 101: 15076-81. [PubMed]

October 8, 2004

Photobiology for Kids

We are in the process of developing a "Photobiology for Kids" section on the **ASP** web site. Your suggestions would be appreciated! - Peter A. Ensminger, ensmingr@twcny.rr.com

Hypericin and Ocular Damage (part 2)

Extracts of St. John's wort (*Hypericum perforatum*) are sold as an herbal antidepressant. These extracts contain hypericin, a phototoxic pigment that absorbs light in the ultraviolet-A (UVA) and visible ranges. In a forthcoming issue of *Photochemistry and Photobiology*, **ASP** members Yu-Ying He (NIEHS), Colin Chignell (NIEHS), and Joan Roberts (Fordham University) report on their studies of the effect of hypericin on ocular damage [1]. They isolated human lens epithelial cells, incubated them with 0.1-10 micromolar hypericin and then irradiated them with UVA or visible light. Controls that were given hypericin alone or light alone exhibited no reduced cell viability. However, cells given hypericin with UVA or visible light underwent necrosis and apoptosis. They conclude that ingested St. John's wort is potentially damaging to ocular tissues.

1. He YY, Chignell CF, Miller DS, Andley U, Roberts JE, 2004, Phototoxicity in Human Lens Epithelial Cells Promoted by St. John's Wort. *Photochem Photobiol* 2004 Jun 1 [Epub ahead of print] [PubMed]

September 24, 2004

Hypericin and Lens Damage

Hypericin is a naturally occurring pigment in Saint John's wort (*Hypericum perforatum*). Extracts of this plant are used to treat depression, but the hypericin in these extracts can cause severe skin photosensitivity. Tissues in the eye may also be subject to hypericin-mediated light damage. In a forthcoming issue of *Photochemistry and Photobiology*, **ASP** members Colleen Trevithick-Sutton, Chris Foote (UCLA), and colleagues report their studies of the effect alpha-crystallin (the major lens protein) on hypericin photophysics [1]. The results of this in vitro study show that hypericin is an effective photosensitizer of lens tissue and thus potentially damaging to the eye.

1. Trevithivk-Sutton CC, Chin KK, Contos SD, Foote CS, 2004, Lens alpha-Crystallin and Hypericin: A Photophysical Mechanism Explains Observed Lens Damage. *Photochem Photobiol* Jun 1 [Epub ahead of print] [PubMed]

Rembrandt's Vision

In the September 16 issue of *New England Journal of Medicine*, Margaret Livingstone and Bevil R. Conway (Harvard Medical School) propose that Dutch artist Rembrandt van Rijn (1606-69) suffered from strabismus (a misalignment of one eye) and thus poor depth perception [1]. In 23 of 24 Rembrandt self-portraits, they found that one eye looks forward while the other looks to the left; in all 12 self-portrait etchings, the situation is reversed, which is consistent because the etching process reverses the image. The authors propose that Rembrandt's lack of depth perception helped him convert the three-dimensional world into two-dimensional paintings.

1. Livingstone MS, Conway BR, 2004, Was Rembrandt Stereoblind? *N Engl J Med* 351:1264-5.[PubMed]

September 10, 2004

Identification of Yellow Lens Pigment

A cataract is a cloudy area in the lens of the eye. Exposure to ultraviolet radiation is a major risk factor for development of cataracts. In the recent issue of *Journal of Biological Chemistry*, **ASP** member Beryl J. Ortwerth (University of Missouri) and colleagues report their isolation of a novel yellow chromophore from the human lens and identify its chemical structure [1]. The 370 Da chromophore has a cross-link between the epsilon-amino groups of two lysine residues and a five-carbon atom ring. Human lenses with cataracts have significantly higher levels of this chromophore, indicating increased protein cross-linking during cataract development *in vivo*.

