



## BECKMAN LASER INSTITUTE

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SUMMER 2011

## CARING FOR THOSE WHO RISK THEIR LIVES FOR US

Having just arrived by air evacuation at the field hospital, the wounded marine appears to be stable enough to allow more critically injured members of his battalion to be the first into surgery when all of a sudden he turns critical as he goes into hemorrhagic shock. A full 80% of potentially survivable battlefield deaths are due to hemorrhage, and a key element in addressing this problem is the development of technologies that allow the early detection and prediction of impending shock before a patient becomes critical.

This Spring, the Beckman Laser Institute (BLI) was visited by Col. Dallas Hack, M.D., Director of the U.S. Army's Combat Casualty Care Research



From left to right: Dr. Howard Schlossberg (AFOSR) and Col. Dallas Hack, M.D. (Director, U.S. Army Combat Casualty Care Research Program).

Program, and Dr. Howard Schlossberg of the Air Force Office of Scientific Research (AFOSR) to review technologies under development by BLI investigators for the trauma and critical care needs of military personnel with potential for spin-off to civilian medical needs. Under a Center grant funded through the Department of Defense Military Photomedicine Program and administered by the AFOSR, the BLI has assembled a team of faculty who are working in 3 project areas related to technology gaps identified by the Secretary of Defense as critical to

*(Critical Care continued on p. 6)*

## BLI Co-Founder Receives Outstanding Teaching Award



Michael W. Berns holding the Dr. Fariborz Maseeh Outstanding Faculty Teaching Award flanked by Dr. Fariborz Maseeh (left) and Interim Dean of The Samueli School of Engineering Dimitri Papamoschou (right).

Michael W. Berns, Ph.D., co-founder of the Beckman Laser Institute and the Arnold and Mabel Beckman Professor, received the 2011 Dr. Fariborz Maseeh Outstanding Faculty Teaching Award at The Henry Samueli School of Engineering Annual Dinner and Awards Banquet on May 5, 2011. The award is sponsored by Fariborz Maseeh, Sc.D., founder and president of The Massiah Foundation, a charitable organization which invests in transformational situations for broad public benefit. He is internationally recognized as an expert in the field of micro-electro-mechanical systems (MEMS).

The citation on the award read: "For his innovative and inspiring contribu-

tions to the Biomedical Engineering curriculum, and in particular his development of the multidisciplinary course 'Photomedicine' that is making unique impacts in the education of undergraduates in the field of biophotonics."

In presenting the award to Prof. Berns, Interim Dean of The Samueli School of Engineering Dimitri Papamoschou, Ph.D., noted that Prof. Berns "has developed the multidisciplinary course 'Photomedicine' that is one of the most popular courses in Biomedical Engineering (BME), and it is also a key course in the BME Biophotonics undergraduate track. This

*(Teaching Award continued on p. 5)*

## My Three Science Mentors

by **Michael W. Berns, Ph.D.**

Arnold and Mabel Beckman Professor  
Co-Founder, Beckman Laser Institute

Since there is a lot in this issue about Smentors, I thought it would be appropriate to focus this column on mine. Unfortunately, all of my science mentors have passed on. I feel sad because, in retrospect, I realize that I did not really express my gratitude in terms of feelings when they were here. I'd like to do that now.

My first mentor was Mr. Robert D. Abrams, my high school biology teacher. But he was more than just my biology teacher. Two days a week after school, he took me to a cancer research lab on Long Island where he had a project to study the effects of stress on cancer in mice. My job was to hold each mouse up by the tail while Mr. Abrams measured each tumor. It was my introduction to research, and it was fascinating to me even though I was bitten numerous times. But there was even more. On Friday nights, I would go over to his house for a steak dinner and an evening of stimulating talk. Unfortunately, that could never happen today, especially since Mr. Abrams lived alone. Thank you, Mr. Abrams, for being a mentor and a friend.

My second mentor was Professor Lowell D. Uhler, who taught a course in scientific methods at Cornell University.

