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Budding Scientists Visit BLI

Are you ever too young to wonder about the effect of osmolarity on cartilage? Apparently not if you were one of the eight undergraduates who visited the Institute this summer.

The students, engineering and physics majors from Harvey Mudd College (HMC), collaborated with Institute researchers on a variety of projects—and in the process got a taste of what graduate school would be like.

Program coordinator and HMC engineering professor Sam Tanenbaum, Ph.D., explained how the five-year-old program worked.

“The students are paired with BLI faculty mentors who shared their research interests. They develop projects and present their findings during weekly meetings,” he said. “With a lot of hard work and a little luck, many of them will co-author research publications this year.”

The students, mainly juniors and seniors, said they were spending their summer indoors for the research experience.

“We’re all really into science,” HMC senior John Fuhrman said. “Eventually, most of us would like to work at a place like Beckman.”

This summer, he and Sheana Karre collaborated on a photon migration project. Ben Markum investigated optical coherence tomography. Andrew Harrington and Jason Ro developed a feedback control system to monitor laser reshaping of cartilage. Jason Yu created skin phantoms to test cryogen spray cooling. Joey Ann Kimball and Darren Gray investigated the osmolarity of cartilage.

Director Michael Berns, Ph.D., found the students’ interest in laser research rewarding.

“It was exciting to work with these young collaborators,” he said. “It also was in keeping with the Institute’s mission to educate the next generation of scientists.” ■



The Beckman Laser Institute's Photonic Incubator expansion will be completed this winter.

Newsbriefs

CHANGES TO THE BLI BOARD

The Beckman Laser Institute Board of Directors elected officers and voted in a new member at its quarterly meeting in August.

Long-time Board member and former vice chairman Richard P. Kratz, M.D., was named chairman. He succeeded founding member Brian M.

Demsey, who remains on the Board. Linda Cahill, a healthcare consultant, was elected vice chair. George E. Hewitt, Hewitt Fellowship program creator and an early BLI supporter, will retain his post as secretary/treasurer.

The Board also elected a new member, Robert L. Stoy, Ph.D., clinical systems director and vice president at

(Continued on pg. 8)

Hospitals: The Dinosaurs of Healthcare

by Michael W. Berns, Ph.D.

Arnold and Mabel Beckman Professor
President and CEO

Like dinosaurs and Navy battleships, hospitals as we know them are destined for extinction by 2020.

Both Navy battleships and dinosaurs became extinct because they were not able to survive change. While the exact origin of dinosaurs' extinction is unclear, it is clear that the animals could not survive a changing environment. Similarly, the Navy's battleships became extinct because they were large, cumbersome, expensive, and unable to respond to rapid changes in their military environment.

So why are hospitals destined for extinction?

Why Hospitals Are Dinosaurs

First, they are large, expensive enterprises that cannot respond quickly to the changing demands of the healthcare environment. The end result is that they cannot necessarily deliver the best quality healthcare.

A noted healthcare specialist, Dr. Martin Paris, recently pointed out that it is more profitable for hospitals to prolong the stay of patients rather than to employ new medical procedures that reduce the number of days the patient stays in the hospital. This seems counter intuitive—but it is not!

Dr. Paris noted that the first few days of a hospital stay generate enough revenue for the hospital to break even. The subsequent 3 - 5 days generate the hospital's "profit" (even in a not-for-profit hospital).

This reason notwithstanding, it is expensive for hospitals to update equipment, even if it makes for a more efficacious procedure.

In addition, healthcare is no longer being driven by physicians or patients (the customer). It is being driven by HMOs, PPOs, and the government

Medicare system. These are businesses (even Medicare) in the sense that they want to deliver a service with the least expense and the maximum return.

Third party payors also are making demands of hospitals. The payors want patients quickly released with as few procedures and tests as possible—the opposite of what the hospital needs.

The result of these changes? The hospital-dinosaurs are struggling.

The Evolution of Hospitals

To survive, hospitals have cut back on the purchase of new innovative equipment and eliminated support personnel. The result is suboptimal healthcare. Fewer people are doing more; old equipment is being pushed to its limits. Physicians, formerly the ship "captains," now are relegated to the ranks of the "enlisted," while the hospital administrators are the "officers," deciding how—and how much—healthcare will be offered.

As the war between the service providers, payors and hospitals grows, customers are caught in the middle. As recent testimony in front of the U.S. Congress illustrates, frustrated patients already are demanding change.

