LASER

BECKMAN LASER INSTITUTE

WINTER 2021/2022

UCI Beckman Laser Institute & Medical Clinic

LASER | WINTER 2021/2022

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Mission

Discover new optics and photonics technologies for biomedical research

Create innovative, accessible methods and devices that transform healthcare

Educate the next generation of scientists, engineers and physicians

On the Cover

Photo: Stuart Nelson, Institute Medical Director and Professor of Surgery and Biomedical Engineering

Stuart Nelson, Institute Director Thomas Milner and Visiting Professors Lars Svaasand and Sol Kimel developed "Dynamic Cooling," an innovative laser technology used to treat children with disfiguring vascular birthmarks. "Dynamic Cooling" is incorporated in over 25,000 laser systems worldwide and has generated the second highest UCI patent royalty to date.

UCI Beckman Laser Institute & Medical Clinic
1002 Health Sciences Rd.
Irvine, California 92697

In this issue

SOL KIMEL MEMORIAL ENDOWED GRADUATE STUDENT AWARD

The Beckman Laser Institute, Inc. non-profit, Institute Founding Director Michael Berns and Professor of Pulmonology Matthew Brenner generously provided the seed funding to establish the **Sol Kimel Memorial Endowed Graduate Student Award** in perpetuity. The award is in recognition of Holocaust survivor Sol Kimel, who impacted the lives of many students, faculty and staff in the 18 summers that he spent as a visiting professor at the Institute.

Thus far, the Institute has raised over $100,000 thanks to the generosity of the following donors:

Beckman Laser Institute, Inc.
Michael Berns
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Kristen Kelly
Etan and Michal Kimmel
Karsten Koenig
Thomas and Jyoti Milner
Stuart and Peggy Nelson
Bruce and Patti Tromberg
Wim Verkruijsse
Brian Wong

Join us in honoring Sol's legacy as a leader in photochemistry and laser spectroscopy, while providing life-changing opportunities for the next generation of talented scientists. To leverage giving, gifts of $5,000 or more made prior to December 31, 2021, the UCI Graduate Division will match dollar for dollar the endowment payout for ten years. To make a gift, please contact Gabby Comfort, Director of Development at gcomfort@uci.edu or 949.824.8859.

HONORING SOL KIMEL

HOLOCAUST SURVIVOR · CHEMICAL PHYSICIST · COLLEAGUE · MENTOR · FRIEND


Photo: Carlos Puma, UCI

It is with deep sadness that we dedicate this magazine issue to Holocaust survivor and our esteemed colleague, revered mentor and dear friend, Professor Sol Kimel. Sol passed away on August 14, 2021 at the age of 92 in Haifa, Israel. In the 18 summers that Sol spent at the Institute, many Institute students, faculty and staff were fortunate to collaborate with Sol.

I met Sol as a postdoc conducting research at the Institute. Medical Director Stuart Nelson, Visiting Professor Lars Svaasand, Sol and I were developing a new laser technology to be used in the treatment of children with disfiguring vascular birthmarks. We knew that laser treatment would burn the surface of the skin, so Stuart had the idea to spray something cold on the skin's surface to prevent burning. Sol interjected with the idea to use a common fuel injector valve from an automobile air conditioning system based on an application that he had seen used in chemistry. It was the perfect way to cool the skin. We could spray a very small amount of liquid on the skin and get a dramatic temperature drop. Then, the liquid boiled off and disappeared.

In addition, Sol provided expertise on the thermal dynamic properties of the refrigerants used to cool the skin, as well as alternative refrigerants and their safety. He also helped with the interpretation of the thermal dynamics process when pressurized refrigerant was released from the valve of the device.

We not only relied on Sol's physical chemistry background, but Sol's creativity had a hand at naming the technology. When we contemplated calling it "Cryogen Cooling," Sol suggested, "Dynamic Cooling" instead. Today, "Dynamic Cooling" is incorporated in over 25,000 laser systems world-wide and has generated the second highest UCI patent royalty income to date. Through Sol's contributions, we were able to streamline the development process and accelerate the commercialization of the technology to impact the lives of our young patients.

Among his many scientific contributions, Sol lived a remarkable life. Learning of the struggles that he faced as a Jewish boy in the Netherlands during Nazi occupation, I realized that I could learn a lot from him and not only as a mentor. Sol had deep life experience – deeper than most – yet he believed in the good and lived life to its fullest.

Sol formed meaningful relationships with all those at the Institute – faculty, staff and students alike. I recall when Sol ran into a former student. Their faces lit up when they saw one another. Even though they were worlds apart in terms of the stages of their careers – student versus senior professor – I witnessed a shared bond.

I will always remember when our first child was born. After the announcement, Sol stopped me and said, "Your life will never be the same." His follow-up was, "You know they're your children for life. Even though they grow up and move on, they'll always be your children." That statement – so true – has stuck with me as I have watched my children grow over the years into young adults.

In recognition of Sol – funny, complete and compassionate – who was important to so many and for his leadership as a photochemist and contributions in laser spectroscopy, we launched a campaign to endow a graduate student award in his name. When I informed Etan Kimmel and Daphna Klein, Sol's children, of our hope to establish the Sol Kimel Memorial Endowed Graduate Student Award in perpetuity, they were touched by our efforts to recognize their father in such a significant way.

