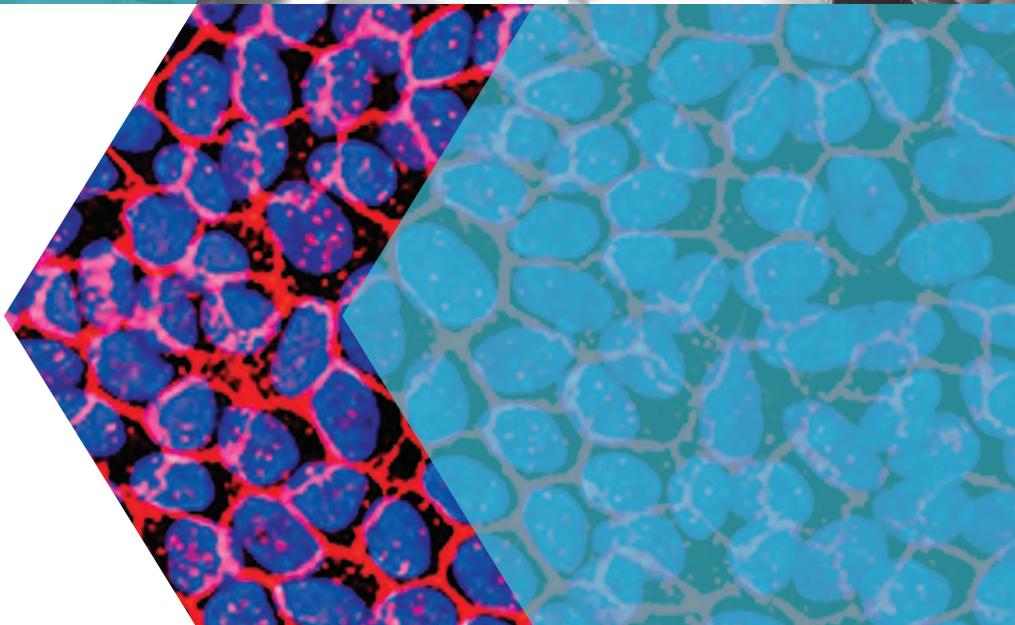




Research to
Prevent Blindness



ANNUAL REPORT 2014



Jules Stein, MD, Founder (1896-1981)

David F. Weeks, Chairman Emeritus

OFFICERS

DIANE S. SWIFT, *Chairman*

BRIAN F. HOFLAND, PhD, *President*

DAVID H. BRENNER, *Vice President & Secretary*

RICHARD E. BAKER, *Treasurer*

BOARD OF TRUSTEES

WILLIAM H. AHMANSON**

RICHARD E. BAKER*

JOHN I. BLOOMBERG

DAVID H. BRENNER*

ANTONIO M. GOTTO, MD

FAYE D. HUNTER

FREDERICK HUNTSBERRY

CAROL LOMBARDINI

DIANE S. SWIFT*

JOHN TINKER

KATRINA VANDEN HEUVEL

WILLIAM J. VANDEN HEUVEL

TOM WERTHEIMER

KARYN L. WILLIAMS, PhD

** Members of the Executive Committee*

*** RPB expresses its gratitude to William H. Ahmanson, who rotated off the Board of Trustees in 2014 having completed 6 years of service.*

MATTHEW LEVINE

Director of Communications and Marketing

PATRICIA R. MORAN

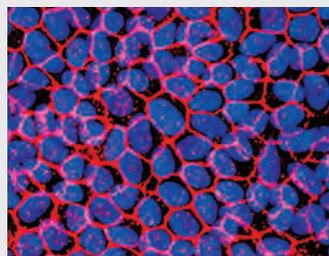
Grants Administrator

CONDON O'MEARA MCGINTY
& DONNELLY LLP AUDITORS

**Financial information
available at www.rpbusa.org**

645 Madison Avenue, New York, NY 10022-1010
212-752-4333 or 1-800-621-0026 • FAX: 212-688-6231
www.rpbusa.org • inforequest@rpbusa.org
facebook.com/ResearchtoPreventBlindness

On the cover:



In the lab of **Stephen H. Tsang, MD, PhD**, Columbia University, retinal stem cells derived from the skin cells of a normal individual were coaxed into forming the structure of the retinal pigment epithelium (shown here).

Defective stem cells derived from the skin cells of a patient with retinitis pigmentosa were corrected with gene therapy. Read more about Tsang's work on page 10.

Photo by Stephen H. Tsang, MD, PhD



LETTER FROM THE CHAIRMAN

Typically, foundations are seen solely as funders of mission-driven initiatives. Most people who know Research to Prevent Blindness (RPB) view us in that way, and for good reason. As a funder, RPB has helped save or restore sight for millions of people. But in 2014, RPB greatly expanded its roles beyond that of “funder” to better fulfill its mission and serve as a catalyst for vision research.

The hundreds of millions of dollars that RPB has strategically awarded to eye researchers have yielded dramatic progress in both the understanding and treatment of eye diseases.

Under the leadership of RPB President, Dr. Brian F. Hofland, we acted as the convener in hosting the first-ever gathering of vision research grant makers with the goal of fostering collaborations. This convening role is a natural fit because RPB funds research into all sight-threatening diseases rather than just one disease or class of diseases.

A natural byproduct of the meeting was the recognition that partnerships could be formed between organizations whose goals are aligned. Thus, we also acted in the additional role of connector. As RPB steps further into this role, the connections we make may be between organizations, research scientists or other foundations.

A foundation can also shine a spotlight on important issues. Early in RPB’s history we did so in a most significant way when we highlighted the need for creation of a separate National Eye Institute. In 2014, we underscored the urgent needs of those losing sight to retinitis pigmentosa (RP) by simultaneously awarding grants to five exceptional RP scientists. Our hope and expectation is that this infusion of flexible support will raise the pace of development for RP treatments.

We also spotlighted the growing potential for stem cell research. Later in this Report, you will read about the Catalyst Award for stem cell approaches for the treatment of age-related macular degeneration—the result of a partnership with the International Retinal Research Foundation (IRRF) and an anonymous donor. In addition to this special initiative, RPB also supports stem cell research at more than 20 other grantee institutions across the U.S.

Other areas will be targeted in the future for more focused, collaborative grant making. But one thing, I hope, is clear. RPB will continue to lead and serve the vision research community, as it has for decades. And we will take on whatever role the times demand to drive eye research.

Finally, I want to pay special tribute to a great supporter of RPB who passed away unexpectedly in 2014. Diane Disney Miller was the daughter of Walt Disney, who had a friendship with RPB’s founder, Dr. Jules Stein. She honored that history and poignantly responded to the diagnosis of a grandchild by contributing more than \$1.4 million to advance amblyopia research. RPB honors her by matching this year’s Disney contribution to extend that work.