I took his class in my junior year (1963) and learned how to do histology sectioning and staining, as well as how to prepare and stuff a dead animal--sort of like taxidermy without the natural pose. I would stop and pick up "road-kill" and take the animal back to my apartment freezer before bringing it to class later in the week. I even did this when I was home for vacation, and my Aunt Shirley had a large freezer in her basement that held lots of dead raccoons, possums, and other various critters. But Professor Uhler was more than just a teacher. One day, he asked me if I would be interested in helping him solve a problem that had been puzzling him for years: why were some green frogs blue? He had a blue frog in a tank in his office whose common name is the "green frog." But sometimes, for no explainable reason, there was a blue "green frog" in the shipment of frogs that was sent to Cornell for research studies. So my project was to breed two blue frogs together to try to get "blue babies" (tadpoles), take pieces of blue skin, and analyze the structure and biochemistry. This project became my Master's Thesis, and it would not have happened if Professor Lowell D. Uhler had not offered me the opportunity to solve the mystery of the "blue frog." Thank you, Professor Uhler, for setting me on my professional path and for being such a kind person with a great smile.

My third mentor was Professor William T. Keeton, who was probably the best science lecturer at Cornell. He could literally make the molecules dance across the lecture hall. His classes were always packed, and he made biology seem alive to all of us. Though I will never be as good as he was, I try to make science seem real to my students, and I try to make them laugh a lot, just like Bill Keeton. But Bill Keeton was more than just a great classroom teacher; he took me under his wing after I completed my M.S. degree and let me pick a problem to pursue for my Ph.D. in his lab. He was there to guide me when I needed it, but by and large, he let me figure out problems on my own. He taught me to view the big picture even though it is so easy to get so wrapped up in what you are doing that you don't see how it all fits together. Thank you, Bill, for that insight and for being such an intense and exciting person. Your excitement for science is still with me, and I try hard to convey that to my students.

Mr. Abrams, Professors Uhler and Keeton are examples of when a teacher just doing his (or her) job takes that extra step and becomes a mentor. With dedication, enthusiasm and kindness, they took the time to nurture the imagination and creativity of a student so that he could realize his potential and more. I have been so lucky. ■

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## Newsbriefs

### Chairman-elect

Brian Wong, M.D., Ph.D., Professor and Director of the Division of Facial Plastic Surgery in the Department of Otolaryngology-Head and Neck Surgery at UCI Medical Center, was named Chairman for 2011-2013 of the Head and Neck Optical Diagnostics Society at its

3rd Scientific Meeting held in Innsbruck, Austria, on May 11, 2011.

### Undergraduate Research Highlighted

Michael Hoang, a Biological Sciences undergraduate student working in BLI Dental Director Petra Wilder-Smith's

lab, presented his research project entitled "Optical coherence tomography can detect and quantify chemotherapy-induced oral mucositis" at the UCI Undergraduate Research Symposium on May 14, 2011.

## Elliot Botvinick, Ph.D.



Elliot Botvinick

Assistant Professor of Biomedical Engineering Elliot Botvinick received a 2011 Pilot Grant from the Institute for Clinical and Translational Science (ICTS) at

UC Irvine for “A bloodless laparoscopic cutting tool.”

## Petra Wilder-Smith, D.D.S., Ph.D.



Petra Wilder-Smith

BLI Dental Director Petra Wilder-Smith has received a National Institutes of Health (NIH) R21 grant for “Stress history is recorded in tooth enamel.” The grant is a

collaboration with UCLA, and Dr. Wilder-Smith is the Principal

Investigator of the UC Irvine subcontract. Dr. Wilder-Smith has also been informed by the UC Irvine School of Medicine Committee on Research and Graduate Academic Programs that two of her proposals have been funded. She is Principal Investigator on the grant, “Mitigation of cancer therapy-induced mucositis by mesenchymal stem cells,” and Co-Principal Investigator with **Jennifer Holtzman, D.D.S., D.P.H.**, BLI Assistant Researcher, on “Prevalence of very early caries in community living adults.”