1. Cheng R, Feng Q, Argirov OK, Ortwerth BJ, 2004, Structure elucidation of a novel yellow chromophore from human lens protein. *J Biol Chem* [Epub ahead of print] [PubMed]

UV-B Radiation Effects on Maize

Depletion of stratospheric ozone has increased the level of terrestrial UV-B radiation (280-320 nm). Many growth chamber and greenhouse experiments have documented the harmful effects of increased UV-B radiation on plants, but field-grown plants may respond differently. In the recent issue of *Photochemistry and Photobiology*, **ASP** member Richard H. Grant (Purdue University) and colleagues report on their field study of the effect of UV-B radiation on growth and yield of maize [1]. They show that increased UV-B radiation reduces dry matter accumulation, overall yield, and the levels of protein, sugar, and starch in maize seed.

1. Gao W, Zheng Y, Slusser JR, Heisler GM, Grant RH, Xu J, He D, 2004, Effects of supplementary ultraviolet-B irradiance on maize yield and qualities: A field experiment. *Photochem Photobiol* 2004 80:127-31. [PubMed]

August 27, 2004

Glow-in-the-Dark Toys

Arizona-based Prolume, founded by Bruce Bryan and Gene Finley, recently developed several glow-in-the-dark toys that employ the light-producing luciferin/luciferase reaction [1]. Their first product is a squirt gun that has a replaceable cartridge with powdered jellyfish luciferase. The rehydrated liquid glows in the dark when it is squirted upon anything containing small amounts of calcium - such as human skin. Prolume plans to use profits from the sales of their glow-in-the-dark toys to fund the research and development of novel light-producing molecules that can be used for cancer screening and other biomedical applications.

1. Prolume.

Blue Light and Macular Degeneration

Age related macular degeneration (AMD) is the leading cause of blindness among older Americans [1]. A patient with macular degeneration typically sees a light, dark, or blurred spot (scotoma) in the center of the visual field. Exposure to ultraviolet radiation is a known risk factor for AMD. In the recent issue of *Progress in Retinal and Eye Research*, **ASP** member David Sliney (Center for Health Promotion and Preventive Medicine) and colleagues review existing evidence for an effect of blue light on the pathogenesis of AMD [2]. Currently available human studies suggest that exposure to blue light may cause AMD, but large-scale clinical trials must be performed to test this relationship.

1. Association for Macular Degeneration.
2. Margrain TH, Boulton M, Marshall J, Sliney DH, 2004, Do blue light filters confer protection against age-related macular degeneration? *Prog Retin Eye Res* 23: 523-31. [PubMed]

August 13, 2004

Carotenoid Functions in Photosynthesis

In plants and photosynthetic bacteria, carotenoids function as light-harvesting pigments and also provide protection by quenching the harmful excited states of oxygen and chlorophyll. In a recent issue of *Biochemistry*, **ASP** member Harry Frank (University Of Connecticut) and Gary Brudvig review the redox functions of carotenoids in photosynthesis [1]. Recent studies show that carotene acts as a redox intermediate in photosystem II of plants. Thus, carotene appears to function as a "molecular wire", in that it dissipates potentially harmful energy to peripheral redox centers of photosystem II.

1. Frank HA, Brudvig GW, 2004, Redox functions of carotenoids in photosynthesis. (Current Topics/Perspectives). *Biochemistry* 43: 8607-15. [PubMed]

N-terminal Region of Phytochrome-B

The phytochromes (phyA-E) are photo-isomerizable proteins that control plant growth and development. In a recent issue of *Plant Cell*, **ASP** member Satoru Tokutomi (Osaka University, Japan) and colleagues report their studies of an N-terminal 450-amino acid fragment of phyB in phyB-deficient *Arabidopsis thaliana* [1]. These plants lack the C-terminal PHY domain of phyB. Their results show that the PHY domain is dispensable for phyB signal transduction but that the PHY domain stabilizes the Pfr form of phyB.

