OPTICS

HAJIM SCHOOL OF ENGINEERING AND APPLIED SCIENCES UNIVERSITY OF ROCHESTER ISSUE 8
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Reflections from the Director

Greetings from sunny and warm Rochester ! We wrapped up another amazing academic year here in Rochester, and this issue of our Institute of Optics newsletter is jam-packed with stories and updates. It has been eight years since I came back to Rochester, and I've seen four full undergraduate classes complete our program. We have a lot of news to share. In our last newsletter, we told you about our newly renovated undergraduate teaching labs, and we have been busy filling them and getting them up to speed. Our students and faculty are thrilled with the new spaces. With help from supporters such as Insight Technologies, Inc., we have been able to finish the project.

We dedicated the new Robert E. Hopkins Center for Optical Design and Engineering in March 2009. Then, on July 4, Robert Hopkins, the father of Optical Engineering, passed away at the age of 94. We are honored to continue his legacy of excellence.

In April we installed Jannick P. Rolland as the first Brian J. Thompson Professor of Optical Engineering. Jannick came to us from CREOL in Florida and enjoyed her first Rochester winter (seriously!). Prof. Tom Brown was appointed as Director of the Hopkins Center and Prof. Rolland as Associate Director. Feel free to contact them to discuss the Center activities. Your opinions, suggestions about the future of Optical Engineering, and your support would be warmly welcomed.

After having only one full-time female Professor in the previous history of The Institute, it is rewarding to announce that we now have two. In September, Julie Bentley will also join the faculty as a full-time Associate Professor of Optics, after teaching as an Adjunct Professor for more than ten years.

Our Industrial Associates meetings went smoothly this year. Many valuable connections were made, students found employment through the program, and research collaborations were established. The program continues to be highly valuable, and we thank Brian J. Thompson for starting the program in 1974. Our Summer Course Series was well attended this year, considering the tough economy. We're in pretty good shape at The University of Rochester and in the Department as a result of a conservative long-term financial structure.

The Institute of Optics' mission is *To Provide the Finest Education and Research Experience in Optical Physics, Applied Optics and Optical Engineering.* Our new Dean of Engineering Robert L. Clark came here from the Pratt School of Engineering at Duke University this year to head our School of Engineering and Applied Sciences, and he sees The Institute of Optics as a critical strength of the University. Send him a note sometime at robert.clark@rochester.edu and tell him what you think about that !

I hope you enjoy this issue of our Institute of Optics Newsletter, and as always, please feel free to contact me with your comments, suggestions, ideas, etc. Thanks for your support and interest.

- ***Wayne Knox***

In Memorium
Robert E. Hopkins
June 30, 1915 – July 4, 2009

We join with the Hopkins family in grieving the passing of Robert E. Hopkins. During his long and productive career, he brought remarkable insight, energy, and humanity to optical science and engineering. As co-founder of Tropel Corporation (now Corning Tropel) and a distinguished professor and director at The Institute of Optics, he had an impact on both the technology and the future leaders who would be responsible for carrying that knowledge to the next generation.

Obituary and information about memorials:
http://robertehopkins.com

A Treasured Legacy

Photos: (above, l-r); Bob in the lab,Bob with John Bruning and Bala Manian, Robert Hopkins as Director of The Institute of Optics, Jim Fienup & Bob, Bob and student; (below) Bob Hopkins as graduate student on campus.

In the long history of The Institute of Optics, few people have been more respected and well-liked than Robert E. Hopkins, better-known to his many friends as "Bob" or "Hoppy." The naming of the new center for optical engineering, as well as the creation, in 2001, of a named professorship in his honor testify to this widespread admiration.

Born in 1915, Hopkins attended MIT on a full scholarship, graduating in 1937. He then came to Rochester and obtained both his MS and PhD from The Institute. He joined The Institute faculty, and when Rudolph Kingslake left in 1940 to join Eastman Kodak, Hopkins became the principal lens design instructor (though Kingslake continued to teach part-time).

In the early 1950s, Hopkins was among the first to recognize how computers could be used in lens and optical-system design. His son, Roger, said that Hopkins "fiddled" with computer programming. An avid bowler, Hopkins tried writing a program that would keep track of players' scores, but Roger said he gave it up, joking that *"it was more complicated than optical design."*

In 1953, Hopkins co-founded Tropel Corp. to make precision optical systems and instruments for industry. The following year he was named to replace Brian O'Brian as The Institute's third director. For the next 11 years he led The Institute with forward-thinking faculty appointments, such as Emil Wolf and Ken Teegarden. He helped establish The Center for Visual Science, and he constantly pushed the University to invest in more powerful computers. In addition, he focused attention on the value of good teaching from undergraduate classes on up. In 1963, along with Parker Givens, Hopkins obtained funding for a novel educational venture called the "Road Show" which featured experiments and demonstrations using lasers that were shown at colleges and high schools in the northeast.

In 1965 Hopkins stepped down as director and returned to teaching. *"He was an excellent one-on-one teacher,"* said Douglas Sinclair, a student of Hopkins and, later, academic colleague. In addition to his many scientific and educational contributions, Hopkins left a long and warm personal legacy. He was, according to colleagues and family members, a big-hearted and rather humble man who gave generously of his time and experience. He was also known to be somewhat detached from the details of ordinary life. This led, over the years, to dozens of "Hoppy Stories" — affectionate anecdotes of his absent-mindedness, such as the time he forgot to raise his car window while going through a car wash.