Diane S. Swift, Chairman



LETTER FROM THE PRESIDENT

Research to Prevent Blindness (RPB) had an extraordinary year in 2014. Headlining the year was our hosting of key leaders from 21 vision-related organizations for a daylong convening. Through this meeting, we started an important discussion on taking collective action in preventing, treating, and curing eye disorders.

We have all been pulling in the same direction, but there is an opportunity for us to pull together more strategically and effectively.

We also received findings from the objective survey we had commissioned on the status and the needs of the vision research community. Going forward, we will be addressing those findings by applying greater resources to: the study of gene and stem cell treatments and neuroprotection; new imaging techniques; exploring ways to increase coordination, both between basic and clinical researchers and across institutions; developing new approaches to attract future talent and support early investigators; and supporting a population health focus.

In fact, we have already started to address these issues. The new Catalyst Awards (page 21) went to three leading scientists addressing age-related macular degeneration through stem-cell research, and contained a strong incentive to build a cross-institutional, collaborative component into their work. To develop future talent with the capacity to integrate basic science findings with the practical needs of patients, for 2015 we enriched the Physician Scientist Award and focused it on earlier career scientists. And we began a partnership with the Heed Ophthalmic Foundation to support their residents' retreat, which encourages and facilitates talented medical residents to pursue a career in academic ophthalmology.

We made a grant to the Institute of Medicine for a major study entitled "Public Health Approaches to Reduce Vision Impairment and Promote Eye Health." The report, to be released in 2017, represents RPB's commitment to play its part in a public/private collaboration to combat the dramatically rising rates of eye diseases.

We heightened our support for advocacy efforts to preserve and upgrade federal funding for the National Eye Institute through a special grant to the Alliance for Eye and Vision Research (AEVR). Through this grant, RPB provided critical financial resources to AEVR and Research!America for the most comprehensive survey of Americans' attitudes on vision loss ever undertaken. The poll, available through the RPB web site (www.rpbusa.org), showed that Americans across all ethnic groups see vision loss as a top health concern and want more support for vision research from the government as well as from philanthropy. It provided a powerful argument to step up activity and financial support in the U.S. to solve issues of vision loss.

Our response to that finding, as evidenced by the activities presented in this Annual Report and on our web site, is "We hear you." RPB is determined to work faster, smarter and better to preserve and restore vision through research support.

Brian F. Hofland, PhD, President

CONFRONTING VISION LOSS WITH COLLECTIVE ACTION

A Historic Moment in the Annals of U.S. Eye Research

There is a sense of urgency in the vision research field. An urgency driven not only by the aging of the baby boomers and the corresponding huge increases in age-related eye diseases, but by the drain placed on the economy in terms of medical costs and lost productivity, and by Americans' concern for their sight, as evidenced by a recent, in-depth, RPB-supported poll.

This urgency is further heightened by the cresting promises of treatments and cures for vision loss that research is bringing us, promises threatened by shrinking financial resources just at the point where we cannot afford to have them suspended.

Here's what scientists are facing: with the loss of a government grant for just one year a lab—whose work may have taken 30 years to bear fruit—has to close. The current proposed budget for national eye research would stop the important work of scores of researchers and their labs.

Research to Prevent Blindness was created with great forethought that allows us to vigorously pursue our mission to prevent blindness and restore sight. But our resources are limited. So, in order to meet this urgent

challenge of delivering on the promises of sight-saving breakthroughs, we are seeking to generate collective action, partnerships and collaborations.

On September 17, 2014, RPB convened an historic meeting of leading vision research funders: *Vision Research Funding Partnership: Imagining the Possibilities*. The task was to explore ways in which we might combine resources, experience and information where it makes sense to do so. The group came to consensus on the following areas for collaborative action, for which initiatives are being refined through follow-up working groups and ongoing dialogue:

- Advancing the Public Health Agenda
- Encouraging Funder Partnerships
- Coordinating Information
- Coordinating and Supporting Advocacy
- Supporting Interdisciplinary Research

Perhaps the most significant area of consensus that attendees came away with was the sense that they should and can find ways to work together to accelerate solutions for vision loss.

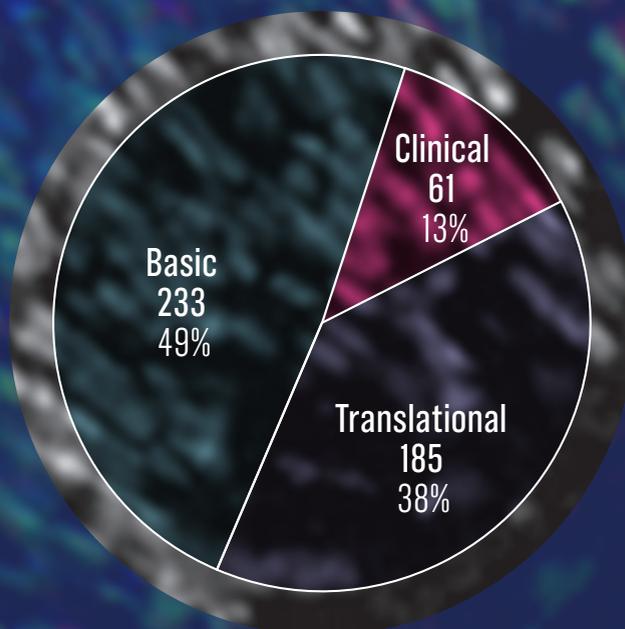


Front row, left to right: **James Jorkasky**, Executive Director/National Alliance for Eye and Vision Research; **Emily Holubowich**, Senior Vice President/CRD Associates; **Susan Olivo**, Executive Director/Reader's Digest Partners for Sight Foundation; **Dawn Prall George**, Executive Director/Macula Vision Research Foundation; **Stacy Pagos Haller**, President and CEO/BrightFocus Foundation; **Alan R. Morse**, President and CEO/Lighthouse Guild; **Elaine Richman**, Founder and President/Richman Associates; **Brian F. Hofland**, President/Research to Prevent Blindness; **Torrey V.A. DeKeyser**, Executive Director/EyeSight Foundation of Alabama; **Helen D. Nickerson**, Director/Juvenile Diabetes Research Foundation; **Paul P. Lee**, Board Chair/ARVO Foundation; **Jinan B. Saaddine**, Team lead/Centers for Disease Control and Prevention; **Sandra Blackwood**, Executive Director/International Retinal Research Foundation; **Stephanie Lederman**, Executive Director/American Federation for Aging Research. Back row, left to right: **Matthew Levine**, Director of Communications and Marketing/RPB; **Tom Brunner**, President and CEO/Glaucoma Research Foundation; **Phillip Albano**, Manager, Sight Partnerships/Lions Clubs International Foundation; **Paul A. Seiving**, Director/National Eye Institute; **Michael C. Crair**, Board Member and Chair/E. Matilda Ziegler Foundation for the Blind; **Kevin D. Frick**, Professor and Vice Dean for Education/The Johns Hopkins Carey Business School; **Brian Mansfield**, Deputy Chief Research Officer/Foundation Fighting Blindness; **Matthew McMahon**, Director of the Center for Translational Research/NEI; **Arthur Makar**, Executive Director/Fight for Sight; **Jeff Todd**, COO/Prevent Blindness. *Not shown*, **Don Gagliano**, Principal/Global Medical Innovation.