1. Oka Y, Matsushita T, Mochizuki N, Suzuki T, Tokutomi S, Nagatani A, 2004, Functional analysis of a 450-amino Acid N-terminal fragment of phytochrome B in *Arabidopsis*. *Plant Cell* 16: 2104-16. [PubMed]

July 31, 2004

Photoinduction of a UV-Absorbing Mycosporine-like Amino Acid

Chondrus crispus is an abundant marine red alga that occurs along coastal regions of the north Atlantic. *Chrondrus* and many other algal species synthesize mycosporine-like amino acids (MAA) that screen out harmful UV radiation. In a recent issue of *Photochemistry and Photobiology*, **ASP** member Masakatsu Watanabe and colleagues present an action spectrum for the induction of shinorine, the major MAA in *Chondrus crispus* [1]. They identify maxima at

320, 340 and 400 nm and propose that one or two as yet unidentified photoreceptor(s) are responsible for the photoinduction of shinorine.

1. Kraeba G, Watanabe M, Wiencke C, 2004, A monochromatic action spectrum for the photoinduction of the UV-absorbing mycosporine-like amino acid Shinorine in the Red alga *Chondrus crispus*. *Photochem Photobiol* 79: 515-519. [PubMed]

Ultraviolet Radiation and Terrestrial Ecosystems

In the recent issue of *Photochemistry and Photobiology*, **ASP** member Donald T. Krizek and Wei Gao introduce a Symposium-in-Print series of articles entitled "Ultraviolet Radiation and Terrestrial Ecosystems" [1]. These papers all derive from presentations at the "Symposium on UV Effects on Terrestrial Ecosystems", which was held at last year's **ASP** Annual meeting in Baltimore (July 5-9, 2003). The five papers in this series discuss many of the major issues that are important for meaningful assessments of UV effects on terrestrial ecosystems.

1. Krizek DT, Gao W, 2004, Ultraviolet radiation and terrestrial ecosystems. *Photochem Photobiol* 79: 379-381. [PubMed]

July 2, 2004

ASP Meets in Seattle

On July 10-14, the **American Society for Photobiology** holds its 32nd Annual Meeting at the Westin Hotel in Seattle, Washington [1]. The complete "Program and Abstracts" are available as a PDF file [2]. **ASP** member Rox Anderson will deliver the keynote lecture on Saturday evening, "Making Light of Photoaging". Anderson is Professor at the Wellman Center for Photomedicine of the Massachusetts General Hospital. His research focuses on new optical treatments and diagnostics for problems in dermatology [3]. Additional symposia at the meeting will cover ultraviolet radiation effects, photodynamic therapy, photosensory biology, and circadian rhythms.

1. 32nd Annual Meeting of the American Society for Photobiology.
2. Program and Abstracts. 32nd Annual Meeting, American Society for Photobiology.
3. R. Rox Anderson, 2004, Wellman Center for Photomedicine.

Green Tea Prevents Ultraviolet Damage

Ultraviolet radiation causes photoaging of human skin via numerous photo-oxidation reactions and via the induction of matrix metalloproteinases (MMPs). In the recent issue of *Journal of Investigative Dermatology*, **ASP** members Santosh Katiyar, Craig A. Elmets (University of Alabama, Birmingham) and colleagues show that oral administration of green tea extract to hairless mice that were subsequently exposed to ultraviolet radiation reduces photo-oxidative skin damage and induction of MMPs [1]. Green tea extracts thus have potential as a dietary supplement to reduce damage by ultraviolet radiation in humans.

1. Vayalil PK, Mittal A, Hara Y, Elmets CA, Katiyar SK, 2004, Green tea polyphenols prevent ultraviolet light-induced oxidative damage and matrix metalloproteinases expression in mouse skin. *J Invest Dermatol* 122: 1480-7. [PubMed]

June 18, 2004

ASP Mentoring Luncheon

Are you an **ASP** associate member interested in meeting established members of the society? Do you wonder what paths their careers have followed or how they chose the field of photobiology? This is your opportunity to ask those questions and more. Are you an established member of the society interested in mentoring associate members? Are you willing to share your career

experiences and discuss how you chose the field of photobiology? This is your opportunity to meet the younger members of the society.