In summing up how Hopkins contributed to optics, John Bruning, former CEO of Tropel, said, *"Bob Hopkins was a strong contributor to the success of many individuals and companies that have become important names in the optical industry. He stands out as one of The Institute's most influential figures, as an optics entrepreneur, an innovator in the field of lens and optical-system design, and as a teacher and mentor for hundreds of students."*

HOPKINS LAB DEDICATED

With the snip of a scissors, a small flock of gold and blue balloons flew aloft in the atrium of the Goergen Building 1:30 p.m. on March 30th, 2009. The balloons halted their rise precisely at the 4th floor level (thanks to a nearly invisible tether of fishing line), which is the location of the new Robert E. Hopkins Center for Optical Design and Engineering. As a brass quartet finished an upbeat fanfare, and the children of Robert Hopkins looked on, the assembled crowd raised glasses in unison as the new Center was officially dedicated. *"As important as the new laboratory space is — and it's a beautiful space — the most important aspect of the new Center is the relationship we will foster between its faculty and the students,"* said Thomas Brown, Director of the center. *"Our hope is to have generations of students leave with a deep understanding of the principles of engineering as well as having hands-on experience with the tools currently being used in the industry."*

The new center represents a renewed commitment on the part of The Institute to reinforcing the fundamentals of optics by applying the principles to 21st-century design and engineering. *"Everyone knows we're the oldest optics department in country,"* said Institute Director Wayne Knox. *"But we're also the newest in many ways. We respect and understand the distinguished past that we've had here, but we're also constantly striving to be as modern as we possibly can in the areas of optical physics, applied optics, and optical engineering. The Hopkins center is really our answer to that challenge in regard to optical engineering."*

Many individuals and companies contributed to the Center's creation, and will continue an ongoing participation. Initial funding was provided by a grant from the KLA Tencor Foundation early in the construction process of the Goergen building. The KLA gift created the "real estate" for the Center. Then, in October 2008, John Bruning, the former CEO of Tropel Corporation, made a $2 million gift to endow a new faculty position and purchase equipment and furnishings for the new Center. Just before the dedication balloon launch, Bruning reflected on his role in the Center's creation. *"Bob Hopkins left a wonderful legacy here,"* Bruning said. *"He was a mentor to myself and many of my colleagues at Bell Labs. The timing was wonderful to allow me to do this — to be a catalyst to make this center a reality."*

The Hopkins Center is a suite of three laboratories, each dedicated to a specific phase of the engineering process and each equipped with state-of-the-science equipment:

- The KLA-Tencor metrology laboratory
- The optical design laboratory
- The fabrication and finishing laboratory

In addition to KLA Tencor, many other companies are supporting the new Center with gifts of equipment, personnel, or financing. The Metrology Lab, for example, features an ETA-ARC spectroscopic instrument for non-destructive testing of thin films and precision lens coatings. The instrument, made by Sweden-based AudioDev, can characterize coatings and thin films on any part of a curved surface. It also allows for the testing of coating thicknesses and uniformity without the destruction of a lens or reliance on so-called "witness" samples. As with other company equipment offerings to the Center, the ETA instrument is on a 3-year loan, and will be replaced with more advanced versions as time goes on. Eric Dilts, President of AudioDev USA, said he deeply values his company's relationship with the Center. *"We didn't do this with any other optics programs - only with The Institute of Optics — because it's the pre-eminent optics program in the U.S.,"* Dilts said. *"We think it's a win/win situation — students get a valuable, state-of-the-art tool, and we get a partnership with The Institute that helps us get the word out to people who might use it in industry."*

Other companies contributing to the center include the Zygo Corporation, Optikos, Optical Research Associates, Zemax, Lambda Research, ThorLabs, JK Consulting, Zeeko, and RSoft Design Group.

Already the Center's labs are abuzz with activity. On the day of the dedication, students filled the design lab, using the 16 workstations, each loaded with the most advanced lens design software available, and conferring with each other at the large circular table in the middle of the room.

"There's no better way to learn lens design than to just do it," says Julie Bentley, a nationally recognized expert in optical system design who serves on the faculty steering committee for the Hopkins Center. As an alumna of The Institute, and professor with more than ten years of experience teaching lens design, she anticipates great things: *"The Hopkins Center is going to be a tremendous resource for decades to come."*

Also on the faculty steering committee: Professor Stephen Jacobs, who has anchored The Institute's research and instruction in optical fabrication and testing for the past 20 years; Professor James Zavislan, who coordinates the metrology laboratory; and Jannick Rolland, the new Brian Thompson Professor of Optical Engineering, who serves as Associate Director of the Hopkins Center and coordinator of the optical fabrication laboratory.

" With the opening of the new Hopkins Center we're entering a new, exciting phase where we can expand the opportunity for students, especially undergraduates, to get more chances for hands-on experiences in the laboratory," Rolland said.

Daniel, Robert, and Greg celebrate graduation with Betsy Benedict, Optics Undergraduate Program Coordinator

Optical Degrees ...In Triplicate

Graduating from The Institute this year are identical triplets Daniel, Robert, and Greg Balonek.

All three transferred from Monroe Community College, where they all graduated from the Optical Systems Technology program. While at MCC the brothers began working as amplifier technicians at the Laboratory for Laser Energetics and they continued working there during their time at The Institute.

Greg and Daniel plan to remain in Rochester after graduation, taking some time off before graduate school and continuing to work at LLE. Robert will soon be moving to New Hampshire to take a position as an optical engineer at BAE Systems, an international defense, security, and aerospace company. Like his brother Daniel, Robert says he may pursue an MBA at some point after getting work experience.

Throughout their schooling at MCC and The Institute, the brothers have lived together in apartments, which means that Robert's departure will be the first time in their lives that they haven't all lived under the same roof. *"I'm not sure how it will feel once we are living apart for the first time,"* says Greg. *"It's exciting and a little worrisome, but I think that with the internet and video conferencing technology long distances aren't as bad as they used to be. I also think it will be a good thing to let each of us define who we are a little better."*

Although the brothers clearly share many traits and broad interests, each also has his own personality and interests. Robert, for example, is passionate about lasers. Daniel is very good at math, and Greg is interested in computers. The three say this individual specialization has come in very handy during their education and will be missed if all three eventually live in separate locations.

"Even though we are all in the same major and have similar interests, each one of us is kind of an expert in certain areas," says Daniel. *"That makes it useful when we would build a project or hash out some kind of issue or problem. When Robert leaves I'll miss the ability to constantly bounce ideas off of each other."*

All three say The Institute and their work at LLE have prepared them well.

"The Optics program exceeded my expectations in terms of what I've learned," Robert says. "The department is very mathematically rigorous — we were definitely taught very in-depth theory."

The brothers were born on April 17, 1987. All three credit their father's interest and aptitude in science with their own career paths in optics. The brothers have an older sister, Christine, who is currently at University of Minnesota, where she is working on her PhD in chemical engineering.