With seed funding from Beckman Laser Institute, Inc. non-profit, Institute Founding Director Michael Berns and Professor of Pulmonology Matthew Brenner and through the generosity of other donors, over $100,000 has been raised thus far. As a way to leverage giving, for gifts of $5,000 or more made prior to December 31, 2021, the UCI Graduate Division will match dollar for dollar the endowment payout for ten years.

Join us in honoring Sol's legacy as a Holocaust survivor, chemical physicist, colleague, mentor and friend by making a gift in support of the Sol Kimel Memorial Endowed Graduate Student Award. Your contribution would be particularly profound in remembrance of Sol, while providing life-changing opportunities to talented scientists for generations to come. To make a gift, please contact Gabby Comfort, Director of Development at gcomfort@uci.edu or 949.824.8859.

Warm Regards,

Thomas Milner

Thomas Milner, Ph.D.
Director, UCI Beckman Laser Institute & Medical Clinic
Professor, Surgery and Biomedical Engineering

IN MEMORIAM **SOL KIMEL**

October 7, 1928 – August 14, 2021

Bruce Tromberg, Ingrid Svaasand, Michael Berns, Miri and Yona Tadir, Sol and Bianca Kimel and Lars Svaasand

On August 14, 2021, the Beckman Laser Institute & Medical Clinic lost chemical physicist Sol Kimel, an esteemed colleague, influential mentor and cherished friend in Haifa, Israel at the age of 92. In his 92 years, Sol lived an astounding life – not only as a scientist and teacher, but also as a Holocaust survivor.

FORMATIVE YEARS

Sol Kimel was born in October 7, 1928 in Berlin, Germany. In 1930, Sol and his mother moved to live with his aunt's family in Amsterdam, while his father stayed in Berlin. For six years, he attended an elementary school of the then-novel Montessori system where children could study according to their development. During these formative years, one of his classmates was Anne Frank. After the war, the school was named the "Anne Frank School."

> "Sol told me about his childhood and shared that he became a very close friend of Anne Frank in the Montessori school. On January 7, 1944, Anne mentioned him in her journal that she liked 'Sally' [Sol] the most among her friends and that if she were asked whom she would consider marrying – she would prefer him," shared Karsten Koenig, Professor, Department of Biophotonics and Laser Technologies, Saarland University, Germany.

Sol's life was upended during the five-year Nazi occupation of the Netherlands. In 1942, Sol's mother was taken in a Nazi razzia to Sobibor to never return. Subsequently, Sol and his aunt's family of four went into hiding, living with a Protestant family on a rural farm. For their safety, Sol's family was confined indoors in one room with no sunlight. In early 1945, Nazi authorities raided the farm. Sol's uncle was killed in the raid, while Sol and his remaining family were sent to Westerbork transit camp where they were detained until the liberation of the camp by Canadian forces on April 12, 1945.

> "Sol's uncle and the farmer who owned the farm were shot when the Germans discovered Sol and his family in hiding. Sol described it as such a senseless loss of life," said Brian Wong, Professor of Surgery and Biomedical Engineering.

Sol pursued higher education after the war. In 1955, he joined the Weizmann Institute, returning to the Netherlands to marry Bianca Blaugrund-Alefrant. In 1956, they immigrated to Israel, where their daughter Daphna and son Etan were born.

Ab Reiner, Sol Kimel's cousin, and Sol, classmates of Anne Frank, in the Montessori School in Amsterdam in 1937

Bianca and Sol Kimel and Bruce Tromberg

Michael Berns and Sol Kimel

WORLD LEADER IN LASER SPECTROSCOPY

In 1960, Sol obtained his Ph.D. in Physics from the University of Amsterdam. From 1961 to 1963, he was a postdoc at Princeton University. After serving as a Research Scientist at the Weizmann Institute, he became an Associate Professor at the Technion in Haifa, Israel. In 1977, he was promoted to Full Professor. Sol served on many Technion assignments, including Chair of the Physical Chemistry Division, a committee member for the promotion and tenure of senior staff, the committee for research, student tribunal and academic staff association.

Sol, a world leader in laser spectroscopy, was a highly demanded visiting professor at many universities worldwide. In addition to two sabbatical years, Sol spent 18 summers at UCI Beckman Laser Institute & Medical Clinic engaged in multiple key projects. After retirement in 1997, Sol spent ten years as a Senior Advisor in the Advanced Technology Center at the Sheba Medical Center in Tel HaShomer, near Tel Aviv, Israel.

JOURNEY IN SCIENCE

Sol's 50-year journey in science started with high-resolution gas-phase spectroscopy and matrix spectroscopy, via laser chemistry and continued with the biomedical applications of lasers, developing photodynamic therapy (PDT) for cancer treatment.

❝ After he stepped down as Chair at Technion, he wanted to continue his research, which brought him to the Institute," stated Stuart Nelson, Institute Medical Director and Professor of Surgery and Biomedical Engineering.

❝ Sol was one of the first scientists from outside the United States to make a real commitment to the Institute," said Institute Cofounder and Founding Director Michael Berns, "He and his wife Bianca spent several summers here and they spent a whole year of sabbatical here as well."