If you answered 'yes' to any of these questions, then you should attend the ASP Mentoring Luncheon on Sunday, July 11 at 12:00 at the ASP Annual Meeting in Seattle. The number of attendees is limited, so please email Linda Hardwick, to reserve your space.
- Laura Lamb McGuckin
ASP Associate Member Council Representative

Salamander Visual Pigments

The visual pigment rhodopsin consists of the protein opsin bound to retinal, the light-absorbing chromophore. Previous studies have shown that the 9-methyl group of retinal is important in the rhodopsin-mediated activation of transducin, a critical event in vision. In the recent issue of *Biochemistry*, **ASP** members Rosalie Crouch (Medical University of South Carolina), Joydip Das, and colleagues report their studies of the role of the 9-methyl group of retinal in salamander rod and cone pigments [1]. They show that the 9-methyl group of retinal is not important in the transducin activation pathway of the red cone, blue cone, or green rod pigments. However, the 9-methyl group of retinal appears to be critical in the deactivation pathway of the red cone pigment.

1. Das J, Crouch RK, Ma JX, Oprian DD, Kono M, 2004, Role of the 9-methyl group of retinal in cone visual pigments. *Biochemistry* 43: 5532-8. [PubMed]

June 4, 2004

Mammalian Cryptochromes and the Circadian Clock

The cryptochromes are blue light-absorbing photosensory receptors that exhibit significant sequence identity to certain photolyases, light-activated DNA-repair enzymes. In the forthcoming issue of *Journal of Biological Chemistry*, **ASP** member Aziz Sancar (University of North Carolina School of Medicine) reviews cryptochrome-mediated regulation of the mammalian circadian clock [1]. Cry2 knockout studies provided the first direct evidence that cryptochrome is a clock protein. However, researchers continue to debate the roles of cryptochrome and melanopsin (a retinal-based photoreceptor) as mammalian blue light-photoreceptors.

1. Sancar A, 2004, Regulation of mammalian circadian clock by cryptochrome. *J Biol Chem* [Epub ahead of print] [PubMed]

Mechanism of Photosynthetic Water Oxidation

Photosynthesis by plants and cyanobacteria generate atmospheric oxygen by the light-induced oxidation of water. The photosynthetic water-oxidation complex is a large protein complex that contains four manganese atoms bridged by oxygen, and also contains calcium and chloride ions. In the recent issue of *Biochimica Biophysica Acta*, **ASP** member Kenneth Sauer and Vittal Yachandra (University of California, Berkeley) present their analysis of spectroscopic data and low-resolution X-ray diffraction data of the water-oxidation complex and suggest several possible structural arrangements [1]. They propose that EPR data will be able to further discriminate among these possible models.

1. Sauer K, Yachandra VK, 2004, The water-oxidation complex in photosynthesis. *Biochim Biophys Acta* 1655(1-3):140-8. [PubMed]

May 7, 2004

Melanoma Review

In the journal *Oncologist*, Cliff Perlis and **ASP** member Meenhard Herlyn (The Wistar Institute, Philadelphia) review recent research on melanoma [1]. There have been dramatic increases in the incidence and mortality of melanoma over the past 20 years and an estimated 7400 Americans died from melanoma in 2003. Recent experimental studies show a clear association between intense intermittent exposure to UV-B radiation and melanoma in human skin. The authors discuss the role of cell adhesion molecules in melanoma progression and the apoptotic pathways that will be targeted in future melanoma therapies.

1. Perlis C, Herlyn M, 2004, Recent advances in melanoma biology. *Oncologist* 9:182-7. [PubMed]

UV-B Radiation Cold-hardens Rhododendron Leaves

In a recent issue of Photochemistry and Photobiology, the official journal of the American Society for Photobiology, **ASP** member Linda Chalker-Scott and James D. Scott (Center for Urban Horticulture, University of Washington) report on their studies of cold-hardening in Rhodendron leaves. The researchers show that leaves from field-grown Rhododendron plants that were exposed to supplemental UV-B radiation exhibit greater tolerance to freezing temperatures than control plants, which received no supplemental UV-B.