Despite their similarities and the fact that each now holds a diploma from The Institute (it is very rare for non-identical siblings to graduate from the same program), the brothers emphasize that their shared genomes are not what has mattered most.

Echoing sentiments also expressed by his brothers, Greg says, *"I think the biggest thing that influences a person is the people around them. Genetics have their part but I feel that if it wasn't for my Dad getting us involved with school and the sciences I don't think I would be the person I am today. I think that people can be molded — you're not locked into your genes."*

Thanks to John Bruning

John Bruning visits the Robert E. Hopkins Metrology Laboratory

John Bruning, who endowed the Brian J. Thompson professorship and the Hopkins Center, is an electrical engineer who received his PhD from the University of Illinois. He is currently an executive scientist at Corning Inc. During his early career at Bell Laboratories, he developed relationships with Hopkins, Tropel and The Institute of Optics. Bruning's early work centered on the development of high accuracy interferometry for testing precision optical surfaces and lenses. Later work culminated with the invention of excimer laser lithography, which is still used today to manufacture microchips.

In 1984, Bruning left Bell Labs to become vice president and general manager of GCA Tropel, the same company founded by Hopkins 30 years earlier. In 1994, Bruning led a management buyout of Tropel, and in 2001, Tropel was acquired by Corning Inc. He is a member of the National Academy of Engineering and a fellow of IEEE, OSA and SPIE.

Honoring TRADITION

Among those honoring the life and work of Bob Hopkins during the dedication ceremonies was Robert J. Potter, an early student of Hopkins. Potter, a student at The Institute in the late 1950s, said that Hopkins had a profound influence on his career.

"He encouraged innovation and was very forward-thinking," Potter said. *"He encouraged me to do my thesis on fiber optics. This was in '56 and '57 before hardly anybody knew anything about optical fibers. We thought that someday people might be able to send information over single fibers or create images with bundles of fibers so it might be an interesting thesis topic."*

Potter took the advice and he produced a thesis, titled A Theoretical and Experimental Study of Optical Fibers. It is the first dissertation on fiber optics written in the U.S.

Potter, 76, currently heads R. J. Potter Company, a Dallas area consultancy providing business and technical advice. Experienced in product development, marketing and technology, he has successfully worked on both strategic and tactical business issues across a wide variety of disciplines. He is a fellow of the Optical Society of America and has written more than fifty articles for various scientific, technical and business publications, including the first description of optical character recognition in an encyclopedia. He has received a number of business and technical awards. He is a member of the Board of Directors of Molex, Incorporated and of Zebra Technologies, Inc. Dr. Potter is on the Board of Trustees of the Illinois Institute of Technology.

Summing up his time at The Institute and as a salute to Hopkins, Potter ended his talk by saying, *"Bob Hopkins is here in the hearts and minds of his children, in his students, this faculty, and in the halls and walls of the University of Rochester."*

A French Connection

JANNICK ROLLAND NAMED THOMPSON PROFESSOR

As an auditorium full of colleagues, students, and family members looked on, Jannick P. Rolland bowed her head slightly so that University President Joel Seligman could drape around her neck a ceremonial medallion hanging from a blue-and-gold ribbon. With that simple act, Rolland was officially installed as The Institute's first Brian J. Thompson Professor of Optical Engineering.

"I am deeply humbled to accept this honor, and I am very excited to be here," Rolland said, after the applause died down.

Rolland then gave a brief summary of the path that led her to her new position at The Institute. It began, she said, when she was 16 and her mother took her to see a play. Rather than paying attention to the drama on stage, Rolland said she was fascinated by the lighting and special effects that were coming from the back of the theater. *"That's what I want to do,"* she recalled thinking.

In the academic and professional career that followed, Rolland studied or worked at four of the world's leading optics programs, beginning in 1984 with her undergraduate degree from Institut d'Optique in Paris, which is where she was raised. She obtained her PhD in optical science from the University of Arizona in 1990. In 1996 she moved to Florida and for the next 12 years taught at the College of Optics and Photonics at the University of Central Florida. There she established the Optical Design and Applications Laboratory, which fostered interdisciplinary research in novel optical instrumentation for 3D imaging and visualization systems, image analysis and assessment methodology.

Rolland sketched some of the ideas that she and her research team are developing: head-worn displays for presenting a range of visual information to users (which she said will someday be as commonly used as cell phones); combining conventional lenses with liquid lenses; and using interferometry to create high-resolution, cross-sectional images of living tissue.

"A large part of the reason I came to the University of Rochester was to help push optical technology into the clinical setting," she said. *"The Institute's close working relationship with the Medical Center and the possibility of pursuing clinical trials is a fantastic opportunity for me."*

Rolland's unique combination of interests and experience made her a perfect candidate for the new position, says Institute Director Wayne Knox. *"She has an amazing skill set,"* Knox says. *"She's highly qualified as an optical engineer, but she's also active in several application areas that fit very well with what we're doing in biomedical engineering. She has strong record of competitive fund raising, and has a large research group of students. On top of that, she's a great teacher and will be teaching optical engineering to both graduate and undergraduate students."*

Rolland holds 15 patents and is the author of six book chapters and over 80 peer-reviewed publications related to optical design, augmented reality, vision, and image quality assessment. She also served on the editorial board of the journal Presence (MIT Press) from 1996 to 2006, and as associate editor of Optical Engineering from 1999 to 2004. In 2004 she was elected a fellow of the Optical Society of America, and in 2008 she was elected a fellow of SPIE, an international society focused on the science and application of light.

The new professorship that Rolland now fills was created to honor the research and teaching legacy of Provost Emeritus Brian Thompson, formerly the William F. May Professor of Engineering, director of The Institute of Optics, and dean of engineering. John Bruning, the former CEO of Tropel Corp., endowed the professorship through a $2 million gift that also helped fund the Hopkins Center, where Rolland will serve as associate director.

During the ceremony, Robert Clark, Dean of the School of Engineering and Applied Sciences, made note of the humility inherent in Bruning's gift.

"I've seen a lot of investitures in my life," Clark said, *"and it's unusual for the money for the faculty position to be given with no expectation that the chair would be named for the donor."*

Rolland's work at The Institute is now in full swing, and she says that already she has benefited from the many opportunities for collaboration offered by the joint occupancy of the Goergen building by The Institute and the Department of Biomedical Engineering.