What will our healthcare system look like in the year 2020? Hopefully foresight, rather than hindsight, will be 20-20.

Healthcare for the 21st Century

In 2020, most hospitals will have evolved from their gargantuan "do everything" personas, to small specialized facilities of between 25 and 50 overnight beds. For example, one day you may find a cardiothoracic facility specializing in heart and lung surgery or a neurosurgical facility specializing in brain and spinal cord surgery.

Amazing as it now seems, there may be hospitals that primarily provide transplant surgery. With our increasing ability to grow organs, in 2020 it won't

be uncommon for a person to have had at least one organ replaced by the time they're 100.

The "hospitals" of 2020 will be lean. They'll outsource such infrastructure costs as infection control, pharmacy, quality control, credentialing, and risk management.

The mainstay of healthcare in 2020 will be: (1) a series of small, local surgicenters equipped to deliver specialized surgical healthcare; (2) mobile "health vans" that will arrive at your home or business equipped with a physician, nurse, and technical support to perform minor surgical and diagnostic procedures (already there are plans for laser-equipped vans that will travel from site-to-site to deliver treatment); (3) in-home healthcare in which a physician or "para-medical" will actually perform the diagnosis, treatment, and even therapy in your home (yes, the return of house calls); and (4) an in-home diagnostic and treatment computer-based telemedicine system.

This last component will involve computer-based "black boxes" in every home and business. The boxes, equipped with DNA-based diagnostic silicon chips and tiny "smart" lasers, will diagnose and treat disease, and provide a fiber optic interface to a central databank of computers. At that location, physicians with training in biomedical engineering will interpret, diagnose and prescribe treatment.

A Challenge to Hospitals

The challenge for hospitals now is to recognize that the healthcare system is going to change drastically. Rather than becoming extinct, hospitals must aggressively meet the future by development and adoption of new, cost-effective and efficient technology, by downsizing their scope of activity, and by proactively dealing with the legal and ethical issues that 21st century medicine will raise. ■

DOE Grant Funds Breakthrough Research

The U.S. Department of Energy (DOE) recently agreed to renew the Beckman Laser Institute's "Center of Excellence" designation, awarding the Institute a grant of over \$1.5 million for the next three years.

What does such a grant mean?

First, it means that the Institute houses an outstanding laser program—only three other programs nationally were awarded this designation. It also means that exciting new non-invasive therapies soon will be available.

Roland F. Hirsch, program manager for the grant, says the DOE is pleased to see such innovative research coming out of the Institute's interdisciplinary programs.

Birthmark Removal

Part of the grant will fund research to refine the current treatment for port wine stain birthmarks like the one found on Mikhail Gorbachev's forehead.

Physicians use heat and cooling to remove these vascular birthmarks. The skin is first treated with cryogen spray, a safe cooling agent, and then exposed to the energy from a pulsed dye laser. The Institute-patented spray allows physicians to use laser energy hot enough to eliminate large and small vessels.

The exact amount of heat and cooling is what DOE funding will help to refine, according to Associate Director J. Stuart Nelson, M.D., Ph.D.

"We're developing a three-dimensional tomographic reconstruction algorithm to calculate the optimal laser light and cryogen dosage for individual patients," he explains.

Dr. Nelson and his colleagues also will apply infrared tomography, a sub-surface tissue scan, to measure how the laser energy affects the blood vessels.

"We hope the algorithm and the infrared tomography will help us to determine the most effective treatment for

each birthmark," he says.

Bahman Anvari, Ph.D., of Rice University; Dennis M. Goodman, Ph.D., of Lawrence Livermore National Laboratory; and Sam Tanenbaum, Ph.D., of Harvey Mudd College also will collaborate on the three-year study.

Breast Cancer Diagnosis

DOE funds also will support clinical trials for an Institute-developed breast cancer diagnostic technique. Frequency Domain Photon Migration (FDPM) may be particularly useful in analyzing the dense breast tissue of women in their 40s and 50s.

The technique employs a portable laser that shoots harmless light through breast tissue. As light exits the tissue, researchers record its activity. The amount of light absorbed or scattered provides information about the tissues the light passed through—how much oxygen, blood, water and fat the tissues contain.

"A great deal of scattering might signal high cell density, a sign of cancer," explains Associate Professor Bruce Tromberg, Ph.D., FDPM group leader.

During a three-year clinical study, researchers will identify the optical properties of healthy and cancerous breast tissue.

"Eventually," Tromberg says, "we'll be able to use optical signatures to understand transformations from normal to tumor tissue."