1. Chalker-Scott L, Scott JD, 2004, Elevated ultraviolet-B radiation induces cross-protection to cold in leaves of Rhododendron under field conditions. *Photochem Photobiol* 79: 199-204. [PubMed]

April 23, 2004

Chlamydomonas Sensory Rhodopsins

Chlamydomonas reinhardtii is a green alga that exhibits many responses to light, including phototaxis (movement with respect to light direction) and the photophobic response (intensity change-induced alteration of cell movement). *Chlamydomonas* Sensory Rhodopsin-A and -B (CSRA and CSRB) are known to mediate phototaxis [1]. In the recent issue of Biophysical Journal, **ASP** member John Spudich (University of Texas Medical School) and colleagues extend their previous studies of these photoreceptors. They used immunoblot analysis to estimate that each cell has about 9×10^4 CSRA apoprotein molecules and 1.5×10^4 CSRB apoprotein molecules [2]. Additional experiments show that both pigments mediate the photophobic response, but that CSRA is more important for this response.

1. Sineshchekov OA, Jung K-H, Spudich JL, 2002 Two rhodopsins mediate phototaxis to low and high intensity light in Chlamydomonas reinhardtii. *Proc Natl Acad Sci* 99: 8689-8694. [PubMed]
2. Govorunova EG, Jung KH, Sineshchekov OA, Spudich JL, 2004, Chlamydomonas sensory rhodopsins A and B: cellular content and role in photophobic responses. *Biophys J* 86: 2342-9. [PubMed]

Perception of Skin Color

Light absorption by melanin and hemoglobin and light scattering by melanosomes and collagen fibers are mainly responsible for perceived skin color. Traditionally, locally elevated levels of hemoglobin were considered responsible for skin redness and elevated levels of melanin responsible for pigmentation. In the recent issue of *Journal of Biomedical Optics*, **ASP** member Nikiforos Kollias (Johnson & Johnson) and colleagues report on their use of diffuse reflectance spectroscopy and other techniques to further investigate the contributions of these chromophores to perceived skin color [1]. They show that deoxy-hemoglobin significantly contributes to skin color and that blood pooling (increased deoxy-hemoglobin) can contribute to perceived pigmentation.

1. Stamatas GN, Kollias N, 2004, Blood stasis contributions to the perception of skin pigmentation. *J Biomed Opt* 9: 315-22. [PubMed]

March 26, 2004
Deadlines for ASP Annual Meeting

Abstract Submission: April 25, 2004
Late-breaking Abstracts: June 15, 2004

Early Registration: April 30, 2004
Advance Registration: May 1 - June 2, 2004
On-site Registration: June 3 - July 14, 2004

Hotel Registration: April 17, 2004

The Six Families of Photosensory Pigments

Light absorption by a photosensory pigment triggers a biochemical pathway that leads to a physiological response, such as vision, phototropism, or phototaxis. In a recent issue of *Accounts of Chemical Research*, Michael van der Horst and **ASP** member Klaas Hellingwerf (Swammerdam Institute for Life Sciences, Amsterdam) review the six major families of photosensory pigments [1]. Pigments in three families - the rhodopsins, phytochromes, and xanthopsins - undergo E/Z photo-isomerization. Pigments the other three families - the cryptochromes, phototropins, and BLUF proteins - undergo flavin-based photochemistry. There may be additional UV-absorbing photosensory pigments that have not yet been discovered.

1. van der Horst MA, Hellingwerf KJ, 2004, Photoreceptor proteins, "star actors of modern times": a review of the functional dynamics in the structure of representative members of six different photoreceptor families. *Acc Chem Res* 37: 13-20. [PDF] [PubMed]

February 13, 2004
Self-sustained Circadian Rhythms in Peripheral Tissues

The suprachiasmatic nucleus (SCN) of the hypothalamus, a pea-sized structure in the brain, regulates the circadian rhythms of mammals. It has long been thought that the SCN is also required for the expression of circadian rhythms in peripheral tissues. In a forthcoming issue of *Proceedings of the National Academy of Sciences*, **ASP** member Michael Menaker (University of Virginia) and colleagues show that peripheral tissues in the mouse can express a self-sustained circadian rhythm for more than 20 cycles in isolation [1]. These results suggest the existence of organ-specific circadian synchronizers at the cell and tissue level.