## BLI Faculty Honored as Mentors

Several Beckman Laser Institute (BLI) faculty have recently received Mentor Awards from various departments at UC Irvine.

**Dr. Brian J. F. Wong**, Professor and Vice-Chair of the Department of Otolaryngology, was awarded the first Stanley van den Noort and Elliot Frohman Mentoring Award at the UC Irvine School of Medicine Gala held on April 7, 2011. The mentoring award, established by Dr. Elliot Frohman in celebration of former UCI Dean of Medicine Dr. Stanley van den Noort’s 75th birthday, is given to an individual faculty member based on his/her documented ability to guide and direct individuals early in their career along a path of accomplishment and success. Dr. Wong specializes in aesthetic, corrective, and reconstructive facial surgery with an emphasis on rhinoplasty. He is also a specialist in reconstructive cranio-maxillofacial surgery and in the treatment of vascular tumors of the head and neck. At BLI, Dr. Wong directs a large research laboratory focusing on the development of new ways to reshape and regenerate living tissues as well as perform minimally invasive surgery and optical imaging.



Mrs. June van den Noort (right) with Dr. and Mrs. Brian Wong at the 2011 UC Irvine School of Medicine Gala.

“He is hands-down, one of the best mentors a medical student can have. Since June 2008, I’ve had the privilege of working in his lab and have interacted with him extensively in the setting of research and clinical work, and I can say with absolute certainty that he is excellent across the board and an excellent

human being as well,” wrote one student who nominated him. Said another medical student, “From my first meeting, I could tell Dr. Wong was someone who genuinely cared about his students and throughout my years in the lab, I saw this to be true.”

*(Faculty Mentors continued on p. 7)*

# UROP Recipients for 2010-2011

Each academic year, the Undergraduate Research Opportunities Program (UROP) awards fellowships to support noteworthy research. The following undergraduate students working in the labs of BLI faculty were named as UROP Fellows for 2010-2011.

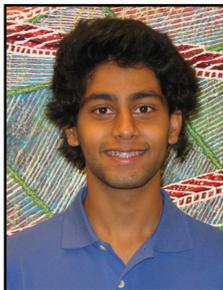
**David Avila,** Biomedical Engineering: Premedicine, who works with Dr. Brian Wong, received funding for “Investigating the correlation between frontal and lateral views of the face using internet-based ratings.”



David Avila

**Michael T. Hoang,** Biological Sciences, who works with Dr. Petra Wilder-Smith, received funding for “Optical coherence tomography and the ability to quantify chemotherapy-induced oral mucositis.”

**Syed F. Hussain,** Biochemistry & Molecular Biology, who works with Dr. Brian Wong, received funding for “Needle electrode-based electromechanical reshaping of cartilage.”



Syed Hussain

**Jinwan Kim,** Biomedical Engineering: Premedicine, who works with Dr. Brian Wong, received funding for



Jinwan Kim

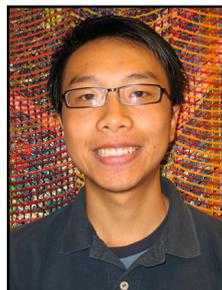
“Electromechanical reshaping of costal porcine model.”

**Tiffany W. Liu,** English/Biological Sciences, who works with Dr. Brian Wong, received funding for “Identifying ideal brow shape: an empiric analysis of the three archetypes.”



Tiffany Liu

**Tony D. Nguyen,** Biomedical Engineering, who works with Dr. Brian Wong, received funding for “Mechanical changes in bovine tendon following electromechanical reshaping.”



Tony Nguyen

**Katherine D. Nielsen,** Public Health Sciences/Public Health Policy, who works with Dr. Bernard Choi, received funding for “In vivo monitoring of VEGF-GFP transgenic mice microvasculature following photothermal injury to blood vessels.”



Katherine Nielsen

**Breanna N. Padilla,** Biomedical Engineering, who works with Dr. Elliot Botvinick, received funding for “Determining the force gradient of the Mr. Twisty



Breanna Padilla

and its influence on capillary formation.”