ADVANCES IN EYE RESEARCH 2014

Research to Prevent Blindness awards research grants to highly productive departments of ophthalmology and to promising individual vision researchers within those departments. Many of these grants are multi-year investments, so every year RPB supports many more active researchers than new awardees. In 2014, for example, RPB approved 33 new grants to individuals (one scientist qualified for two grants), but 137 scientists reported to RPB on their use of funds in ongoing studies. To date, RPB's total investment in cutting edge vision research is \$326 million.

Investigations Reported by Active RPB Researchers in 2014*



RPB grants can be used to support basic lab research (molecular biology, genetics, biochemistry, etc.), clinical studies (to determine the safety and effectiveness of new medications or devices), and translational research (which finds medical applications for basic research).

*An individual researcher may be conducting more than one investigation, or his/her research may apply to more than one eye condition.

The diversity of the investigations funded by RPB, reported in the following pages, reflect the scope of our mission to prevent all forms of blindness. These are highlights from published and in-progress studies submitted to RPB by departments of ophthalmology, as well as individual researchers, as part of annual reporting of outcomes from RPB funding. Last year, 1,783 papers in professional publications cited RPB support—the second highest total ever reported.

Omega-3s May Slow AMD

▶ With the prevalence of AMD projected to increase 50% by the year 2020, there is a pressing need to develop new pharmacological treatments and preventions. Enter nature. RPB-supported researchers from Massachusetts Eye and Ear/Schepens Eye Research Institute, Harvard Medical School and other institutions have demonstrated for the first time that the omega-3 fatty acids DHA and EPA, commonly found in seafood, show promising potential to slow the progression to wet AMD and other eye conditions or diseases that involve excessive blood vessel growth and inflammation.

Gel May Reduce Cataract Chances

▶ Vitrectomy surgery, which involves removal of the vitreous gel that fills the eye, is sometimes necessary to treat conditions such as vitreous hemorrhage, retinal detachment, and diabetic retinopathy. Most vitrectomy patients develop cataracts shortly after surgery, probably due to elevated oxygen levels inside the eye. Researchers at University of Louisville School of Medicine are developing a biocompatible gel that coats the back surface of the lens and prevents cataract formation, eliminating the need for a second operation for the patient and reducing medical costs.

Edible Anti-Uveitis Med

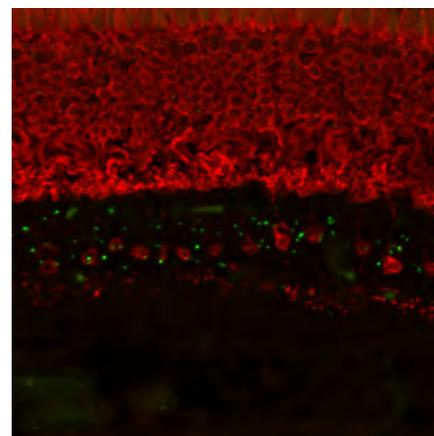
▶ Researchers at University of Florida College of Medicine are exploring an innovative, efficient, and cost-effective strategy to treat ocular inflammation (uveitis). They have already demonstrated proof-of-concept that, by encapsulating an anti-inflammatory enzyme in lettuce cells, the treatment can be taken orally.

Exercise May Save Sight

▶ Growth factors—substances that are known to improve brain health—also contribute to the health of neurons in the retina. Eye researchers have been trying to deliver them to aging eyes, typically via injections into the retina. Now, RPB scientists at Emory University School of Medicine have uncovered a potentially better method: physical exercise. Exercise raises the level of growth factors in the bloodstream so, while their investigation continues, these scientists are suggesting that people with a family history of retinal degeneration might want to consider a fitness program.

The Eye as Window to Other Diseases

▶ Among other research projects, Northwestern University's RPB Unrestricted Grant supported the work shown here: manifestations of amyotrophic lateral sclerosis (ALS) in the retina, which appear as ALS-related protein green specks. Advanced retina imaging techniques may help diagnose ALS earlier.



“There is no single greater facilitator of our research mission than RPB.”

—Nicholas J. Volpe, MD,
Chair of Ophthalmology,
Northwestern University

ADVANCES IN EYE RESEARCH 2014

Free System to Detect ROP

▶ Retinopathy of prematurity (ROP) causes abnormal blood vessel development in the retina of infants who are born too early. Its prevalence is rapidly increasing worldwide due to improvements in the care of premature infants, but the specialized knowledge to enable effective diagnosis and therapy is restricted to very few centers in the developed world. With RPB funds, investigators at Weill Cornell Medical College have created a web-based system to improve accuracy in ROP detection and are making it available to pediatric ophthalmologists and retina specialists worldwide.

Unborn Eyes Need Light

▶ To treat ROP, ophthalmologists may soon have a new tool: light. David R. Copenhagen, PhD, University of California, San Francisco, School of Medicine and RPB Disney Awardee for Amblyopia Research, has produced very strong evidence that light exposure can regulate vascular development in embryonic eyes and that there is a possibility that vascular complications in ROP might be mitigated by light exposure.

Better Feel for Eye Surgery

▶ With the goal of improving the outcome of surgical procedures in the eye, Innovative Ophthalmic Research Awardee George D. Stetten, MD, PhD, at the University of Pittsburgh School of Medicine, is combining two innovative yet very different systems—image-

guidance and haptics (the sense of touch)—to build a system that allows ophthalmologic surgeons to see and feel structures that were previously invisible and imperceptible to touch.

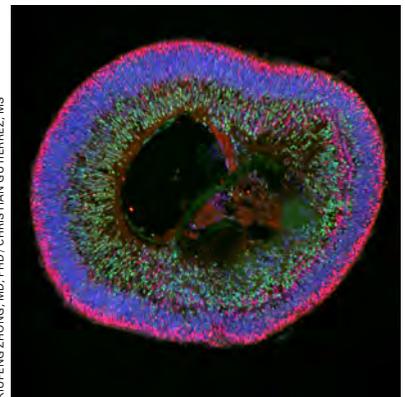
Adaptive Optics Gets an Upgrade

▶ Adaptive optics imaging technology was originally developed to remove the blur from telescope images created by turbulence in the earth's atmosphere. The same technology can also be used to compensate for the optical imperfections of the living eye and is gaining traction as a clinical tool for routine monitoring of disease progression. RPB Career Development Awardee Alfredo Dubra, PhD, Medical College of Wisconsin, has created a simple software upgrade that will allow all such scanning instruments to achieve the best image resolution possible without the need for in-house optics expertise.