1. Yoo S-H, Yamazaki S, Lowrey PL, Shimomura K, Ko CH, Buhr ED, Siepka SM, Hong H-K, Oh WJ, Yoo OJ, Menaker M, Takahashi JS, 2004, PERIOD2::LUCIFERASE real-time reporting of circadian dynamics reveals persistent circadian oscillations in mouse peripheral tissues. *Proc Natl Acad Sci* 10.1073/pnas.0308709101 [PubMed]

Lipsosomes in Photodynamic Therapy

Photodynamic therapy (PDT) uses light and a photosensitive chemical to destroy cancerous or other harmful cells. In the recent issue of *Advanced Drug Delivery Review*, **ASP** member Peter A. de Witte (Katholieke Universiteit Leuven, Belgium) and colleagues review the role of liposomes as carriers and delivery systems for the photosensitizers used in PDT [1]. Liposomes that have a design modified to remain in circulation and to target cancerous tissues have the greatest potential

as carriers. There are numerous strategies under development that can be used to trigger release of the photosensitizers from liposomes to the cancerous tissue.

1. Derycke AS, de Witte PA, 2004, Liposomes for photodynamic therapy. *Adv Drug Deliv Rev* 56:17-30. [PubMed]

January 30, 2004

Photosensory Plant Pigments

Plants have numerous photosensory pigments that control growth and development in response to the light environment. The December 2003 issue of *Plant Physiology* is a "Focus Issue" on light signaling in plants that features 24 articles on the developmental responses of plants to light. This special issue features five articles by **ASP** members and award winners.

ASP member and New Investigator Award winner Emanuel Liscum and colleagues review recent research on blue light signaling in plants [1].

ASP members Donat-Peter Haeder, Masakatsu Watanabe, and colleagues show that photoactivated adenylyl cyclase, a novel blue light-receptor, controls phototaxis in *Euglena gracilis* [2].

ASP member, Research Award winner, and Lifetime Achievement Award winner Pill-Soon Song and colleagues show that overexpression of a mutant basic helix-loop-helix protein activates a pathway of light signaling in *Arabidopsis* [3].

ASP Research Award winner Peter Quail and colleagues use microarray data and genomic analysis to identify promoter regions in genes regulated by phytochrome A [4]. Quail and colleagues also show that the ELF4 gene functions in phytochrome B-regulated *Arabidopsis* seedling de-etiolation [5].

1. Liscum E, Hodgson DW, Campbell TJ, 2003, Blue light signaling through the cryptochromes and phototropins. So that's what the blues is all about. *Plant Physiol* 133: 1429-36.
2. Ntefidou M, Iseki M, Watanabe M, Lebert M, Hader DP. Photoactivated adenylyl cyclase controls phototaxis in the flagellate *Euglena gracilis*. *Plant Physiol* 2003 Dec; 133(4): 1517-21.
3. Yang KY, Kim YM, Lee S, Song PS, Soh MS, 2003, Overexpression of a mutant basic helix-loop-helix protein HFR1, HFR1-deltaN105, activates a branch pathway of light signaling in *Arabidopsis*. *Plant Physiol* 133: 1630-42.
4. Hudson ME, Quail PH, 2003, Identification of promoter motifs involved in the network of phytochrome A-regulated gene expression by combined analysis of genomic sequence and microarray data. *Plant Physiol* 133: 1605-16.
5. Khanna R, Kikis EA, Quail PH, 2003, EARLY FLOWERING 4 functions in phytochrome B-regulated seedling de-etiolation. *Plant Physiol* 133: 1530-8. January 16, 2004

Phototoxicity of a New Fluoroquinolone Antibiotic

Fluoroquinolones are a class of antibiotics that interfere with bacterial DNA replication and exhibit activity against a broad spectrum of microbes. Unfortunately, patients taking fluoroquinolones typically exhibit phototoxic skin reactions following exposure to sunlight. In the recent issue of *British Journal of Dermatology*, **ASP** member Sally Ibbotson (University of Dundee, United Kingdom) and colleagues report on their comparison of the phototoxicity of sitafloxacin, a novel fluorquinolone, with several established fluoroquinolones, sparfloxacin, enoxacin, and levofloxacin [1]. They show that sitafloxacin is associated with less phototoxicity than the established fluoroquinolones.