❝ Sol and Bianca lived on campus for two to three months during the summer. We used to call Southern California paradise – a 'Disneyland for adults.' These trips to 'Disneyland for adults' was a way for Sol to share his vast experience and collaborate with people who came from Europe and other countries. Sol as a Ph.D. and I as an M.D., he brought a broad spectrum of knowledge that medical doctors usually aren't exposed to," stated Yona Tadir, Former Institute Medical Director and Adjunct Professor, "Together with him, we had Lars Svaasand from Sweden and they synchronized their visits. We learned a lot from them. They had projects with everyone, including Tom Milner, Stuart Nelson, Bruce Tromberg and I. A large part of our careers belonged to Sol. He was the optimum teacher and the optimum scientist."

Sol introduced the chick chorioallantoic membrane (CAM), as well as PDT. The CAM is a very simple extraembryonic membrane which serves multiple functions with the main one being to exchange gases and nutrients. Scientists at the Institute grew tumors on the CAM to test PDT. PDT, a combination of photosensitizing drug and laser light that selectively destroys tumor tissue, works by destroying the blood vessels that feed the tumor. Nitric oxide (NO) signals the endothelium inside vessels to dilate, thereby increasing blood flow.

In PDT, the photosensitizer creates free radicals that counteract the NO, thereby constricting the vessels. The CAM provided key information on the amount of light and photosensitizer needed to "kill" the vessels – and the tumor. This model helped to determine the PDT parameters to develop the best treatment protocols for patients.

❝ I thought the world of Sol. He was incredibly gracious and a clear thinker – a good person to bounce ideas off of. His ability to dissect problems and look at research in a different way uncanny," stated Wong.

Sol developed photosensitizing drug candidates, including porphyrins, porphycene and phthalocyanines. He also used advanced video microscopy in real-time and computerized image analysis to monitor and quantify the entire process of tumor growth and tumor regression.

❝ Sol was adventuresome. As a physical chemist, Sol had a sense of curiosity and wonder about biology, a bond we shared. I wish I had the opportunity to tell him about recent discoveries, just over the past five years, of intrinsic epigenetic and circadian clocks that drive

Lars Svaasand and Bianca and Sol Kimel

Sol and Bianca Kimel and Kristen Kelly

Sol Kimel's "Holocaust Oral History Project of the Orange County Anti-Defamation League" interview filmed on September 11, 1994

metabolism," said Bruce Tromberg, former Institute Director and current Director, National Institute of Biomedical Imaging and Bioengineering, "Biologists are just now beginning to validate these musings, speculations we shared decades ago about how living systems must work. Many of these ideas now play a crucial role in my work at the NIH [National Institutes of Health] to bridge biology and medicine with engineering and physical science," stated Tromberg.

The CAM also aided imaging research, serving as an in vivo model to test pulsed-photothermal radiometry (PPTR). As an imaging method, PPTR uses laser light to induce a temperature increase in vessels. When the laser is removed, heat diffuses out of the vessels and up to the CAM's surface. By measuring the surface temperature as a function of time, the position of subsurface vessels can be determined.

❝Another postdoc and I were working on an experiment zapping glass capillary tubes filled with blood using clinical lasers trying to look at bubbles that would form inside the glass capillaries. From the experiment, the idea was to get a sense of how wavelength affects these bubbles that form in blood vessels when you radiate them. It was a basic science experiment and Sol was the architect of the experimental work, while Lars was the theoretical arm who did the computational modeling to explain the outcomes. It was a nice example of collaborative work," explained Bernard Choi, Institute Associate Director and Professor of Surgery and Biomedical Engineering.

❝There was a lot of discussion with Sol on experiments. He had a certain approach and was a very careful scientist. He wasn't afraid to express when he didn't think an experiment was done well or properly. He would speak up, but in a kind way. It involved spending more time than I originally would have and it spoke volumes of how Sol approached doing experimental work," continued Choi, "He was a thoughtful scientist and very thoughtful in general."

The CAM's clear membrane also allowed researchers to see the vessels, which the human epidermis obscures. With PPTR, the goal was to improve the treatment of vascular birthmarks. Knowing the temperature within the target vessel and its depth helped to make improvements.

❝We were fortunate to have Sol at the Institute. He and Lars were here when Tom Milner and I invented and conceived the idea of dynamic cooling and we were in the process of translating it," stated Nelson, "Sol made really important contributions. After that we were able to develop the device quickly."

❝There are many brief moments we experience with others that, for one reason or another, become etched into our memories. Sol was able to inspire positive memories at a very high frequency – ever the spectroscopist," stated Tromberg. "Some were technical, but Sol also took the time to personally sit with his collaborators and discuss the relative merits of specific words and ideas, sentence by sentence, relentlessly pursuing clarity and purpose in writing scientific manuscripts. Sol taught us rigor, but was never rigid, and was always willing to integrate new ideas and build consensus on any project."

❝When I think about all those whom I have had the opportunity to interact with in my professional career, Sol was certainly one of the top. He was a gifted writer with a stellar grasp of grammar – fluent in at least six languages," stated Nelson, "I published 41 papers with Sol. We used to sit with a red pen over manuscripts for hours, arguing over English grammar. When we finished collaborating over a paper, not only was the science top notch, the paper was always well written. It was fun and I enjoyed every minute of our time together."