Buggy Glaucoma Treatment

▶ Currently, there are no known modifiable environmental factors that can affect the development or progression of neurodegeneration due to glaucoma. But RPB investigators at State University of New York Downstate Medical Center (Brooklyn, NY) have found that an imbalance of microbes that live in our mouths may play a role. If initial findings are confirmed, they could potentially provide a straightforward, new approach to lessening damage from glaucoma.

XIUFENG ZHONG, MD, PHD / CHRISTIAN GUTIERREZ, MS



The Canto-Soler lab creates 3D human retinas (shown here) as tools for modeling retinal diseases.

The process involves first obtaining adult human skin or blood cells through a routine clinical biopsy. In the laboratory, these cells are then forced to regress and acquire an “embryonic stem cell-like” status, from which they can be re-directed to differentiate into any cell type of the adult body.

PROFILE: A NEW DIRECTION

On June 10, 2014, **M. Valeria Canto-Soler, PhD**, The Johns Hopkins University School of Medicine, caught the attention of the entire medical research world when she and collaborators announced that they had created miniature human retinas in a dish that not only had the architectural organization of a human retina but also the ability to sense light. It was the culmination of a career change five years in the making—one that started with financial support from RPB.

“My research focuses on the mechanisms that regulate the behavior of retinal cells in both normal and diseased conditions,” says Canto-Soler, Director of the Retinal Degenerations Research Center at Wilmer Eye Institute. “In 2009, I wanted to start a completely new line of cutting-edge research. I was fortunate to be able to use funds from RPB’s Unrestricted Grant [to the department of ophthalmology] to incorporate the use of human induced pluripotent stem cells (iPSCs) in my work. That support, literally, launched a whole new direction in my career.”

Her training in this new field took Dr. Canto-Soler and her post-doctoral fellow, Dr. Xiufeng Zhong, to the lab of David Gamm, MD, PhD, and Director of the McPherson Eye Research Institute at the University of Wisconsin School of Medicine and Public Health. Gamm, who received an RPB Nelson Trust Award in 2014 (page 18) as well as an RPB/IRRF Catalyst Award (page 21), is recognized as a pioneer in directing iPSCs into becoming retinal cells. “We spent two weeks there, learning the techniques that we took back to our lab,” she recalls. “Funds from RPB supported that critical visit as well. To this day, Dr. Gamm and I maintain a dynamic communication and frequently discuss potential projects.”

The skills and techniques she acquired with RPB support, coupled with her lab’s successes, helped her to receive additional grants from government sources. “We knew that if we were to reproduce the functional characteristics of the retina we would have to recreate its complex, three-dimensional cellular structure,” explains Canto-Soler. “But when we began this work, we had no idea if our iPSCs would be able to form a retina, almost on their own. Somehow the cells knew what to do.”

That was their first, pleasant surprise. They were equally surprised when the cells responded to light stimulus. “The element of the unknown in science can be humbling,” she adds. “While our mini retinas may



M. Valeria Canto-Soler, PhD

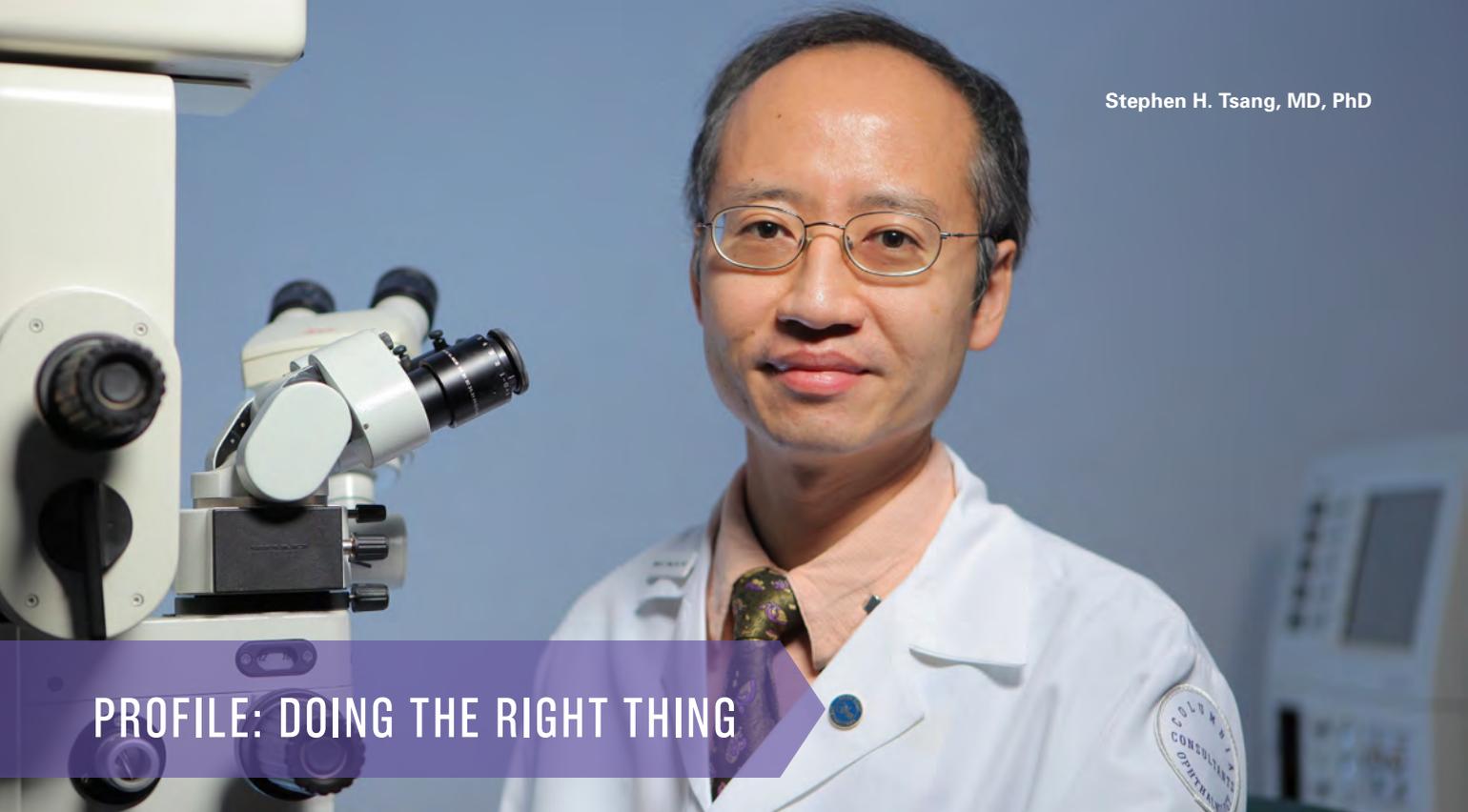
“This project has required significant financial investment. The continuous support from RPB has been essential for its success.”

respond to light, we do not know if they are capable of producing a signal that the brain can interpret as an image. That may take quite some time yet.”