**Natalie A. Popenko,** Biological Sciences, who works with Dr. Brian Wong, received funding for “Determining the ideal lips through manipulating upper and lower lip ratios.”



Natalie Popenko

**Adria J. Sherman,** Biomedical Engineering, who works with Dr. Michael W. Berns, received funding for “The implementation of threshold laser parameters to further characterize the DNA damage response of mitotic chromosomes.”



Adria Sherman

**Erica Su,** Biomedical Engineering: Premedicine, who works with Dr. Brian Wong, received funding for “Femtosecond and pulsed infrared laser ablation of articular cartilage: an alternative to microfracture surgery.”



Erica Su

**Joseph Youssef,** Biological Sciences, who works with Dr. Petra Wilder-Smith, received funding for “Assessment of pulpal blood flow using laser speckle imaging.”

## Big Smiles All Around

Two 199 undergraduate students who work in BLI Dental Director Petra Wilder-Smith's lab, Michael Hoang and Joseph Youssef, guided 50 kindergarten and first grade students as they used the mouth as a laboratory to investigate tooth decay. With the help of BLI Assistant Researcher Dr. Jennifer Holtzman and the support of UCI's Center for Future Health Professionals, Hoang and Youssef presented curriculum devised by the National Institutes of Health, "Open Wide and Trek Inside," at University Montessori School in Irvine, CA, from February through May 2011.

Open Wide and Trek Inside's curriculum applies science concepts to

real life while concurrently promoting oral health self care. The UCI students provided a series of six 20-30 minute lessons which included inter-



Two of the University Montessori teachers with UCI volunteers. From left to right: Michael Hoang, Nobuko Christoph, Elizabeth Ahn and Joseph Youssef.

active activities that illustrated the factors that contribute to tooth decay and the decay process itself. In one

lesson, children learned good oral self care through role playing: children dressed as teeth were covered in bacteria (post-it notes) as they ate various

foods "throughout the day" and then "brushed" and "flossed" off the bacteria before bedtime.

Tooth decay is an important health issue since, though completely preventable, it can result in failure to thrive and difficulty communicating as well as issues of low self-esteem. If left untreated, tooth decay can even cause death. Dr. Holtzman reported that when she asked Michael and Joseph how the program went, their "faces were beaming." ■

## Teaching Award *(cont'd from p. 1)*

course covers principles of biology, engineering, medicine, physics, and chemistry—a daunting task at which he has been most successful. It has also been recognized across the country as an innovative melding of basic and applied science that covers equally engineering and biological principles. Prof. Berns has mesmerized and excited the students by mixing in his own personal anecdotes about science with often difficult concepts so as to make them more understandable, relevant and, even at times, palatable to the students. Prof. Berns clearly is an outstanding teacher and has

been able to maintain the high level of teaching (and enthusiasm) throughout his 40-year career at UCI."

Dr. Berns began his academic career in 1970 at the University of Michigan at Ann Arbor as an Assistant Professor before moving to UC Irvine in 1973 to be an Associate Professor and Chair of the Department of Developmental and Cell Biology. In 1998, Dr. Berns became a Professor in the Department of Electrical Engineering and Computer Science, where he was involved in the founding of the UC Irvine Center for Biomedical Engineering in 1999, and

helped establish The Henry Samueli School of Engineering's Department of Biomedical Engineering in 2001.

Dr. Berns' research interests include: the application of lasers and associated optical technologies in biology, medicine, and biomedical engineering; laser tissue interactions; laser microbeam studies on cell structure and function; development of photonic-based biomedical instrumentation; and clinical research in oncology, fertility, and ophthalmology. ■

## Critical Care *(cont'd from p. 1)*

improving care for wounded military personnel. These areas include: 1) early detection and treatment of impending hemorrhagic shock; 2) early detection and the treatment of inhalation airway injury related to smoke, toxic gases and chemical agents; and 3) a tissue perfusion surgical camera for the assessment of burns, wounds and reconstructive surgery.