"When I first saw this building dedicated to both optics and biomedical engineering, I couldn't believe it," she said. *"I thought, 'Wow, somebody finally had this vision.' But it's not just a building, either. The people here are really serious about working together. People have great individual strengths, and if you put them together you can do amazing things. That's what's happening here."*

Honoring 50 Years

OF EXCELLENCE IN OPTICS

On March 2nd of this year, the lights of Sloan Auditorium dimmed so that students could better see the slides of Professor Emil Wolf's presentation, *Unified Theory of Coherence and Polarization of Light and Some of Its Applications.*

Wolf was just about to begin his talk when suddenly the lights went back on again. Puzzled, Wolf saw Optics Institute Director Wayne Knox smiling and walking toward him carrying something large and flat. Then Nick Bigelow, Chair of the Physics Department, rose as well and joined Knox and Wolf by the podium.

Knox and Bigelow had decided to make a surprise out of a ceremony to honor the fact that Wolf joined The Institute faculty 50 years ago this July. On behalf of both the Department of Physics and The Institute of Optics, Knox presented Wolf with a plaque to honor his half-century tenure at the University of Rochester. Both he and Bigelow congratulated Professor Wolf and thanked him for his long and distinguished career.

Nicholas Bigelow, Emil Wolf and Wayne Knox

Wolf, the Wilson Professor of Optical Physics and Theoretical Physics, is an icon in the field of optics. He is perhaps most well known for his classic book *Principles of Optics: Electromagnetic Theory of Propagation, Interference and Diffraction of Light,* which he wrote with Nobel Laureate Max Born. The book was published by Pergamon Press in 1959 and is now in its seventh edition (now published by Cambridge University Press).

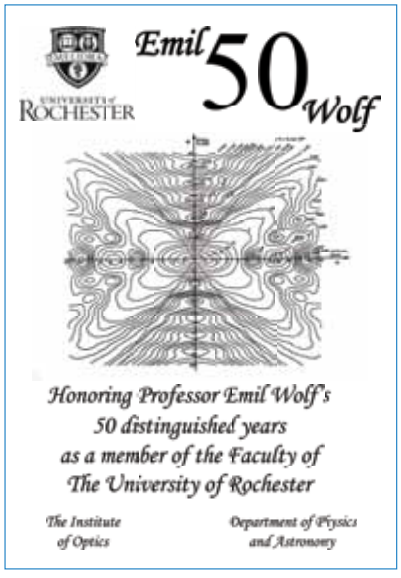
Wolf recently won the 2008 Joseph W. Goodman Book Writing Award presented by the Optical Society of America (OSA) and the International Society for Optical Engineering (SPIE). His winning book is *Introduction to the Theory of Coherence and Polarization of Light,* which was published in 2007. In addition to textbooks, Wolf is a prolific author of scientific papers: the count is currently 423 but continues to grow because of Wolf's continuing scientific productivity.

Professor Wolf is the recipient of numerous awards for his scientific contributions and is an honorary member of the Optical Society of America, of which he was the President in 1978. He is also an honorary member of the Optical Societies of India and Australia and is the recipient of seven honorary degrees from Universities in the Netherlands, Great Britain, the Czech Republic, Canada, France and Denmark.

Wolf is also a famously tough teacher. Knox recalled taking a course from Wolf in mathematical methods of theoretical physics.

"I remember vividly getting a 37 on the midterm," Knox said. *"I was really upset, and I went to see him about it. He listened to me and said, 'Well, yes, what are you upset about? You got one of the highest marks in the class.' And I said, 'What? How can that be?' He just smiled and said, 'Oh, I made the test hard because I just wanted to leave a little headroom for the exceptional student'."*

For a few more minutes, Knox and Bigelow told other anecdotes, which elicited chuckles from an audience that now filled every seat, the aisles, and the floor in the front. Then, with handshakes, Professors Knox and Bigelow left the stage, the lights dimmed, and Professor Wolf began teaching yet another generation about the theories of coherence and polarization of light.



Renaissance Man

In introducing Brian Thompson at the start of the ceremony to install Jannick Rolland in the new professorship, University President Joel Seligman said that Thompson was *"a renaissance man who has given his heart and soul to the university."*

That sentiment was echoed repeatedly by other speakers both during the ceremony itself and in a series of lectures presented earlier the same day in Thompson's honor.

Thompson himself, in remarks that were alternately humorous and moving, called the attention he was receiving *"amazing"* and said that he was feeling *"a strange mixture of pride and humility."*

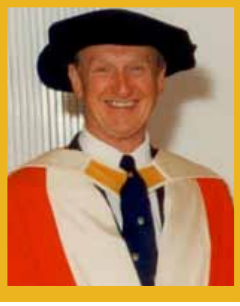
"The importance of this event today is not about me," he said. *"We are here to celebrate John Bruning's very significant support of The Institute through this endowed chair, which will further enhance the academic profile of The Institute as a world leader in optical science and engineering."*

Thompson, who speaks with the lilt of his British heritage, received his doctorate at Manchester University in the 1950s where he worked for a time with physical optics pioneer Emil Wolf, now the Wilson Professor of Optical Physics at Rochester. He came to the United States in 1963, working in industry and higher education before arriving at the University in 1968 as the director of The Institute of Optics. Thompson remained at Rochester thereafter, making a name for himself as a leading researcher in coherent optics, holography, phase microscopy, and image processing.

Thompson's experiments on partially coherent light have become standard works in the literature of the field, and his illustrations of optical phenomena appear widely in textbooks and publications. He developed the first direct application of holography: dynamic particle size analysis, which is now used in many fields. The author of more than 180 scientific and technical papers, Thompson was editor of the world's most widely-circulated optics journal, *Optical Engineering,* from 1990 to 1997. In 1975 he became dean of what was then the College of Engineering and Applied Science, and moved to the provost's office in 1984. Thompson retired in 1994 but has continued to be a vital presence at the University and a source of guidance and insight for people at all levels of the administration.

Thompson ended his remarks during the ceremony with characteristic wit and poignancy, referring to his late wife Joyce.