To expand her work on the retina-in-a-dish system, her department chair nominated Canto-Soler for an RPB Special Scholar Award, which she received in 2013. “These mini retinas develop at the same pace as human embryonic retinas. A three-month-old retina-in-a-dish has developed to the same extent as a retina at three months of gestation. The system allows us, for the first time, to study healthy retinal development as it occurs. We can also introduce retinal disease gene mutations in order to study the steps and mechanisms in the development of human retinal diseases, such as retinitis pigmentosa and Stargardt’s.”

One of the goals with these studies is to develop a platform for patient-specific screening of drugs that could have a clinical application. Eventually, the Canto-Soler lab hopes to recreate in these mini retinas a level of maturation such that lab-grown retinal tissue transplantation would be feasible.

“An RPB grant makes it possible for a researcher to switch direction not only mid-investigation, but also, as in my case, mid-career. This is profoundly liberating. All of us in vision science are aware of the high quality of the researchers who receive RPB grants and of the rigorous approval process that takes place there. I think I am not alone when I say that, if you receive a grant from RPB, you feel that your work is of value to the vision research community. This gives you a sense of self-assurance and added motivation.”



PROFILE: DOING THE RIGHT THING

The headline on the Columbia University web site reads “With Cells from Patients, Researchers Recreate Eye Disease in a Dish.” The story goes on to describe a game-changing breakthrough that paves the way for the personalized treatment of age-related macular degeneration (AMD). Skin cells, taken from patients whose genes increase their risk of developing AMD, are converted into pluripotent stem cells, then prompted to become retina cells and “aged” to mimic the diseased retinal cells of a 60-year-old. These are the first “living” human cells in which treatments for specific AMD patients can be tested.

Listed among the sources of support for the study are the following: unrestricted department funds from Research to Prevent Blindness (RPB), the RPB Physician-Scientist Award, and the RPB Medical Student Eye Research Fellowship. This story starts with a RPB Medical Student Fellowship, but not the one cited in the study.

“I have been both the recipient of, and a mentor for, an RPB Medical Student Fellowship,” says the first author on the paper, **Stephen H. Tsang, MD, PhD**, Columbia University College of Physicians & Surgeons. Dr. Tsang is an internationally recognized physician and geneticist specializing in the treatment of retinal degenerations. His recent mentee is Huy Nguyen, the recipient of the

“The encouragement from RPB that I received at the beginning of my research career was a crucial endorsement that I was doing the right thing.”

RPB Medical Student Fellowship cited in the paper, who will be starting his residency in ophthalmology at Massachusetts Eye and Ear Infirmary (MEEI).

Ever since Dr. Tsang’s own experience as a mentee, he has sought to help PhD students and postdoctoral fellows develop their full potential to become outstanding scientists, keeping an open-door policy with students. “In both roles,” says Tsang, “it has been apparent that RPB seeks to have the highest impact, allowing scientists to pursue out-of-the-box thinking as it evolves. An RPB grant is not like a conventional grant, which typically can only be applied to work that is defined within a proposal.

“As an RPB Medical Student Fellow, you are required to work with a mentor. My mentor was a well-known molecular virologist and cancer biologist. But he didn’t have the flexibility to fund work outside of his grant project. If I wanted to test my own hypothesis in his

lab, I would have to find research money to fund my project. For this, there's no other mechanism than the RPB Medical Student Fellowship. Some of my work from that Fellowship ended up being published in *Science*. The rest of the results eventually ended up in a *Journal of Neuroscience* paper that I worked on as a resident."

He laughs: "In fact, even as a resident, RPB sustained me. There was an additional award mechanism that I received from RPB: the RPB/Association of University Professors of Ophthalmology (AUPO) Resident Award. It does not provide financial support, but early in your career it creates recognition for your work among colleagues because you are invited to make a presentation to chairs of departments of ophthalmology and directors of research.

"This kind of support is critical because, during residency, there's a tendency to constantly question whether or not you're making the right choice by going into research. This mentality is not surprising given that as a resident you can be praised by cataract patients as 'having the hands of god' after restoring their vision, while returning to the lab to face humbling, discouraging and sometimes even scathing comments from grant and journal reviewers. It is understandable that a high number of residents go into private practice as opposed to academic ophthalmology. The encouragement from RPB that I received at the beginning of my research career was a crucial endorsement that I was doing the right thing.

"Eventually, after I became both a clinician and a researcher, RPB supported me in that decision as well. In 2005 I received the RPB/Becker/AUPO Award, which was designed to strengthen the role of the physician-scientist in ophthalmology. That award was essential in generating preliminary data for my NIH funding.

"In my RPB projects and beyond, I have always sought to combine the expertise I have acquired as a researcher with clinical experience to advance the cutting edge of gene therapy and regenerative medicine. I believe that collaboration and knowledge sharing are vital components of today's research endeavors. With government support, grants from other sources and ongoing support from the RPB

"Theoretically, with new and rapidly emerging techniques, we can remove defective genes and replace them with healthy genes as needed...and these rebuilt photoreceptors will integrate with the patient's visual circuitry."

Unrestricted Grant at Columbia, I have been able to work with outstanding colleagues.

"For example, that 'eye disease in a dish' investigation would not have been possible without the involvement of Dr. Janet Sparrow [Columbia, who received a 2007 RPB Senior Scientific Investigator Award for related research] whose process to age the stem cell-derived retinal cells we had created was fundamental to our success. Other labs had created retinal cells in the same manner but, like ours, they were immature and did not display mechanisms or characteristics of disease. Dr. Sparrow's aging process mimics some of the factors that promote the development of AMD.

"Vision scientists have arrived at a remarkable point in our journey to eventually prevent vision loss. We can now analyze an adult's genetic profile and determine with high accuracy whether he or she is at risk for developing retinal diseases. And we have demonstrated that we can use the patient's skin cells to grow retinal cells that will not be rejected by the patient's body.

"But before we get to actual tissue replacement, the first uses of these patient-specific retina cells will be for testing and refining of treatments. Instead of testing new drug candidates on thousands of patients, we will relatively quickly be able to screen for drugs on a couple of thousand cell lines.