BEYOND SCIENCE

Beyond the knowledge and expertise that Sol brought to the Institute, the impact of his life and who he was as a person will be felt by many for years to come.

Sol was a jokester.

❝He loved to tell jokes and had a phenomenal sense of humor. He could deliver the punch line superbly and everyone would laugh and laugh," stated Nelson.

❝For decades, I received emails with jokes from Sol," said Tromberg.

Sol Kimel in his birthplace in Berlin, Germany

Karsten Koenig, his son Askar and Sol Kimel in Haifa, Israel in November 2018

Sol Kimel and Askar Koenig

Sol was well-rounded.

❝When Sol would return home after working at the Institute all day, he would devour the newspaper. He described it as his food for going to sleep at night, reading for at least an hour every night. Although he put in a full day of research, he still needed to know what was going on in the world," stated Thomas Milner, Institute Director and Professor of Surgery and Biomedical Engineering, "That was the personal aspect of Sol. He was such a well-read and well-rounded person. There was nothing that he couldn't talk about and add a new and different perspective."

Sol was a family man.

❝He and Bianca were a nice couple. Every other weekend they used to go on excursions and enjoy the area. It was a very nice combination of doing cutting edge science and quality of life," stated Tadir.

❝I was extremely thankful to meet Sol, who was such a great person – an excellent scientist from Israel, a Holocaust survivor and a very warm, kind person with knowledge of history and culture. He was a real friend," said Koenig, "He was honest, always a positive and a very diplomatic and excellent communicator. He knew all about my scientific activities, my holiday travels and family affairs. He wrote about his family, his daughter and son, as well as his five grandchildren."

Sol will be remembered.

❝Coming to the Institute changed my life and it had a lot to do with Sol. He introduced me to the Institute. I owe a lot of my career to Sol and I cannot see a bigger impact," stated Tadir, "He was always teaching and his contributions to so many peoples' careers was so significant. He left his footprint not only on the Institute, but also on science."

❝Sol was energetic, optimistic and always offered a positive perspective, especially having experienced a truly dark time in human history. He was a part of every step of my training – one of the most important and critical formative influences of my career. Not only was he was part of the foundational direction of the Institute, but also a part of so many of us who were privileged to know and work with him. He enjoyed interacting with everyone, not just scientists, but everyone from students to staff," continued Tromberg, "Sol was easy to talk to and always had uplifting words. He cared very deeply about sharing his knowledge, teaching and training and spent an enormous amount of time, investing years learning and passing on his experience to the next generation. We have been passing on the lessons he taught us for decades, and this will continue."

❝I will miss Sol not only because of his sharp mind and wit, but also for his humanity. Sol was a pleasure to be around. His spirit was always in an 'up-mode' and this had a positive affect on our students, faculty and staff," stated Berns.

❝I am thankful to Sol for the wonderful time we spent together. I will miss him every day for the rest of my life," stated Koenig.

❝The man had an absolutely amazing life and it's not hyperbole. What I remember most is that talking with Sol was like talking to your grandfather. I always sought his advice whether business or personal," stated Nelson, "Even when you messed up or did something wrong, Sol always said that you did the best you could. He always had a kind word. I will miss him a great deal."

And how would Sol want to be remembered? For the "Holocaust Oral History Project of the Orange County Anti-Defamation League" filmed on September 11, 1994, Sol concluded the interview:

❝I hope that my grandchildren… I hope that they will see this video and learn something about their grandfather and know that all together I'm a happy man, partly because I have these 4 [now 5] wonderful grandchildren – they're really wonderful children."

To learn more about Sol Kimel, please visit: bli.uci.edu/Sol. Join us in honoring the life of Sol Kimel, by making a gift in support of the Sol Kimel Memorial Endowed Graduate Award. To make a gift, please contact Gabby Comfort, Director of Development at gcomfort@uci.edu or 949.824.8859.

ACING "ACES"

UCI GRADUATE STUDENT SHARES HIS UNDERGRADUATE STEM SUMMER PROGRAM EXPERIENCE AND MORE

For the past five summers, the Institute has hosted a total of 42 talented undergraduate college students for the Accelerating Careers in Engineering and Science (ACES) program and its predecessor Pathways to Biophotonics and Biomedical Engineering (PBBE) program. This University of California (UC) Office of the President-supported Historically Black Colleges and Universities (HBCU) partner program introduces high-achieving, underrepresented undergraduate students to the possibilities of graduate education and to UCI graduate programs in the fields of biomedical engineering, biophotonics and related science, technology, engineering and math (STEM) disciplines.

Chris Johnson, a former ACES program participant, is in his third year as a graduate student in the UCI Department of Biomedical Engineering. He shares his ACES experience, impactful research as a UCI graduate student and future career aspirations.

How did you connect with UCI?
As an undergrad at Hampton University, I participated in two UCI internships. The first was after my freshman year. I helped with a pilot study, gathering data to help apply for a grant. I really enjoyed the first internship, so I decided to come for a second time.

I was in UCI Professor of Mechanical & Aerospace Engineering, Anatomy & Neurobiology and Bioengineering David Reinkensmeyer's lab and he does stroke rehabilitation. I helped develop the thumb, index and middle fingers of a hand exoskeleton, which looked like an Ironman hand.