"I regret that my wife is not here to celebrate with me," he said. *"I could always count on her to critique my public utterances, both on campus and off. I'm sure, however, that she is with us in spirit, and that my grade is already in."*




"***Brian Thompson has a great sense of humor, he's really smart, and he is one of the few people I knew during my time at the university who bridged the gap between long-term university research and real-world commercial applications."***

--Robert Sprague, first graduate student under Thompson and currently Senior VP at SiPix Imaging Inc.

"Brian came to The Institute in 1968 at a troubled time…things were pretty unorganized and many students had left. But very soon after Brian came, things calmed down. He has a very calm demeanor."

--Gary DeBell, third graduate student under Thompson, currently CTO and Managing Member at MLD Technologies, Inc.

"I first met Brian Thompson on January 19, 1955…he was my assistant and we were talking about x-ray crystallography. We did some work together…he did the experiments and I did the theory. When we compared results we got different values. Of course we both thought the other was wrong. Well, Brian went back and double-checked his instruments and found that one had been incorrectly calibrated. When he repeated the experiment, the results were in complete agreement with my theory. It was the start of a long and productive relationship!"

--Emil Wolf, Wilson Professor of Optical Physics and Professor of Optics, UR

"Brian has had an incredible impact on many of us sitting here today and we all really appreciate it."

--Duncan Moore, Rudolf & Hilda Kingslake Professor of Optical Engineering; Vice Provost for Entrepreneurship, UR

"One of the greatest things is to have great friends, and it's all the better when the friend has so many accomplishments that set an example for others. You have been my idol for many years."

--Daniel Malacara, professor at Centro de Inv. En Optica, Mexico

"One time we were making a larger chamber for a multidimensional slit-scan flow system. Brian stopped by the lab and asked us what we were doing. I said, 'Well, we're getting another chamber made.' Without skipping a beat, Brian said, "Well, how many chambermaids do you need?'"

--David Kay, optical scientist at Quality Vision International, Inc.

"Brian always had an immense concern and interest in helping young people get started in their careers."

--Conger Gabel, President, Hardy Gabel Group LLC

"Never follow Brian Thompson to a podium—you'll be a loser unless you're Winston Churchill."

--Chris Dainty, professor at the National University of Ireland, Galway

"Brian is one of the most sane individuals I've ever met."

" Great curiosity and creativity are great traits in a scientist, but also great traits in an administrator, and those were traits Brian brought to the job of Provost."

"Brian, you and Joyce made the university bloom."

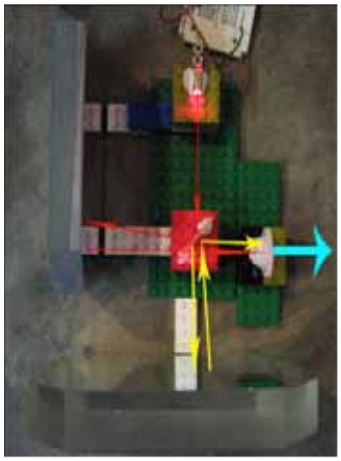
--Dennis O'Brien, UR President 1984-1994

Photobar pages 8 & 9 - l to r: Page 8; 1) Emil Wolf with Bob Hopkins & Brian Thompson; 2) Barbara Hopkins, Marlies Wolf and Joyce Thompson; Page 9; 1) Brian Thompson; 2) book cover; 3) Brian Thompson and Wayne Zyra; 4) Brian Thompson, Jannick Rolland with John & Barbara Bruning. Photo at left on page 8 - Brian Thompson; Photo at right on page 9 - Dennis O'Brien. A photo of some of the symposium attendees is on page 14.

Child's Play ? ... No Way !

The June 1, 1998 issue of Applied Optics featured a rather unusual article titled *"Optomechanics with LEGO"* by F. Quercioli et al. The abstract was succinct: "*The basic elements of a fairly complete optomechanical kit based on the use of LEGO are presented. Taking advantage of the great variety of standard LEGO elements, and adding a few custom components made of Plexiglas, we show how most of the mechanical parts of an optical setup can be built with little effort and at an extremely reduced cost. Several systems and experiments are presented, mainly in the fields of optical filtering and interferometry, to show that the proposed mounts are excellent for didactic purposes and often perfectly suitable even in applied research.*"

The authors proceeded to demonstrate the many ways the familiar plastic building blocks and related pieces could be used to build a range of serviceable optical devices. Eleven years after this publication, the veracity of the paper's assertions regarding LEGO blocks has been confirmed by Gregory, Daniel, and Robert Balonek, who graduated from The Institute this summer (see article page 4).

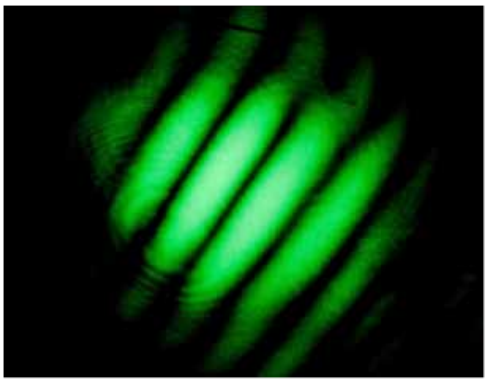


The brothers began by building a standard Michaelson interferometer, in which a laser beam is split and one of the two beams is allowed to take a slightly longer path, which sets up interference patterns when they are recombined into a single spot. *"The tricky part is trying to get the two beams to intersect at the same point just before the negative lens so they will interfere with each other,"* said Robert Balonek. *"The whole set up is very vibration sensitive, which is one reason we did it on a concrete floor."*

The brothers succeeded in obtaining the classic interference fringe pattern with both red and green light from a laser diode source. Observing and encouraging the triplet's efforts was professor Jim Zavislan. While appreciating the creativity of using LEGO elements, he noted that obtaining fringes with laser light is not terribly challenging because the coherent nature of such light makes it relatively easy to obtain fringes without balancing the optical paths. Obtaining fringes from a non-coherent (i.e. white light) source would be much trickier, he noted—and, as a spur to the triplets' efforts, he said that if they succeeded, he would treat them all to a steak dinner.

The triplets responded eagerly to the dangled gastronomical reward—though not in the way Zavislan expected.