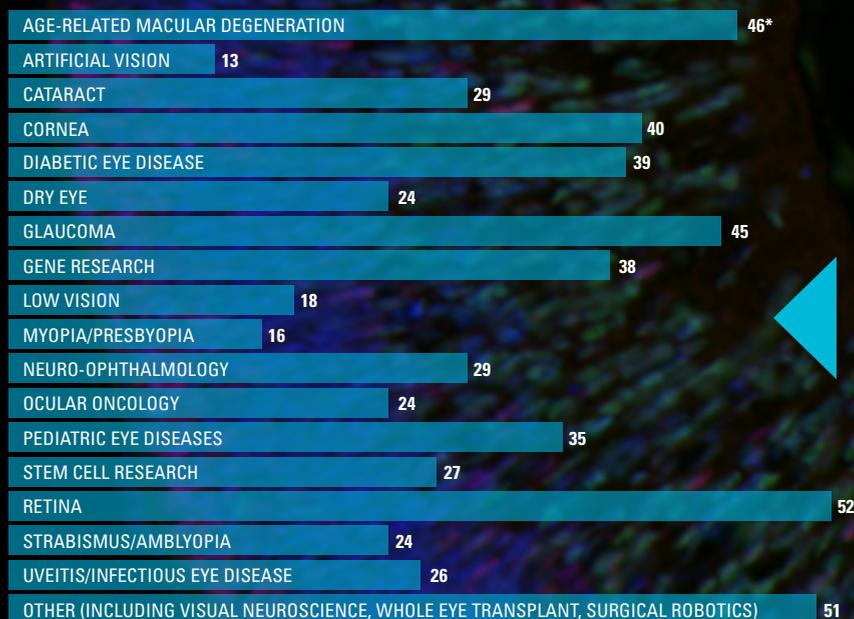
"In fact, with flexible funds from my recent RPB Physician Scientist Award, I am conducting a high-risk, high-payoff project in this area that would not be supported by conventional federal granting mechanisms. So you see, with RPB support, one is able to lay the groundwork for a creative career as a researcher."

RPB GRANTS PROGRAM

In 2014, RPB continued its strategic redeployment of resources through our grants program, awarding a total of \$10.7 million in new grants. We launched a new grant in honor of our founder, Jules Stein, MD. The RPB Stein Innovation Award replaces the RPB Jules and Doris Stein Professorship as well as the Innovative Ophthalmic Research Award while maintaining the goals of those awards of attracting leading scientists and new ideas into eye research.

We took advantage of an extraordinarily strong field of applications for the RPB Nelson Trust Award for Retinitis Pigmentosa to give out five grants instead of the intended one-per-year.

HOW RPB UNRESTRICTED GRANTS WERE APPLIED BY SCHOOLS IN 2014



In 2014, RPB provided \$5.5 million in unrestricted departmental support.

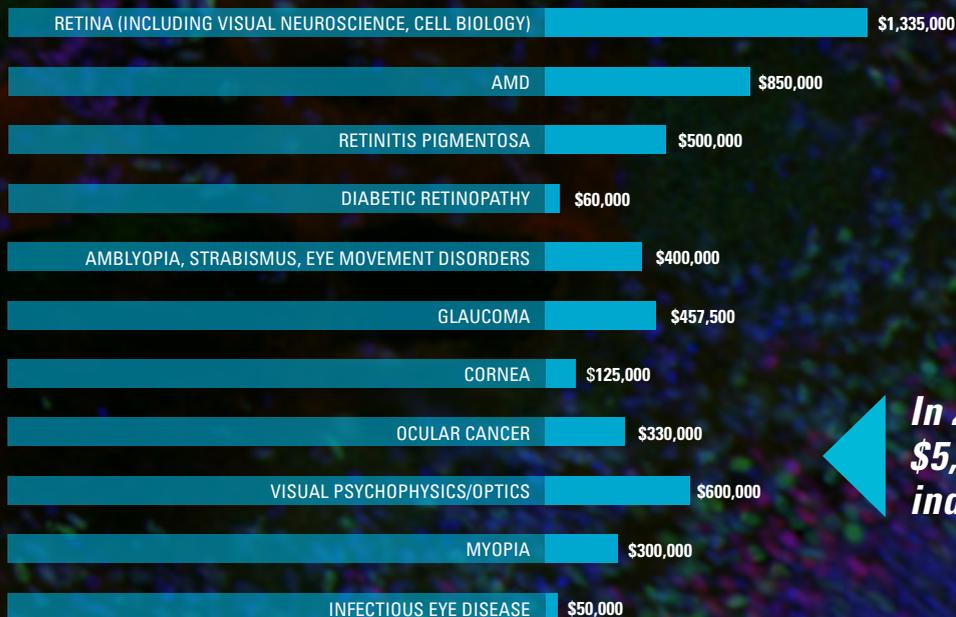
*Number of schools researching in this area out of total 53.

NEW GRANTS 2014

In response to a donor request, and in partnership with the International Retinal Research Foundation (IRRF), we created a new grant, The RPB/IRRF & RPB Sybil B. Harrington Catalyst Awards for Stem Cell Research Approaches for Age-Related Macular Degeneration. There is a collaborative component to this one-time-only award that will have the recipients working together to share information on areas of mutual interest and overlap.

Finally, we made special grants to the Alliance for Eye and Vision Research, the Association of University Professors of Ophthalmology, the Heed Ophthalmic Foundation and the Institute of Medicine to create and/or strengthen strategic alliances that move vision research forward in this country.

HOW RPB ALLOCATED GRANTS TO INDIVIDUALS IN 2014



In 2014, RPB awarded \$5,007,500 in grants to individual researchers.



David R. Williams, PhD

RPB Stein Innovation Awards

This new award was developed to uncover and encourage fresh, high-risk/high-gain vision science research which is innovative, cutting-edge, and demonstrates out-of-the-box thinking. It provides \$300,000 over three years to researchers whose goal is understanding the visual system and the diseases that compromise its function. The proposed research cannot be funded—previously or currently—by others. This first cycle of awards focused on researchers whose primary appointment was outside of Ophthalmology.

Boris C. Bastian, MD, PhD, University of California, San Francisco, School of Medicine, Department of Dermatology

To develop and validate a DNA-based assay that provides improved prognostic information, and to test drugs known to inhibit pathways that lead to growth and metastasis of uveal melanomas.

David H. Brainard, PhD, University of Pennsylvania School of Medicine, Department of Psychology

To combine adaptive optics scanning laser ophthalmoscopy (AOSLO) with high resolution functional testing of vision for use in future gene, cell, or small molecule-based therapies.

David R. Williams, PhD, University of Rochester School of Medicine & Dentistry, The Institute of Optics

To refine a new retinal camera for higher resolution imaging of capillary remodeling and retinal blood flow in order to track microvascular structure changes as early manifestations of diabetic eye disease.

Robert W. Williams, PhD, University of Tennessee Health Science Center, Department of Genetics, Genomics and Informatics

To use microfluidics and single-cell RNA-sequencing methods to determine the first molecular steps in the cascade of events that causes subsets of ganglion cells to die; data will be used to design neuroprotective interventions to insulate cells from glaucomatous stressors.



Felice Audris Dunn, PhD

RPB Career Development Awards

This award provides \$300,000 over four years to attract promising young MDs, PhDs, and MD/PhDs to eye research and to support their early investigations, which helps qualify them for larger NEI/NIH grants. Their primary appointments must be in ophthalmology, and they must show potential for independent research.

Felice Audris Dunn, PhD, University of California, San Francisco, School of Medicine
To examine the sequence and mechanisms of reaction to photoreceptor damage in eye diseases with the ultimate goal of reprogramming retinal connectivity after photoreceptor injury.

Quan V. Hoang, MD, PhD, Columbia University College of Physicians & Surgeons
To use collagen cross-linking agents to restrict scleral growth in patients with myopia (near-sightedness), one of the most prevalent eye diseases in the world.