BLI Director Bruce Tromberg, Ph.D., and co-investigators Matthew Brenner, M.D., and Albert Cerussi, Ph.D., demonstrated for Col. Hack and Dr. Schlossberg the capabilities of Diffuse Optical Spectroscopy (DOS) to non-invasively detect changes in tissue hemoglobin, oxygenation and water content. In collaboration with colleagues at the U.S. Army's Institute of Surgical Research, DOS has shown the capability to track critical changes that precede the onset of shock which are not detectable by standard critical care monitoring systems. Drs. Tromberg, Brenner and Cerussi also demonstrated how their research teams have been able to reduce the size of the DOS instrumentation from an original refrigerator size research instrument down to the size of a large smart phone, potentially suitable for field deployment.

Recognizing that 10-20% of civilian and up to 30% of military burn patients sustain airway injury related to the inhalation of superheated air, smoke and toxic fumes that result in a 10- to 20-fold increase in patient mortality, Drs. Matthew Brenner, Zhongping Chen, Michael Berns, Petra Wilder-Smith and George Peavy have been developing minimally invasive imaging technologies and novel treatments for early diagnosis and management of inhalation airway injury. One of the products of this effort is the commercial development of a field deployable Optical Coherence

Tomography (OCT) imaging device that has been demonstrated to be able to detect injury to airways within 5 minutes of smoke exposure that generally is not detectable by standard bronchoscopy until 4 hours later. The commercial prototype OCT device has received U.S. Army SBIR Phase II funding and has demonstrated the ability to acquire

rapid, almost histology quality images with immediate 3-D image reconstruction and analysis capabilities.

In a specialized application of the principles of DOS, Drs. Anthony Durkin



*Dr. Anthony Durkin demonstrates for Col. Hack the ability of the Modulated Imaging surgical camera to image tissue perfusion and oxygenation for the accurate assessment of burns, wounds and reconstructive surgery.*

and Bruce Tromberg are working on the development of a surgical camera that is able to visually map tissue hemoglobin, oxygenation and water content which will enable a surgeon to accurately assess the health of tissue in the evaluation of burns, trauma wounds, and in performing reconstructive surgery. Having been invented at the BLI and initially evaluated in a study of skin grafts, the modulated imaging surgical camera is being used in a preliminary study of burn patients, and in collaboration with a commercial partner, Modulated Imaging Inc. (one of four companies located in the BLI Photonics Incubator), this technology is being reduced in size and ease of operation to be similar to that of a standard digital camera.

Following the tour and demonstrations, Col. Hack shared with the BLI faculty and research teams the broad challenges and research priorities for combat critical care that address the needs of the men and women who put their lives on the line for our country. He was encouraged by the BLI's on-going projects and suggested additional technology challenges that could benefit from the efforts of Institute investigators. ■



*A portable broadband Diffuse Optical Spectroscopy instrument that measures tissue absorption and scattering at 1000 wavelengths in a few seconds is put on display by Dr. Albert Cerussi for Dr. Schlossberg and Col. Hack during an arterial occlusion experiment demonstration.*

# Arrivals and Departures

## ARRIVALS

**Jan Fisher** has joined BLI as the Payroll/Personnel Analyst. Jan previously worked within the School of Medicine and received her Master's in Public Administration from California State University Northridge.



Jan Fisher

**Eren Taydas, M.D.**, has joined Dr. Anthony Durkin's lab to work on burn wound severity assessment and monitor early failure in reconstructive flaps using Spatial Frequency Domain Imaging.



Eren Taydas

## DEPARTURES

**Shigeto Ueda, M.D.**, has returned to the Department of Surgery, Breast Oncology Service, National Defense Medical College, Japan, after working with Dr. Albert Cerussi for the last two years on optical imaging of breast cancer.

**James Yeh, B.S.**, who worked as a Jr. Specialist in Dr. Bernard Choi's lab, was accepted into the M.D./Ph.D. program at the University of Buffalo.