"I assumed that they'd use a configuration of the interferometer that was similar to what they already had, which would have been very challenging," Zavislan said. *"But what they did was to change the design to a common-path interferometer, which allowed them in a fairly straightforward way to get white light fringes. I appreciated their ingenuity and tenacity. As with many things, when you're faced with a challenge, change the rules and you can get the job done."*



True to his word, Zavislan had the triplets over to his house and cooked them all a steak dinner as congratulations for their creative solution and their demonstration of the principles of economy and simplicity that were suggested in the original Applied Optics paper.

(To see more images of the experiments and read more details, visit Robert Balonek's website: www.kenolab.com)

Greg, Hillary Maben,Daniel and Robert Balonek enjoy their reward - a steak dinner at the home of Prof. Jim Zavislan

Optics Seniors Cheon Jeon, Jack Chang, and Brandon Zimmerman enjoy the fun with Professor Tom Brown and Optics Senior Tom Bruno

A Friendly Mutual Roasting

Upholding a long tradition of good-natured joking at The Institute, faculty and students recently "roasted" each other in an event they mutually organized. *"We wanted to have some occasion to celebrate all the members of the graduating class, separate from commencement exercises, which are formal and place other time constraints on students,"* said Professor Andrew Berger. *"So the faculty and students each put some effort into gently roasting the others. The faculty gave each student a 'paper plate' award — a humorous superlative — as well as some sort of appropriate gift. The students did several skits poking fun at the faculty and also produced a humorous PowerPoint presentation ribbing various faculty."* By all accounts, none of the participants were unduly scalded and great fun was had by all. *"It was very well done,"* said Director Wayne Knox. *"It was respectful but very, very funny."* The flavor of the proceedings can be gleaned from the following verbatim text of four paper plate awards.

The Spin Angular Momentum award. This award goes to the senior whose extracurricular hobbies best exemplify the motto "Be The Photon" when it comes to extracurricular pursuits. Specifically, the student must spend multiple evenings each month engaged in dancing activities that cause him to spin around or in place for extended periods of time. While not absolutely required for candidacy, regular participation in Lindy Jam is considered a plus. For selflessly donating countless quanta of h-bar to his personal photonic journey, the Angular Momentum award is enthusiastically presented to Daniel Balonek.

The Homogeneous, Isotropic, and Linear award. This award is given annually to a senior who, in trying to figure out what on earth to do after graduation, consults material from his Optics classes to provide guidance and inspiration. This year's winner creatively deployed the HIL construct from Optics 262 by applying to every graduate program imaginable, with no dependence upon where one was located or how it was oriented. Although he has finally chosen a school to attend, he remains in a linear superposition of two possible departments from which to earn his degree, and therefore has retained his eligibility for the award. For blindly entrusting his entire future to the mystical teachings of The Institute faculty, the Homogeneous, Isotropic, and Linear award is hereby conferred upon Cheonha Jeon.

The Senate Filibuster award. This prestigious award goes annually to the graduating senior who is most capable of carrying on a conversation with other Optics students or teaching staff without requiring them to actually say anything for large stretches of time. While a student can qualify for this award based solely upon discussions involving Optics homework and tests, the ability to discourse learnedly on closely-related topics such as summer employment and DC-area sports teams is considered a plus. For adding a new definition to the term "high bandwidth," the Senate Filibuster award is unhesitatingly given to Jonathan Brand.

The Quantum Tunneling award. The Quantum Tunneling award is awarded only on those occasions when a student manages to evade one or more required Optics courses by vanishing from the premises and then magically reappearing, having met the course's requirements in the interim. Traditionally, past winners have chosen to evade Quantum Theory, but as it is currently offered during the eighth and final semester of the major, tunneling past Electromagnetic Theory is considered an appropriate, and by many people preferable, alternative. This year's winner was nearly disqualified when it was alleged that she took a thematically similar course during her tunneling time, but upon further review the title of the course was revealed to be "Ha ha ha It's February and I'm Somewhere Warm." For elegant evasion of electromagnetic excess, the Quantum Tunneling Award is proudly presented to Rebecca Berman.

Teaching Labs Come Home at Last

After decades residing in an entirely separate building from the rest of The Institute of Optics, the suite of undergraduate teaching labs has finally become fully integrated with The Institute, occupying the entire 5th floor of the Wilmot building.

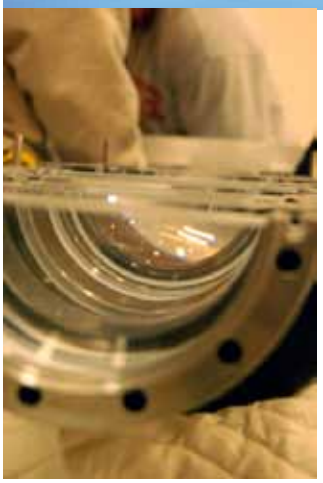
"*We've run a full year of labs up there, and it's been really great,"* says Per Adamson, Director and Coordinator of the labs. *"Having such proximity to the rest of The Institute and resources like the instrumentation in the Hopkins Labs has been terrific. The students really enjoy working up here."*

The labs were previously located in the Dewey Building. That physical separation from the rest of The Institute meant that students didn't tend to hang out in the labs. In addition, there was no lab dedicated to informal experimentation. Now, in addition to being in the same physical space as the rest of The Institute, a new "hacking lab" has been created which is open 24 hours a day, 7 days a week." *"The 24/7 hacking lab was used quite a bit,"* Adamson says. *"It worked really well."* Optics-related companies such as Insight Technologies, Edmund Optics, and the Newport Corporation have donated significant equipment and funds to help get the teaching labs up and running. But Adamson says there are always new ways for interested corporations to contribute to the educational mission of The Institute. *"We could really use a new UV curing source for gluing glass elements together,"* he says. *"Also it would be great to have a new long-wavelength thermal camera. We want to create more labs that relate to 'green technology' and energy. With an IR camera we could do experiments involving thermal management and similar things."*

2009 Graduates; top row: Tom Bruno and Zachary DeSantis; middle row: Greg Balonek, Rebecca Berman,Zachary Darling, Daniel Balonek, Anthony Visconti, Ezra Milby, Robert Balonek, Jonathan Brand; horizontal Per Adamson; front Cheonha Jeon. (Missing: Jack Chang, Ken McKay, Roger Smith, Megan Winn, Brandon Zimmerman)

(For more info about ways to contribute to the teaching labs, contact Adamson at: adamson@optics.rochester.edu)

Cut-Through Lens in Munnerlyn Atrium



The latest addition to the optical décor of the new Goergen building: this state-of-the-art lithography lens, donated by the Corning-Tropel Corporation, was sliced in half with a water-jet cutter to reveal the many lens components of which it was made.