Rajesh C. Rao, MD, The Regents of the University of Michigan School of Medicine
To generate clinically relevant cell types from retinal stem cells for disease modeling and therapy.

Sujata Rao, PhD, Cleveland Clinic Lerner College of Medicine
To examine the role of environmental light in processes necessary for development of the eye.

Gregory W. Schwartz, PhD, Northwestern University Feinberg School of Medicine
To measure connectivity and function of neural circuits to increase our understanding of how information is processed in the retina.



Sandeep Jain, MD

RPB Physician-Scientist Awards

The purpose of these \$100,000 awards is to help strengthen and promote clinical and/or basic research conducted by MDs or MD/PhDs who are nationally recognized in a subspecialty and actively engaged in clinical research.

Rajendra S. Apte, MD, PhD, Washington University in Saint Louis School of Medicine
The role of macrophages in cholesterol metabolism in the retina with relevance to both early and advanced age-related macular degeneration (AMD).

John H. Fingert, MD, PhD, University of Iowa Carver College of Medicine
The role of a novel normal-tension glaucoma gene discovered by the applicant with potential to lead to the development of a neuro-protective therapy for glaucoma.

Jonathan C. Horton, MD, PhD, University of California, San Francisco, School of Medicine
To examine how humans with strabismus decide which eye to use to look at targets; a possible new basis for developing prevention and treatment strategies.

Sandeep Jain, MD, University of Illinois at Chicago College of Medicine
To test the therapeutic potential of removing immune cell secretions from the ocular surface of dry eye patients in a clinical trial.

Alon Kahana, MD, PhD, The Regents of the University of Michigan School of Medicine
To explain neurological mechanisms that underlie strabismus and determine success or failure of surgery.



Paul D. R. Gamlin, PhD

RPB Walt & Lilly Disney Awards for Amblyopia Research

The award is available to MD or PhD scientists conducting research of unusual significance into the diagnosis and treatment of amblyopia, which develops in up to 4% of children, causing decreased vision without detectable anatomic damage. RPB received a funding commitment for 2014 from Walt Disney's daughter, Diane Disney Miller, who initiated the award in 2002 and recently passed away. RPB is honoring Ms. Disney Miller by matching her contribution and supporting two investigators at \$100,000 each.

Paul D. R. Gamlin, PhD, University of Alabama at Birmingham School of Medicine
To investigate the role of the brain's cerebellum in maintaining eye alignment.

Stacy L. Pineles, MD, MS, David Geffen School of Medicine at the University of California, Los Angeles
To evaluate the effectiveness of an interactive program, originally designed to improve vision by optimizing visual processing, as an amblyopia therapy.

RPB International Research Scholar Award

This grant, covering transportation costs only, encourages established foreign scientists to engage in collaborative research activities in American eye research labs.

M. Francesca Cordeiro, PhD, from University College London, UK, collaborating with Sanjoy Bhattacharya, PhD, University of Miami Miller School of Medicine
To identify and quantify lipids in the trabecular meshwork and the optic nerve.



RPB Nelson Trust Awards for Retinitis Pigmentosa

This \$100,000 award is designed to stimulate, strengthen and promote exceptional research to improve the diagnosis and treatment of retinitis pigmentosa (RP).

Vadim Arshavsky, PhD, Duke University School of Medicine

To develop a possible treatment for multiple forms of RP arising from a newly discovered, common RP risk factor.

Wolfgang Baehr, PhD, University of Utah Health Sciences Center

To apply cutting edge genetic tools to address broad mechanisms shared by many forms of RP.

David M. Gamm, MD, PhD, University of Wisconsin-Madison School of Medicine and Public Health

To develop a rod-replacement-therapy for RP using skin-derived, human induced pluripotent stem cells.

Eric A. Pierce, MD, PhD, Harvard Medical School/MEEI

To help define the genetic causes of RP and provide a path to developing gene therapy.

Donald J. Zack, MD, PhD, The Johns Hopkins University School of Medicine

To identify candidate drugs for the treatment of RP.

RPB Research Sabbatical Award

The award provides up to \$50,000 in matching funds and allows mid-career scientists to participate in programs which either enhance their professional expertise or allow them to pursue a new ophthalmic career path.

Michael S. Gilmore, PhD, Harvard Medical School/MEEI

Collaborating with Philip Stewart, PhD, Montana State University and Colin Hughes, PhD, Cambridge University to improve understanding of antibiotic-resistant bacteria.



Devang L. Bhoiwala

RPB Medical Student Eye Research Fellowships

This \$30,000 grant allows outstanding medical students to take a year off from medical school and devote time to a research project in an RPB grantee department while working closely with a mentor. The fellowship is designed to stimulate students to consider careers in eye research.

Devang L. Bhoiwala, conducting research at the University of Pennsylvania School of Medicine
Mentor: Joshua L. Dunaief, MD, PhD

Clara Jiayun Men, conducting research at Harvard Medical School/MEEI
Mentor: Eric A. Pierce, MD, PhD

Angelica Gabriela Ortiz, conducting research at the University of Miami Miller School of Medicine
Mentor: J. William Harbour, MD

RPB Special Scholar Awards

These \$25,000 to \$75,000 awards are named in tribute to individuals who established funds at RPB and are meant to encourage promising young, independent researchers who are Assistant Professors with primary appointments in ophthalmology.

Seongjin Seo, PhD, University of Iowa Carver College of Medicine, recipient of the \$75,000 RPB Ernest & Elizabeth Althouse Scholar Award
To better understand the origin and development of cilia diseases affecting photoreceptor cells.

Lucia Sobrin, MD, MPH, Harvard Medical School/MEEI, recipient of the \$60,000 RPB William & Mary Greve Scholar Award
To identify genetic risk factors associated with diabetic retinopathy progression in African-Americans.

Kate E. Keller, PhD, Oregon Health & Science University School of Medicine, recipient of the \$55,000 RPB Sybil B. Harrington Scholar Award
To identify extracellular matrix components and cell adhesion characteristics that contribute to the regulation of intraocular pressure, leading to possible novel glaucoma therapies.

Carlo Iomini, PhD, Icahn School of Medicine at Mount Sinai, recipient of the \$25,000 RPB Dolly Green Scholar Award
To better understand corneal repair mechanisms and anterior segment diseases.



Special Grants for Partnerships and Collaboration

In 2014, RPB strengthened its support of strategic alliances through selected special grants. RPB's synergistic affiliations with these organizations are designed to help advance the entire field of U.S. vision research.

Alliance for Eye and Vision Research (AEVR) Grant

AEVR's mission is to ensure the best eye and vision care for all Americans through education of congressional legislators, government policymakers, coalition partners, the media and consumers about the value of eye and vision research. This \$50,000 grant is intended to support AEVR's programs including Congressional briefings, educational brochures and national attitudinal surveys.