The second summer, I did a stand-alone project, rebuilding a haptic device. When I arrived, the device was in pieces. I reconstructed it and the device worked successfully before I left.

What did you think about those two projects?
The projects were very interesting. Some of the work was difficult. As an undergrad, I studied electrical engineering. For the projects, I had to do some mechanical engineering work. It was definitely a challenge because I hadn't taken some of the classes that would have helped. Fortunately, I was surrounded by helpful people.

Was this the first time that the exoskeleton was built?
It was Quentin Sanders' project to build a hand exoskeleton for stroke patients. He was a graduate student in Professor Reinkensmeyer's lab. Quentin worked on the index and middle fingers, and I created designs and prototypes for the thumb to attach the exoskeleton.

That must have been rewarding to build something to help stroke patients. How did you become interested in this area?
I did robotics in middle school and high school and loved it. During my senior year of high school, my grandfather suffered from a stroke. Once he had a stroke, I thought about what I could do to help. I asked myself questions: "What are my interests?" "What can I find to help him?"

It was interesting because during my first UCI internship, I met Institute Director at the time, Bruce Tromberg. I shared my interests and he suggested that I connect with Dr. Reinkensmeyer. Dr. Tromberg told me about Dr. Reinkensmeyer's work in stroke rehabilitation and he thought the two of us would get along. The rest is history.

When you returned to your undergrad program, how did you hear about the ACES program?
At the time, ACES was the PBBE program. Hampton University was an HBCU ACES program partner. Hampton University School of Engineering & Technology Assistant Dean for Research Raymond Samuel collaborated with Dr. Tromberg and Institute Associate Director Sari Mahon. As an undergrad, I worked in Dr. Samuel's lab and he suggested that I apply to ACES. I hadn't done research and I didn't know that it was an option after graduating from undergrad. I really liked the program and my interest in conducting research stuck.

What did you think when you returned to UCI to participate in the ACES program?
Quentin Sanders was a great graduate mentor. He introduced me to a lot of UCI faculty and staff. It was almost as if I had a mini-network, so I didn't feel like I was alone on an island.

Also, Quentin and I are from the same hometown in Maryland. We connected because of our backgrounds and now we're the best of friends.

What was your experience like in the ACES program?
My experience in ACES was great. We lived on campus

with students from other programs. Many different majors were represented – from history to psychology. I called it "the melting pot." It was interesting to hear about the interests of others and all the research going on at UCI.

What made you decide to apply to graduate school at UCI?

Between the two internships and ACES, I had already been on campus and knew that I wanted to join Dr. Reinkensmeyer's lab. I also wanted to explore other options in the UC system, so I applied to a couple of UC schools.

Overall, what drew me to UCI was my previous experience and that I had a network. Quentin and former Assistant Dean of the Office of Access and Inclusion Sharnnia Artis were my biggest influences to continue my education and attend graduate school.

I was thankful for the people in the Engineering Department and those in the Engineering program who looked like me. Those in my network shared that this was a good place to grow and pursue a degree.

How did you pick the field of biomedical engineering?

At first, I was interested in mechanical engineering. Dr. Reinkensmeyer suggested biomedical engineering instead. He recommended the field not only because of my electrical engineering background, but because he knew that I was interested in doing clinical work. It was the perfect combination for graduate school and my future career.

Now that you are in graduate school, what are your career aspirations?

Right now, I'm doing stroke rehabilitation. I'm focused on improving ankle function, specifically ankle sensation and movement for walking. When someone has a stroke, one side of the body is affected. Depending on the severity of the stroke, it may be difficult for someone to independently complete their activities of daily living (ADL). Examples of ADLs are getting dressed, getting in and out of a chair, walking, etc. For these examples, it is important that ankles function properly. It may be difficult for them to walk without an assistive device, such as an ankle foot orthosis because of foot drop. Foot drop is muscle weakness that makes it difficult to lift the front part of the foot. This can cause them to trip and fall, so what I focus on is proprioception.

Proprioception is your body's awareness in space. Some people call it your "sixth sense." Patients need this awareness to know the position of their ankle.

When I arrived at UCI as a graduate student in June 2019, I told Dr. Reinkensmeyer that I wanted to build a robot. I designed AMPD, or Ankle Measuring Proprioception Device, from the ground up. In February 2020, I finished building AMPD and within a month, it was and is still being used to assess ankles.

I watched the process from the beginning to the end – from the design, to the build and now to watch stroke patients interface with the device. The feedback that patients provided was extremely helpful. I couldn't have asked for a better experience.

Now, I'm building a second robot. In the future, maybe I'll build another robot for the clinic or launch a company to commercialize the robots that I build.

How is it going building the second robot?

The design of the second robot is going really well and the CAD, or online software, is about 95 percent complete. I tried to take what I learned from building the first robot and applied it to this second version.

The biggest thing that I learned from building AMPD was time management and setting realistic goals. It took me a lot longer to build the robot than I had anticipated. It was extremely challenging and I worked a lot of late nights.

In the upcoming weeks, I will be meeting with the physical therapists who I work closely with to ask for their feedback. It's important to get their input because they're going to operate the machine.

I need to know: What is good? What is bad? The dos and don'ts of the device.

I've learned to make things as simple as possible. Complexity is great, but it has to be user friendly, or it will not get used.