1. Dawe RS, Ibbotson SH, Sanderson JB, Thomson EM, Ferguson J, 2003, A randomized controlled trial (volunteer study) of sitafloxacin, enoxacin, levofloxacin and sparfloxacin phototoxicity. *Br J Dermatol* 149: 1232-41. [PubMed]

Cyanobacterial Phytochrome Chromophore Functions in *Arabidopsis*

Phytochrome is a photo-isomerizable sensory protein that exists in a red light-absorbing form and a far-red light-absorbing form. The phytochromes of *Arabidopsis* and other higher plants have a phytochromobilin (PB) chromophore, whereas the phytochromes of green algae and cyanobacteria have a phycocyanobilin (PCB) chromophore. In a forthcoming issue of *Proceedings of the National Academy of Sciences*, **ASP** member J. Clark Lagarias (University of California, Davis) and colleagues show that nearly all of the phytochrome-mediated responses of PB-deficient Arabidopsis mutants can be restored when these plants are genetically transformed to synthesize PCB [1].

1. Kami C, Mukougawa K, Muramoto T, Yokota A, Shinomura T, Lagarias JC, Kohchi T, 2004, Complementation of phytochrome chromophore-deficient Arabidopsis by expression of phycocyanobilin:ferredoxin oxidoreductase. *Proc Natl Acad Sci* 10.1073/pnas.0307615100. [PubMed]

January 2, 2004

Novel PDT Enhances Drug Delivery to Tumors

Photodynamic therapy (PDT) uses light and a photosensitive drug to destroy cancerous or other harmful cells. In the recent issue of *Cancer Research*, **ASP** members John Snyder, Barbara Henderson, and David Bellnier (Roswell Park Cancer Institute, Buffalo NY) report on their development of a novel PDT in which a photosensitizer facilitates delivery of a chemotherapeutic agent to tumors [1]. In particular, they show that 2-[1-hexyloxyethyl]-2-devinyl pyropheophorbide-a, coupled with low fluence rate light, facilitates the delivery of doxil (a liposomal formulation of doxorubicin) to tumors in mice. Doxorubicin is currently approved for treatment of breast, ovarian, lung, and other human cancers, so this study has important implications for development of new cancer therapies.

1. Snyder JW, Greco WR, Bellnier DA, Vaughan L, Henderson BW, 2003, Photodynamic therapy: a means to enhanced drug delivery to tumors. *Cancer Res* 63: 8126-31. [PubMed]

UV Radiation and Heavy Metals Induce Similar Stress Response

In plants, UV radiation and heavy metals are known environmental stressors that damage plants. In the recent issue of *Plant and Cell Physiology*, **ASP** member Bruce Greenberg (University of Waterloo, Canada) and colleagues report on their studies of the effects of simulated solar radiation (which includes UV) and copper on the aquatic plant *Lemna gibba* [1]. They show that copper and simulated solar radiation both cause formation of reactive oxygen species (ROS), a class of compounds that damage proteins, lipids, and nucleic acids. Interestingly, both stressors also induce elevated levels of same flavonoids and enzymes (superoxide dismutase and glutathione reductase) that help plants adapt to elevated levels of ROS. It appears that ROS are a common signal for acclimation to stress by copper and UV radiation.

1. Babu TS, Akhtar TA, Lampi MA, Tripuranthakam S, Dixon DG, Greenberg BM, 2003, Similar Stress Responses are Elicited by Copper and Ultraviolet Radiation in the Aquatic Plant *Lemna gibba*: Implication of Reactive Oxygen Species as Common Signals. *Plant Cell Physiol* 44: 1320-1329. [PubMed]