Other FDPM collaborators include John Butler, M.D., of the Chao Family Comprehensive Cancer Center, and BLI researcher Joshua Fishkin, Ph.D.

Gynecological Therapy

The DOE grant also will fund clinical trials for a light-based system to detect the early spread of ovarian cancer. Using photodynamic fluorescent diagnosis (PDD), researchers hope to better visualize microscopic cancer nodules.



Photo by Paul Kennedy

A BLI hand-held device uses a new method for breast cancer diagnosis.

Such current methods as laparotomy or laparoscopy sometimes miss these tiny concentrations of cancer tissue.

PDD uses the combination of light and a light-activated drug to locate the malignant tissue. Researchers first administer the drug which, after a few hours, concentrates mainly in cancerous tissue. They then shine light on the tissue with a small, specially-designed fiber optic laparoscope developed by corporate partner Olympus Inc.

"We expect any cancer nodules present to fluoresce," explains Professor Yona Tadir, M.D., the study's leader. "Fluorescent tissue will be much easier to see and remove than the nearly microscopic nodules that sometimes develop after the removal of cancerous ovaries."

Institute Director and collaborator Michael Berns, Ph.D., adds, "PDD's potential ability to locate tiny cancerous nodules could provide a valuable minimally-invasive method to detect the early spread of ovarian cancer."

PDD researchers also include Philip DiSaia, M.D., UCI obstetrics and gynecology professor. ■

Boning up on Laser Surgery

Lasers are being used to correct vision, manipulate cells, and diagnose and treat cancer. Now, Institute scientists are using lasers to cut bone. They hope the laser ultimately will replace the bone saw, making joint replacement and reconstructive surgery more efficient.

Laser Osteotomy

“The success of some orthopedic surgeries hinges on osteotomy, or bone cutting,” explains George M. Peavy, D.V.M., director of the Institute’s veterinary program. “Right now, surgeons are limited by the accuracy of the hand-held bone saw. We’re hoping the laser will be more precise.”

Osteotomy is a common part of reconstructive and joint replacement surgeries. An imprecise incision can contribute to implant or prosthesis failure.

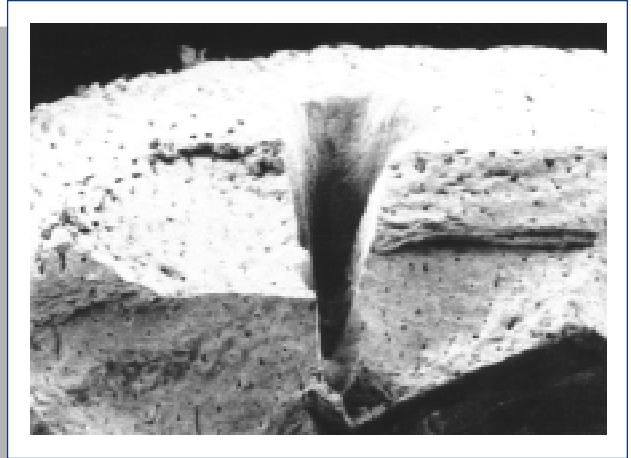
It also may encourage bone remodeling—something surgeons try to avoid.

Bone remodeling is a normal process the body initiates when an injury occurs. But when bone remodels around a prosthesis—especially around the cementless prostheses of today—it may cause the prosthesis to fail.

“To reduce trauma and excessive remodeling,” Dr. Peavy explains, “it’s important to minimize bone damage.”

The Free Electron Laser

For almost two years, he and his col-



A bone incision made using the free electron laser.

leagues have made a variety of bone incisions with the free electron laser (FEL). The FEL is a powerful, tunable laser that, unlike the argon or excimer lasers, permits the use of wavelengths ranging from visible to infrared. The researchers have tested wavelengths from 2.9 to 9.3 μ m.

“So far, we’ve found that a pulsed infrared wavelength produces the cleanest and deepest ablations,” Dr. Peavy says. “The most efficient wavelength seems to be one where the laser energy is absorbed by water and protein, instead of minerals.” Bone is comprised mainly of protein, water and minerals.

With the help of UCI’s orthopaedic department, he notes that the next step will be pre-clinical studies. “Ultimately, we’d like to see the laser used in orthopedic procedures,” he adds.