A close-up view on the left reveals a lens slice; on the right Professor Tom Brown plays laser light through the lens.

The Art of Optics / / The Optics of Art

In May, 1959, the British physicist and novelist C.P. Snow delivered a lecture titled *"The Two Cultures"* in which he expressed dismay at the apparent gulf of understanding between scientists and those involved in the arts and humanities. If he were alive today, he might find some solace in a project that has joined a prominent local artist and two Optics students: Jack Chang, '09 and Jaime Gruttadauria, '10. The two students worked with a 2-foot-tall "desktop model" of a sculpture made from pieces of BK-7 optical-grade glass by artist Michael Taylor. As a for-credit independent project, Chang and Gruttadauria learned about Taylor's artistic processes and advised by Prof. Knox, who created and organized the collaboration, also explored in scientific terms the many ways that light interacts with the highly-faceted sculpture. They wrote a paper about their results and also created a backdrop for the sculpture consisting of hundreds of optics-related mathematical equations.

Wave, 2009, Glass
Laminated cast optical glass
24 in. x 13 in. x 9 in.
(60.96 cm x 33.02 cm x 22.86 cm)

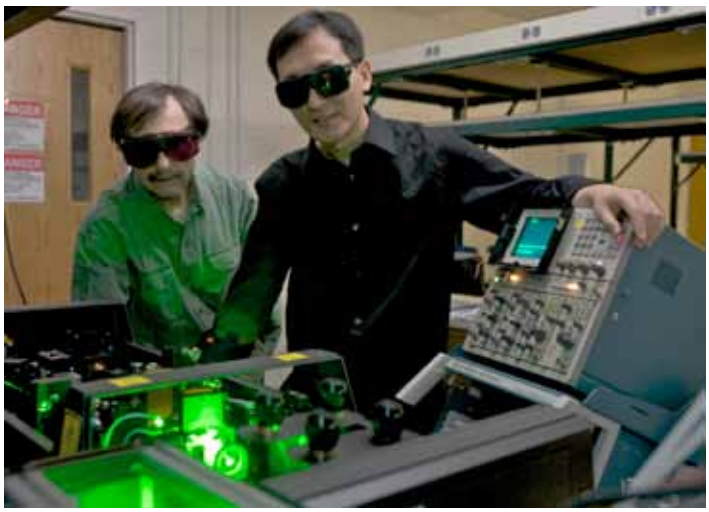
"It took us a couple of days — and nights too — to write out all of the mathematical equations in the background," Chang said. *"We looked at all the various optical artifacts created by the sculpture, such as chromatic aberrations, diffraction, diffusion, and the shadow patterns produced on a background when light is shined through the sculpture."* On the evening of the dedication of the new Hopkins Center, Chang used red, blue, and green LED lights, each independently controlled, to illuminate the sculpture for guests, including Taylor.

As Chang tweaked the lights to produce "seasonal" palettes of colors, from icy-cool "winter" to toasty "summer," Taylor talked about his vision of the piece, which he titled "Wave" in recognition of both one property of light as well as the overall shape of the sculpture. *"The piece has a sweeping kind of movement to it,"* he said. *"The final piece will have an even more pronounced and dynamic sweep to it. The piece has the amazing quality of appearing almost to be the source of the light itself. These students have done a really incredible job."* For the past 20 years, Taylor served as professor and chair of the Glass Department in the School for American Crafts at Rochester Institute of Technology. His work is included in many public and private collections around the world. In June the model was moved to the Memorial Art Gallery where it was included in an exhibition of about 15 other examples of Taylor's work.

"Math, poetry, molecular biology, and color theory all have a place in Taylor's work," said Museum Chief Curator Marie Via. *"He's as interested in quantum physics as he is in beauty, as fascinated by the possibility of alternative universes as by engineering."*

After the exhibition is over, *"Wave"* will return to The Institute where it will be mounted for display somewhere in the Goergen building. Meanwhile, efforts are underway to find sponsorship for a 12-foot-tall version of the sculpture, which would provide a dramatic artistic accent to the new building. (A 16-foot-tall glass sculpture by Taylor already graces the new Wilmot Cancer Center at the Medical Center.) *"It would be nice if the final piece could be used by other students for other ideas or projects,"* Taylor said.

Optics in the News



Chunlei Guo, Associate Prof. of Optics, and Research Associate Anatoliy Vorobyov have been keeping the science blogs busy this year. After discovering a way to transform the color of nearly any metal to blue, gold, gray, or pitch black a couple of years ago, they continued exploration of how different metals interact with exposure to intense burses of laser light. *"During its brief burst, the laser unleashes as much power as the entire electric grid of North America does, all focused onto a spot the size of a needle."* said Guo. As he likes to point out, one femtosecond is to one second as one second is to 32 million years. The black metal created by this process absorbs all radiation that shines upon it, which is proving to be promising in various technological applications. Using the laser, Guo and Vorobyev also created a simple slab of metal that actually lifts liquid uphill. And most recently, they determined that their ultra-powerful laser can turn regular incandescent light bulbs into power-sippers. The process could make a light as bright as a 100-watt bulb consume less electricity than a 60-watt bulb while radiating a more pleasant light than a fluorescent bulb. The laser process creates a unique array of nano- and micro-scale structures on the surface of a regular tungsten filament—the tiny wire inside a light bulb—and these structures make the tungsten become more effective at radiating light. The findings have appeared in many publications, including the *New York Times, Scientific American, U.S. News & World Report, Los Angeles Chronicle* and *Science News* and will be published in an upcoming issue of the journal of *Physical Review Letters*.