Another question that the therapists have asked: "Chris, is it safe?" Safety is the biggest thing. It doesn't matter if the device helps people. If it's not safe, then it won't be used.

Right now, the device is solely for stroke patients, but it has the potential to help many people. People with ankle injuries, including athletes and dancers could benefit – among others.

What do you want to do in the future?

I am considering academia versus industry. I like conducting research that interests me, rather than what a company perfers, and I like to teach. I am a graduate mentor for ACES and I mentor a couple of undergrad students. I get a lot of fulfillment out of watching students' progress. It makes me smile. I suppose it sounds like I am leaning towards academia.

Would you recommend ACES to other students and if so, what advice would you give students?

I would definitely recommend ACES. The advice that I would give is not to be afraid to try new things. Even if you had one experience or heard about the experience of others, you should try it for yourself. You don't want to question "what if" later.

How is your grandfather doing? Has he tried the robot?

He's doing good. He lives in Virginia, so he hasn't tried the robot. I wish I could transport the machine. Maybe one day. He's doing good though.

ROYAL TREATMENT

UCI PROFESSOR OF CELL BIOLOGY FOLLOWS IN THE FOOTSTEPS OF CHARLES DARWIN, LOUIS PASTEUR, EDWARD JENNER AND SIGMUND FREUD AMONG MANY OTHER OF THE WORLD'S MOST EMINENT SCIENTISTS

Among numerous prestigious scientists and physicians, Michael Berns, Cofounder and Founding Director of the Institute, has been elected as a Fellow of the Royal Society of Medicine in the United Kingdom.

"I am truly honored to be invited to join the Royal Society, especially because it's the same society that has honored so many elite luminaries of the past," said Berns.

Fellows and Foreign Members of the Royal Society of Medicine are elected for life through a peer review process on the basis of excellence in science. The Society's 200-year-old history has seen prominent figures in medicine and science as part of its membership and governance. Famous Fellows include Charles Darwin, Louis Pasteur, Edward Jenner and Sigmund Freud. Elected Fellows of the British Royal Society of Medicine are comparable to members of the National Academy of Medicine in the United States.

The Society is a leading provider of high quality continuing postgraduate education and learning to the medical profession. The mission of the organization is to advance health, through education and innovation.

The Royal Society of Medicine was founded in 1805 as the Medical and Chirurgical Society of London. In 1834, the Society was granted a Royal Charter by King William IV and was renamed, becoming the Royal Medical and Chirurgical Society. In 1907, the Royal Medical and Chirurgical Society of London merged with 15 specialist medical societies and, with a supplementary Royal Charter granted by Edward VII, the Royal Society of Medicine was born.

The organization hosts scientific symposia and training courses, as well as public information and discussion events. In addition, the Society operates one of the largest medical libraries in the world with approximately 600,000 volumes and 12,000 journals.

Berns was invited to join the Royal Society of Medicine based on his extensive biomedical optics contributions in the fields of biology and medicine. In addition to the Royal Society of Medicine, Berns is a Fellow of the British Royal Society of Biology and the Royal Norwegian Society of Sciences and Letters. In the United States, Berns is a Fellow of the American Association for the Advancement of Science (AAAS) and the International Society of Optics and Photonics (SPIE).

"I am grateful to UCI and the Beckman Laser Institute & Medical Clinic for all the support in encouraging my career development in biomedical optics during the last 50 years," stated Berns.

In 1994, Berns received the UCI Medal. In 2011, he was honored with the Fariborz Maseeh Outstanding Faculty Teaching Award from the UCI Henry Samueli School of Engineering.

"Receiving this award will enable me to conduct the necessary research work and translational training to bring a medical device from a laboratory bench-top to the market where it can have a meaningful impact on percutaneous coronary intervention outcomes in patients suffering from chronic total occlusions."

—Nitesh Katta

POSTDOCTORAL FELLOWSHIP WINNER

Nitesh Katta was the winner of the 2021 SPIE-Franz Hillenkamp Postdoctoral Fellowship in Problem-Driven Biomedical Optics and Analytics. The annual award of the International Society for Optics and Photonics supports interdisciplinary problem-driven research and provides opportunities for translating new technologies into clinical practice for improving human health.

Katta's research project, "A cold laser wire (CLW) for true-lumen crossing of tortuous coronary arteries with calcified chronic total occlusions (CTOs)," will be conducted in conjunction with Thomas Milner and Marc Feldman at the Institute. The team will build on a challenge Nitesh discovered during his doctoral work in recognizing an unmet need for piercing calcified material in performing true-lumen percutaneous coronary intervention (PCI) of CTOs.

Katta, together with his then-doctoral mentors Milner and Feldman, invented intravascular cooling and guidance methodologies for achieving true-lumen crossing in CTOs using the cold laser wire. Katta's aim is to bring this research into the clinical setting, addressing an urgent clinical need of a tool for safe true-lumen PCI crossing in patients suffering from CTOs in coronary arteries.