Funding from the Medical FEL Program at the Office of Naval Research will support the research until 2000. Study collaborators include Lou Reinisch, Ph.D., of Vanderbilt University; Charles Cobb, Ph.D., D.D.S., and Paulette Spencer, Ph.D., D.D.S., of the University of Missouri-Kansas City; and John M. Payne, D.V.M., from the University of Missouri-Columbia. ■

Beckman Laser Institute and Medical Clinic University of California, Irvine

1002 Health Sciences Road East
Irvine, CA 92612
(949) 824-4713 (Administration)
(949) 824-7997 (Clinic)

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Beckman Laser Institute News

Nicole Knight, Editor

Newport-Incubator Alliance Formed

Newport Corporation of Irvine recently agreed to support the development of biomedical technologies and to donate optical research equipment valued at approximately \$100,000.

The agreement, finalized this summer, is part of an arrangement that makes the optical equipment manufacturer the inaugural corporate partner to the soon-to-be-completed Photonic Incubator.

Newport Vice President Robert J. Phillippy says the company is pleased to be the first of the Incubator's industry collaborators.

"The Incubator is an excellent example of how academia and industry can work together," he says. "We are confident this collaboration will lead to some very beneficial developments."

Specific developments may include an optical coherence tomography (OCT) system. OCT is a real-time optical scanning method used to view sub-surface blood vessels and tissue. Newport also is interested in jointly developing OEM sources for an optical mi-

"The Incubator is an excellent example of how academia and industry can work together."

croscopy system that incorporates laser trapping devices into standard microscopes.

Noting that the expansion will be completed this winter, Institute Director Michael Berns, Ph.D., says the contribution is well timed.

"We are thrilled that they are the first corporation to become a partner with

the new Photonic Incubator," he notes. "Newport also was one of the first companies to affiliate with the Institute back in the 1980s."

Newport is a leading manufacturer of test and measurement and laboratory research equipment. Newport makes vibration-free tables, prisms, mirror mounts, positioners, motion control systems, and other electro-optical components.

Such equipment will be invaluable in the 12,000 square foot expansion. The Incubator will add four optical engineering labs, an operating room, recovery room, and conference and office space. The new wing will be shared with industry partners like Newport. When completed, the \$3 million project will be able to house up to six corporate collaborators at any given time. ■

Institute Contributors and Partners

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Dana O'Brien Bids Beckman Farewell

Dana O'Brien has "a lot of fun" working as the Beckman Laser Institute's human resources manager, so her recent decision to leave was not work-related.

"It's time for me to explore new interests," the Huntington Beach resident explains. "I'd like to devote more time to my family and pursue a psychology degree."

Director Michael Berns, Ph.D., among others, will miss working with O'Brien. "She always has been willing to assume new responsibilities and has a great can-do attitude," he says.

O'Brien joined the Institute as a personnel assistant in August 1994. Her responsibilities included managing payroll, recruitment, compensation and benefits for almost 100 employees. A Southern California native, she came to BLI from a personnel position at UC Riverside's Soil and Environmental Sci-

ences Department.

"I was looking to relocate to Orange County but wanted to stay in the UC system," O'Brien says.

After a promotion last year, she assumed managerial responsibilities on top of her human resources duties.

O'Brien says she struggled for weeks with the decision to leave BLI.

"I have made wonderful friends here. My favorite thing about working at Beckman is the people."

She says she'll continue to keep in contact with her BLI friends but plans to focus her energies on her children: Sandon, 11; Ryan, 7; and Samantha, 6.

"Sandon is starting junior high this fall so it's a very important time for him," explains O'Brien.

She also wants to spend more time with her husband, Russell.

"Some of our favorite activities are camping in the Sierras and the Central



Dana O'Brien

Coast, sailing, and biking along the coast," she says.

Dr. Berns is sad to see O'Brien leave but adds that she is doing what a lot of parents wish for. "We hope the best for her," he says. ■

Dr. Chao Appointed Associate Director

Lawrence C. Chao, M.D., assistant clinical professor in UCI's ophthalmology department, recently was named Associate Director for Refractive Surgery. He will specialize in laser correction of nearsightedness, farsightedness and astigmatism.

Although his title is new, Dr. Chao is no stranger at the Surgery Laser Clinic. He has been a clinical instructor and corneal and refractive surgery fellow at UCI since 1997.

A laser-certified surgeon, Dr. Chao is skilled in photorefractive keratectomy (PRK) and laser assisted in situ keratomileusis (LASIK), both of which correct myopia up to 12 diopters. PRK and LASIK also correct astigmatism up to 4 diopters. He will begin offering correction of farsightedness when the procedure gains full FDA approval.