Thompson Symposium Attendees

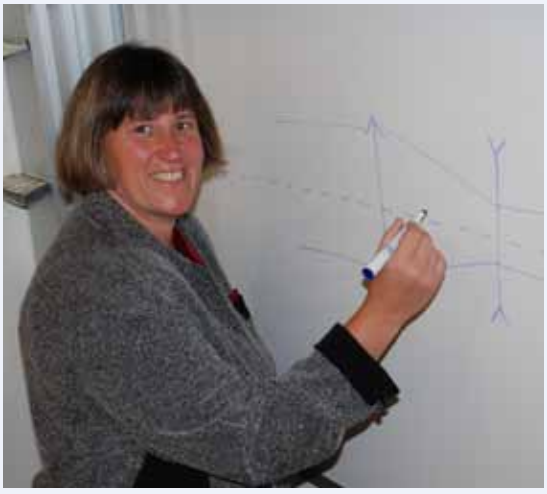
Participants and Guests of the Brian J. Thompson Symposium gather on the front steps of Rush Rhees; Front row l-r; Marlies Wolf, Emil Wolf, Austin Smith-Usher, Tanya Usher, Linda Jewel, Brian J. Thompson, Jannick Rolland with sons Roman and Yvan, Kevin Thompson, Wayne Knox. Second row l-r, Mohamed Salem, Duncan Moore,Emilienne and Roger Rolland, Daid Kay, Carlos Stroud, Bruce Horowitz, Gary DeBell, Robert Sprague, Erwin Loewen, Conger Gable, Keith Knox; Third row l-r; Miguel Alonso, Wayne Zyra, Kate Bennett, Charles Miersch, David Williams, Dennis O'Brien, Gary Wicks, Richard Becherer, Jean Louis Meyzonnette, Alan Wertheimer

A Passion for Teaching
in the Kingslake Tradition

The future of the field of lens design at The Institute of Optics just grew brighter with the hiring of Julie Bentley as full-time Associate Professor of Optics. For the past twelve years, Julie has balanced a full time position at Corning-Tropel and her role as wife and mother while faithfully teaching classes in lens design as an adjunct professor. Starting in September, students will benefit from her passion and commitment on a full-time status. *"One of the things I love about teaching is how much I learn when teaching,"* says Julie. *"I firmly believe that the best way to understand a subject is to try to teach it to someone else."*

And Prof. Bentley is successful in sharing her knowledge. Her classes have always been very popular with students. *"Her teaching is regarded as extremely beneficial by our graduate and undergraduate students who rank her highly and value enormously her teaching skills,"* says Prof. Govind Agrawal. Indeed, students often cite her command of the material, enthusiasm and expertise, and say her course is "a must take" for students in Optics. *"She will be a welcome addition to the faculty,"* says Amber Beckley, PhD candidate, who took Bentley's Optics 444 course. *"She is a very good Professor and the students are excited she will be here full-time."*

Julie will start her full-time endeavors by teaching four undergraduate and graduate courses per year (two per semester), where up to one may be curriculum development in preparation for the launching of our new BS in Optical Engineering. Her main teaching interests include geometrical optics, optical design, and toleranc-ing.



Julie shares, *"I spend a significant amount of time in my classes on both individual and group projects."* This has paid off for her students, four of whom have been awarded prestigious ORA Student Optical Design Competition Awards. The titles give a sample of projects completed in her class each year:

"Design of a 360 degree panoramic camera lens," Manuel Guizar-Sicairos. (2007). (An earlier ssue of *Optics* featured this project.)
"All-plastic Compact HMD design," Yijing Fu. (2006).
"Design of a Sparse-Aperture Interferometric Telescope," Matthew Bolcar. (2004).
"Design of Backwards Compatible Blu-Ray and HD-DVD Objectives for Reading High Capacity (15 GB and 23 GB) DVDs," Chris Supranowitz. (2004).

Receiving her BS degree in Optics, Julie earned the honor of "highest distinction," from The Institute of Optics, University of Rochester in 1990. She continued her studies at The Institute of Optics in Rochester and completed her MS in 1992 and PhD in 1995, maintaining a 4.0 GPA. Her PhD thesis focused on the integration of the design and manufacture of gradient-index optical systems. Among her numerous awards and scholarships, Julie earned the UR's most prestigious, the Sproull Fellowship (90-92), and was named a Sproull Distinguished Alumna in 2007.

After graduating she spent two years at Hughes Aircraft Co. in California designing optical systems for the defense industry. She then moved to Corning Tropel Corporation in Fairport, New York, and worked in the area of optical design of microlithographic inspection systems.

Holder of three patents, Julie has completed more than 20 publications and presentations and her first book, *"SPIE Field Guide to Lens Design,"* will be available early next year. Julie looks forward to increased involvement in the Hopkins Design Center to help develop undergraduate research and senior design projects that have a commercial focus. Over time, she will develop a research program independently as well as in collaboration with other Optics faculty.

Julie is particularly well qualified to continue teaching in a similar role that The Institute enjoyed under the design expertise of Rudolf Kingslake. In addition, her teaching style often mirrors much of the wonderful spirit of Robert Hopkins. And not insignificantly, as Prof. Alonso states, *"She will serve as a role model to female students interested in optics."*

Perhaps her former PhD advisor, Prof. Duncan Moore sums it up best, *"Julie will be a great asset to the department!"*

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Institute Director Wayne (Kimo) Knox and wife Victoria (Ka'iulani) share Aloha spirit with their performance of the 2009 Munnerlyn Atrium Performing Arts Series Finale

For more information on Optics programs, contact Wayne Knox at (585) 273-5520 or wknox@optics.rochester.edu.

To make a donation, contact Eric Brandt at (585-273-5901) or ebrandt@alumni.rochester.edu

OPTICS

About the Newsletter Author

STEPHEN BRAUN is an award-winning science writer and producer with strong ties to both Rochester and the University. After earning his B.A. in journalism from St. John Fisher College, Braun worked as a writer for City Newspaper in the early 1980s. He then worked for two years at the University of Rochester in the public relations department before winning a fellowship for science writers at Boston's public television station, WGBH. Since then he has written nine popular science books and has produced dozens of videos and CD-ROMs on topics in science and medicine. He lives with his wife and family in Amherst, Mass.

Note: This copy of *Optics* was designed and produced in the department. Wayne Knox's assistant, Gina Kern, enjoyed learning InDesign while creating this issue, as well as drafting a couple of the articles.