CONSORTIUM RESPONSE TO COVID-19

"Mechanical Ventilation Amid the COVID-19 Pandemic," a recent book release, highlights the many contributions of Institute faculty and others worldwide who sought to solve ventilator shortages experienced during COVID-19. As the surge in COVID-19 cases leading to hospitalizations around the world quickly depleted hospital resources and reserves, physicians were forced to make extremely difficult life-or-death decisions on ventilator allocation between patients. To combat this problem, leaders in academia and industry developed numerous ventilator support systems using both consumer- and industry-grade hardware to sustain life and to provide intermediate respiratory relief for hospitalized patients.

The book is the first of its kind to discuss the respiratory pathophysiology underlying COVID-19, explain ventilator mechanics, provide and evaluate a repository of innovative ventilator support devices conceived amid the pandemic and explain both hardware and software components necessary to develop an inexpensive ventilator support device. "Mechanical Ventilation Amid the COVID-19 Pandemic," serves both as a historical record of the collaborative and innovative response to the anticipated ventilator shortage during the COVID-19 pandemic and as a guide for physicians, engineers and DIY-ers interested in developing inexpensive transitory ventilator support devices.

For more information about "Mechanical Ventilation Amid the COVID-19 Pandemic," please visit: bli.uci.edu/BVC.

Edited by UCI Professors Thomas Milner, Brian Wong and Govind Rajan and Amir Hakimi

Elliot Botvinick, Professor of Surgery and Biomedical Engineering

REVOLUTIONIZING EAR CARE

Established in 2019 in the Institute's Photonic Incubator, Cactus Medical, LLC is developing a new otoscope system to improve the diagnosis of otitis media or ear infections on the front line of care. Almost every child, approximately 90 percent, will have at least one ear infection before kindergarten. At roughly 30 million annual office visits, suspected ear infections are the second most common reason children are seen by a physician.

Despite the frequency of cases, subjective reporting puts diagnostic certainty in primary care at approximately 60 percent. This makes otitis media the most common cause of unnecessary antibiotic use in children and the leading surgical indication in pediatrics.

Cactus Medical's revolutionary Optical Tympanometry technology is 98 percent accurate and importantly, works through ear wax. UCI Head of Otology Hamid Djalilian, Institute Professor of Surgery and Biomedical Engineering Elliot Botvinick and Institute alumni Samir Shreim, John Weidling, Sean White and Mark Keating comprise Cactus Medical's leadership team.

Cactus Medical

Revolutionizing Ear Care

IMPROVING GUM HEALTH

SCIENTIST CONDUCTS FIRST EVER STUDY TO SHOW NOVEL TOOTHPASTE IMPROVES PERIODONTITIS SYMPTOMS

Petra Wilder-Smith, Institute Director of Dentistry and Professor of Surgery

While several recent studies show that individuals with chronic gum disease are more likely to experience potentially life-threatening complications if they contract COVID-19, a new study shows promise in addressing the root issue. Petra Wilder-Smith, Institute Director of Dentistry and Professor of Surgery, recently reported results of a six-month long study, published in *The Journal of Periodontology*, showing for the first time that a novel toothpaste demonstrated medically significant improvements in the health of the gums of patients with periodontitis, the most severe form of gum disease.

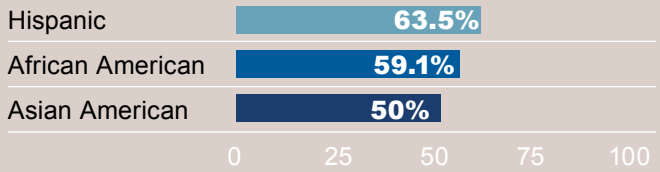
Gum disease affects 65 million Americans today (almost half of Americans adults over 30 years of age). New research has shown that COVID-19 patients with gum disease are almost nine times more likely to die compared to those without gum disease. They were also 3.5 times more likely to be admitted to intensive care and 4.5 times more likely to need a ventilator. Furthermore, a study in *The Journal of Periodontology* found that periodontitis or severe gum disease is highest among ethnic minorities. In other words, severe gum disease could be a contributing factor to high risk of COVID-related complications and deaths, especially in ethnic communities.

As a part of her focus on translational research, Wilder-Smith initiated a double-blinded study testing a novel dental gel against an FDA approved anti-gingivitis toothpaste to investigate their effects on gum health in patients with early to moderate periodontitis. The six-month long study compared how the two toothpastes affected periodontal pocket depths, gingival inflammation and gum bleeding in patients with periodontitis who were in maintenance care.

The findings revealed that subjects who brushed with the novel LivFresh Dental Gel experienced clinically and statistically significant improvements in their symptoms versus the control group that brushed with an over-the-counter, FDA approved anti-plaque, anti-gingivitis toothpaste.

Dental plaque is the root cause of gum disease and a primary barrier to healing and resolution of periodontitis. Several previous laboratory and clinical studies by Wilder-Smith's research team have demonstrated that the novel formulation retards, on a molecular level, dental plaque formation, attachment and re-accumulation at the tooth surface by increasing its negative charge.