"Technological advances have changed the way ophthalmologists think about the cornea," says Dr. Chao. "Today, we can treat it with a hands-on approach."

He notes that he has been fortunate to have studied with corneal experts. While at UCI, he trained under Ronald N. Gaster, M.D., and Lee Nordan, M.D. Dr. Chao served his residency at St. Vincent's Medical Center in New York, a program started by corneal surgery pioneer Ramon Castroviejo, M.D.

Dr. Chao's qualifications, explains Director Michael Berns, Ph.D., weren't the only reason for naming him associate director.

"He has a warm, friendly manner that I know our patients will appreciate," Dr. Berns explains.



Dr. Lawrence C. Chao

For more information about refractive procedures, call (949) 824-7980. ■

PUBLICATIONS

Yona Tadir, M.D., published "Intrauterine Light Probe for Photodynamic Therapy" in *Obstetrics and Gynecology* and "Ten Years of Laser-assisted Gametes and Embryo Manipulation" in *Contemporary Obstetrics and Gynecology*. He also published "Minimally Invasive Applications of Lasers in Gynecology" in *Surgical Techniques in Gynecology*.

Petra Wilder-Smith, Ph.D., D.D.S., published "Effects of a 532nm Q-switched Nanosecond Pulsed Laser on Dentin" in the *Journal of Endodontics*.

Vasan Venugopalan, Sc.D., published "Radiative Transport in the Diffusion Approximation: An Extension to Highly Absorbing Media and Smaller Source-detector Separations" in *Physical Review E*.

Vickie LaMorte, Ph.D., published "Molecular Aspects In The Feedback Regulation of Gene Expression by Cholesterol In Mammalian Cells" in *Methods: A Companion to Methods in Enzymology*.

Johannes de Boer, Ph.D., published "Two-dimensional Birefringence Imaging in Biological Tissue Using Polarization-sensitive Optical Coherence Tomography" in *Proceedings of the Society of Photo-Optical Instrumentation Engineers*. He also published "Two Dimensional Birefringence Imaging in Biological Tissue Using Phase and Polarization Sensitive Optical Coherence Tomography" in *Trends in Optics and Photonics*.

Brian Wong, M.D., published "Measurement of Radiometric Surface Temperature and Integrated Back-Scattered Light Intensity During Feedback Controlled Laser-assisted Cartilage Reshaping" in *Lasers in Medical Science*, and "Video Laryngoscopy with Head Mounted Display" in *Phonscope*. His fellowship thesis on "Characterization of Temperature Dependent Biophysical Properties During Laser-mediated Cartilage Reshaping" was accepted by the American Academy of Facial Plastic and Reconstructive Surgery.

Rene Hornung, M.D., published "In vivo Detection of Metastatic Ovarian Cancer

by Means of 5-ALA Induced Fluorescence in a Rat Model" in the *American Journal of Gynecology*.

PRESENTATIONS

Yona Tadir, M.D., presented "Photomedicine in Gynecology" to the Israeli Society of Obstetrics and Gynecology.

Zhongping Chen, Ph.D., presented "Functional Imaging Using Optical Coherence Tomography" at the Gordon Research Conference in Meriden, N.H. He also presented "Optical Coherence Tomography and Optical Doppler Tomography: Technology and Applications" to the Biomedical Engineering Department at the University of Michigan.

Petra Wilder-Smith, Ph.D., D.D.S., presented "Marginal Microleakage After Cavity Preparation with the Er:YAG Laser" to the International Association for Dental Research meeting in Nice, France.

Vasan Venugopalan, Sc.D., presented "Physical Mechanisms of Pulsed Infrared Laser Ablation of Biological Tissues" at the SPIE Symposium on High Power Laser Ablation in Santa Fe, N.M.

Johannes de Boer, Ph.D., presented "Functional Imaging of Biological Tissue with Optical Coherence Tomography" at the Gordon Conference.

Andrew Dunn, Ph.D., presented "Microscopic Origins of Tissue Scattering" at the Gordon Conference.

Bruce M. Achauer, M.D., presented "Laser Resurfacing Update" to the American Society for Aesthetic Plastic Surgery. He also presented "Complications of Laser Resurfacing" and "Treatment of Vascular Lesions with the Laser" at the New York University School of Medicine.

Jeffrey Gross, M.D., presented "In Vivo Optical Properties of Brain Tissue" to the Rocky Mountain Neurosurgical Society Annual Meeting in Vail, Colorado. He also presented "Optical Spectroscopy of Brain Tumors" at the New Mexico State Neurosurgical Society Annual Meeting.