## Special Departure: Jeff Beckwith

Jeff Beckwith came to the Beckman Laser Institute (BLI) from the Department of Earth System Science in 2006. A long-term employee of UC Irvine,



Jeff Beckwith

Jeff was first hired by the Dean's Office in the School of Medicine in 1989 as an Administrative Assistant. Within six months, he accepted a job in the Department of Physiology and Biophysics as an Administrative Assistant III where he handled the payroll and all functions backing up academic personnel, such as merit reviews and visas. Throughout the years, he has worked in the same capacity in the Department of

Neurobiology and Behavior as well as the Department of Earth System Science. At BLI, he was hired as the Payroll/Personnel Analyst which entails the same duties for which he was previously responsible.

This year, Jeff finally decided to officially retire from full employment, but he will be returning part-time to assist his successor, Jan Fisher. This is good news to BLI staff because while Jeff would be missed, the picture perfect pumpkin pies he bakes (which taste as good as they look) might be missed a little bit more. Hopefully, when he comes back, he'll be sharing pies as well as his expertise. Besides baking pies, Jeff will use his extra time for reading, gardening, and traveling, including regular trips to the family owned apple orchard in Kent, Ohio.

## Faculty Mentors (cont'd from p. 3)

BLI Director **Bruce J. Tromberg** and Associate Professor of Dermatology **Kristen Kelly** were two of the 2011 Mentor Award Winners announced by the Institute for Clinical and Translational Science (ICTS). Their achievements were recognized at the inaugural ICTS Spring Colloquium and Workshop on Mentoring held on May 20, 2011.



Bruce Tromberg



Kristen Kelly

Dental Director **Petra Wilder-Smith** was named Mentor of the Month for August by the Undergraduate Research Opportunities Program (UROP) in recognition of her outstanding efforts in mentoring undergraduate research projects. Her profile is highlighted on the UROP Website ([www.urop.uci.edu](http://www.urop.uci.edu)). ■

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## Selected Recent Publications

“Postoperative quantitative assessment of reconstructive tissue status in cutaneous flap model using spatial frequency domain imaging” by A. Yafi, T. S. Vetter, M. R. Pharaon, T. Scholz, S. Patel, R. B. Saager, D. J. Cuccia, G. R. Evans and A. J. Durkin in *Plastic & Reconstructive Surgery* 127: 117-130, 2011.

“Quantification of airway thickness changes in smoke-inhalation injury using in-vivo 3-D endoscopic frequency-domain optical coherence tomography” by S.-W. Lee, A. E. Heidary, D. Yoon, D. Mukai, T. Ramalingam, S. Mahon, J. Yin, J. Jing, G. Liu, Z. Chen and M. Brenner in *Biomedical Optics Express* 2: 243-254, 2011.

“Multispectral imaging of tissue absorption and scattering using spatial frequency domain imaging and a computed-tomography imaging spectrophotometer” by J. R. Weber, D. J. Cuccia, W. R. Johnson, G. Bearman, A. J. Durkin, M. Hsu, A. Lin, D. K. Binder, D. Wilson and B. J. Tromberg in *Journal of Biomedical Optics* 16: 011015, 2011.

“Electric field Monte Carlo simulation of the effects of scattering on the focal fields of tightly focused laser beams in tissue” by C. K. Hayakawa, E. O. Potma and V. Venugopalan in *Biomedical Optics Express* 2: 278-299, 2011.

“Survival of chondrocytes in rabbit septal cartilage after electromechanical reshaping” by D. E. Protsenko, K. Ho and B. J. F. Wong in *Annals of Biomedical Engineering* 39: 66-74, 2011.

“Optical tweezers and non-ratiometric fluorescent-dye-based studies of respiration in sperm mitochondria” by T. Chen, L. Z. Shi, Q. Zhu, C. Chandsawangbhuwana and M. W. Berns in *Journal of Optics* 13: 044010-1-6, 2011.

“Imaging: focusing light in scattering media” by S. D. Konecky and B. J. Tromberg in *Nature Photonics* 5: 135-136, 2011.