Prevalence of severe gum disease among ethnic minorities



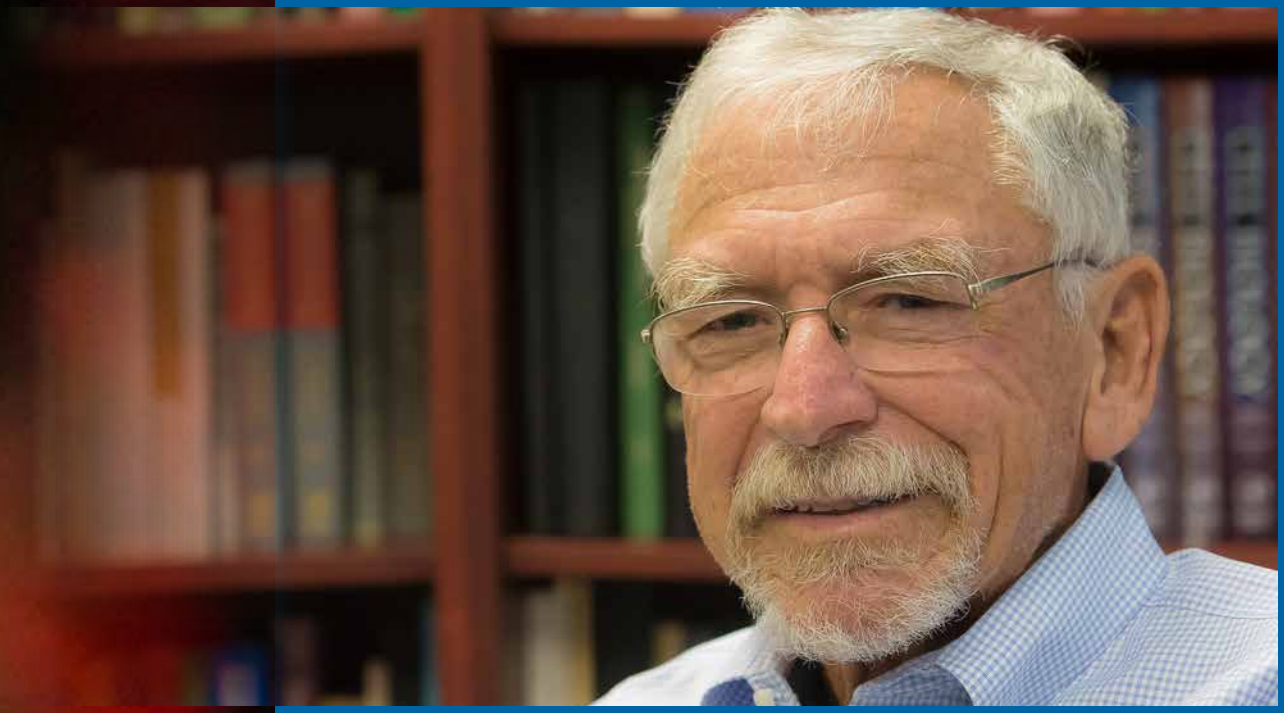
The charged surface prevents early individual plaque islands from coalescing into larger deposits, discourages plaque from attaching to the tooth surface and supports the breakup of existing plaque deposits. Thus, by inhibiting dental plaque, the novel formulation reduces the presence of the harmful plaque bacteria and bacterial products that are implicated in chronic gum disease.

In individuals who brushed with the test gel, pocket depths in the gums improved in more than 80% of diseased sites. Additionally, subjects who brushed with the new formulation had 2.5 times less gum inflammation and 1.9 times less gum bleeding, when compared to the group using the conventional toothpaste.

"This novel dental gel represents a potentially ground-breaking tool for improving and maintaining gum health in patients suffering from periodontal disease. The results of our studies show that periodontal patients may be able to obtain significant oral health benefits through this new formulation," said Wilder-Smith, "We anticipate that this novel formulation, when used in combination with professional periodontal care, may revolutionize healing in the gums and maintenance of periodontal health."

FOUNDER'S COLUMN

AFTER 50 YEARS



It has been a year since retiring after spending 50 years at UCI. Although, that is not entirely true because I have been "recalled" to continue my research in the Institute's Michael and Roberta Berns LAser Microbeam Program (LAMP) Laboratory. At the same time, the Institute is developing a strategic plan. It has been interesting to watch and participate in creating a plan for the Institute's future.

A lot has changed since the Institute opened its doors in 1986. In the past, federal funding was fluid and we were fortunate to garner four center grants. Today, government priorities have changed and obtaining center grants is much more competitive. However, the uniqueness of the Institute, particularly having the laser clinic a few steps away from the research labs, allows us to cross barriers and accelerate the translation of breakthrough technologies to transform human health. With this "bench to bedside" combination, we have an excellent opportunity to garner significant research funding in the years to come.

Thus far, we were successful in securing funds to renovate two Institute labs. In addition, we recently secured a grant to upgrade the building's security system. Despite the challenge of undergoing a review and assessment period and acquiring research funding in support of our mission, we have a strong and dedicated team of scientists and clinicians, which will only grow stronger in the upcoming years.

Michael W. Berns
Cofounder, UCI Beckman Laser Institute & Medical Clinic
Arnold and Mabel Beckman Chair in Laser Biomedicine
Distinguished Professor, Surgery, Biomedical Engineering
and Developmental and Cell Biology

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REVAMPING THE INSTITUTE

The Institute was awarded a second UCI Small Capital Improvement grant, providing upgrades to security of research operations and building safety. The project includes entry hall alterations, creating an improved clinic and visitor experience; a strategic addition of security devices for access to research laboratories and improvements to the conference room and library.