Xunbin Wei, Ph.D. candidate, presented

"T-cell Activation Studies with an Optical Trap and Calcium Imaging" to the UCI Optical Biology Users Group Meeting. He also presented the poster "Mapping the Polarity and Stimulus Density Requirements for T-cell Activation" at the Cambridge Healthtech Institute's conference.

NOTABLES

Petra Wilder-Smith, Ph.D., D.D.S., was awarded a Tobacco-related Disease Research grant for research on fluorescence-based diagnosis of oral neoplasia.

Vickie J. LaMorte, Ph.D., Vasan Venugopalan, Sc.D., and Brian Wong, M.D., were promoted to assistant professor.

Andrew Dunn, Ph.D., was awarded a grant to simulate the light-scattering properties of cells by the San Diego Supercomputing Center.

David W. Furnas, M.D., was named was named 1998 Physician of the Year by the Orange County Medical Association.

UCI medical student Amir Karamzadeh was awarded a Dean's Office Summer Research Fellowship for cartilage reshaping by the College of Medicine.

Undergraduates Linh Nguy and Young Yoon won UCI President's Fellowships for their oral neoplasia research.

ARRIVALS

The Institute is pleased to welcome:

Kareem Baha, Assistant Development Engineer

Andrew Berger, Ph.D., Hewitt Fellow

Jackie Cotton, Human Resources Director

Heather Lee, Administrative Assistant

Christopher Saxer, Ph.D., Postdoctoral Researcher

Yonghua Zhao, Ph.D., Postdoctoral Researcher

NEWSBRIEFS

(continued from pg. 1)

Beckman Coulter, Inc.

"We are delighted to have Dr. Stoy join the Board," says Institute Director and Board President Michael Berns, Ph.D. "His membership continues our ongoing commitment to including senior Beckman executives."

Louis T. Rosso, Beckman Coulter's Chairman and CEO, is a past Board member.

Other Board members are: George Argyros, president of Arnel and Affiliates; Patricia Beckman, Beckman Foundation Board member; Thomas C. Cesario, M.D., dean of UCI's College of Medicine; Harry Gray, Ph.D., director of the Caltech Beckman Institute; Gavin S. Herbert, chairman emeritus at Allergan, Inc.; Richard Nesbit, Ph.D., retired vice president of advanced technology at Beckman Instruments; and David S. Tappan, Jr., retired chairman of Fluor Corp.

TROMBERG HONORED

The Beckman Laser Institute recently

established The Sheldon Tromberg Memorial Fund for Medical Research in memory of Sheldon Tromberg. Mr. Tromberg, 68, died of a heart attack in July. He was the father of Institute Associate Professor Bruce Tromberg, Ph.D.

Mr. Tromberg's diverse career included stints as an entertainment reporter, movie producer, and consultant to the Federal Trade Commission.

As a Washington, D.C., radio personality in the 1970s, he spoke live to the Iranian revolutionaries who'd seized the American Embassy. In the 1980s, while working as a screenwriting instructor at Georgetown University, he published "Making Money Making Movies." After a 1994 move to the San Francisco area, he and his wife Jessie appeared as extras in films including "Junior," an Arnold Schwarzenegger comedy.

Mr. Tromberg leaves behind a wife, three children, and five grandchildren.

Director Michael Berns, Ph.D., was saddened by Mr. Tromberg's passing.

"I met him briefly, but immediately realized that he was a very special person," Dr. Berns says. "We all share Bruce's sorrow."

Memorial services were held in Washington, D.C., and San Francisco. Contributions to the memorial fund may be made by calling (949) 824-4111.

SUPPORT GROUP GROWS

The Beckman Laser Institute's Support Group grew by five members this summer.

New members include Howard Conn, M.D., and Rita Conn. Dr. Conn, whose work was profiled in this newsletter last fall, is chief of ocular plastic surgery at UCI.

Dr. and Mrs. W. Andrew Cies also joined the Support Group. Dr. Cies is an ophthalmologist who practices out of BLI and his Newport Beach office.

In addition, Premier Laser Systems, Inc. became a Support Group member. Premier is a medical laser manufacturer based in Irvine.

The Support Group is a philanthropic organization of over 50 members. Donations to the Support Group help fund new laser technology and the treatment of indigent children's birthmarks, among other things. For more information, call Support Group Director Erin Miller at (949) 824-4111. ■



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