Association of University Professors of Ophthalmology (AUPO) Grant

This \$125,000 grant is a continuation of ongoing support for AUPO's research and training programs, which RPB has supported since 1967. AUPO is a key ally in RPB's commitment to enrich the development of the Chairs, Directors of Research, and other leaders from departments of ophthalmology.

Heed Ophthalmic Foundation Grant

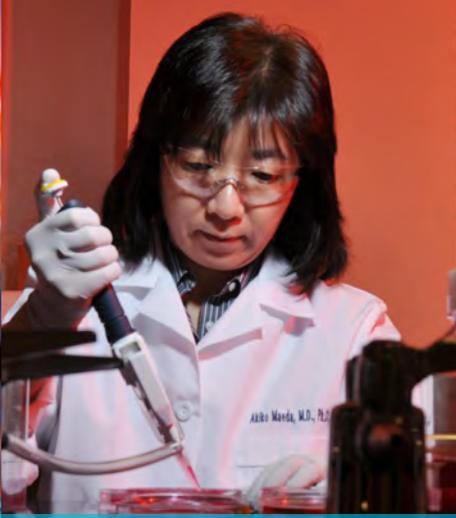
This \$30,000 grant over two years is specifically for support of the Heed Ophthalmic Foundation Residents Retreat, whose purpose is to encourage and facilitate talented residents to pursue a career in academic ophthalmology.

Institute of Medicine Grant

The nonprofit Institute of Medicine (IOM), part of the National Academy of Sciences, is conducting a study to examine the public health needs for improving U.S. vision and eye health. These issues become ever more critical as the baby boomers age and the number of people with vision problems and eye diseases increases dramatically. The proposed IOM study is likely to receive wide attention and have significant impact, and aligns with RPB's overall mission to preserve and restore vision through research. Through this \$50,000 grant in partial support of the \$1.1 million study, RPB continues its leadership role in the vision field and further extends its collaborative funding partnerships.



David M. Gamm, MD, PhD



Akiko Maeda, MD, PhD



Budd A. Tucker, PhD

RPB/International Retinal Research Foundation

RPB Sybil B. Harrington

Catalyst Awards for Stem Cell Research Approaches for Age-Related Macular Degeneration

The Catalyst Awards were made possible by a donation from an anonymous donor, which was matched by the International Retinal Research Foundation (IRRF) and by a bequest from the Sybil B. Harrington estate, making possible three grants at \$250,000 each over four years. The Awards are designed to advance knowledge about AMD through novel stem cell research, providing seed funding for high-risk/high-gain, innovative, cutting-edge research which demonstrates out-of-the-box thinking. *Fall 2014 only.*

David M. Gamm, MD, PhD, RPB/IRRF Catalyst Awardee, University of Wisconsin-Madison School of Medicine and Public Health

To optimize transplanted retinal pigmented epithelium (RPE) cell survival, which is critical to the success of RPE transplantation as a therapy for retinal degenerative diseases. Visual loss in AMD is largely due to damage to the RPE, the tissue that nourishes and supports the light-sensing photoreceptors.

Akiko Maeda, MD, PhD, RPB Sybil B. Harrington Catalyst Awardee, Case Western Reserve University School of Medicine

To create induced pluripotent stem cell (iPSC)-derived retinal 3D-optic cups from AMD patients, then to test their validity as platforms for individualized drug screening for AMD patients. If successful, these models will greatly accelerate drug screening and development for the treatment of AMD.

Budd A. Tucker, PhD, RPB/IRRF Catalyst Awardee, University of Iowa Carver College of Medicine

To produce outer retinal cell grafts (grown from fibroblasts taken from a patient's own skin) on biodegradable scaffolds and deliver the cell scaffolds into an eye. These studies will ultimately define the choice of cell and delivery techniques used for the treatment of AMD patients.

2014 RPB APPROVED GRANTS TOTAL: \$10,697,500*

U.S. medical schools receiving new 2014 departmental and/or individual investigator awards

STATE	RPB GRANTEE INSTITUTIONS	TOTAL GRANTS 2014	TOTAL SUPPORT INCLUDING 2014
ALABAMA	University of Alabama at Birmingham School of Medicine	\$ 215,000	\$ 4,070,000
ARIZONA	University of Arizona College of Medicine	115,000	2,380,000
CALIFORNIA	David Geffen School of Medicine at UCLA	215,000	8,875,750
	University of California, San Diego, School of Medicine	115,000	3,400,000
	University of California, San Francisco, School of Medicine	815,000**#	7,884,256
CONNECTICUT	Yale University School of Medicine	115,000	3,402,224
FLORIDA	University of Florida College of Medicine	115,000	4,420,600
	University of Miami Miller School of Medicine	147,500	4,747,700
GEORGIA	Emory University School of Medicine	115,000	3,822,100
ILLINOIS	Northwestern University Feinberg School of Medicine	415,000**	3,195,000
	University of Illinois at Chicago College of Medicine	215,000	4,241,712
INDIANA	Indiana University School of Medicine	115,000	2,654,000
IOWA	University of Iowa Carver College of Medicine	540,000	4,892,425
KENTUCKY	University of Louisville School of Medicine	115,000	3,959,800
LOUISIANA	Louisiana State University Health Sciences Center in New Orleans	115,000	2,717,100
MARYLAND	The Johns Hopkins University School of Medicine	215,000	9,100,140
MASSACHUSETTS	Harvard Medical School	355,000	9,110,315
	Tufts University School of Medicine	115,000	3,528,697
MICHIGAN	The Regents of the University of Michigan School of Medicine	515,000**	7,468,050
	Wayne State University School of Medicine	115,000	4,028,000
MINNESOTA	Mayo Medical School	115,000	3,169,600
	University of Minnesota, Academic Health Center, Medical School	115,000	3,363,701
MISSOURI	Washington University in Saint Louis School of Medicine	215,000	7,209,981
NEBRASKA	Stanley M. Truhlsen Eye Institute, University of Nebraska Medical Center	115,000	2,125,000
NEW YORK	Albert Einstein College of Medicine of Yeshiva University	115,000	2,092,500
	Columbia University College of Physicians & Surgeons	415,000**	6,033,167
	Weill Cornell Medical College	115,000	5,008,700
	Icahn School of Medicine at Mount Sinai	140,000	4,208,200
	University of Rochester School of Medicine & Dentistry	415,000#	3,170,250
	SUNY at Buffalo School of Medicine & Biomedical Sciences	115,000	1,015,000
NORTH CAROLINA	Duke University School of Medicine	215,000	7,285,150
	University of North Carolina at Chapel Hill School of Medicine	115,000	1,745,500
OHIO	Case Western Reserve University School of Medicine	365,000	3,877,500
	Cleveland Clinic Lerner College of Medicine	415,000**	3,150,000
	University of Cincinnati College of Medicine	115,000	1,825,250
OKLAHOMA	University of Oklahoma Health Sciences Center	115,000	5,126,600
OREGON	Oregon Health & Science University School of Medicine	170,000	5,012,150
PENNSYLVANIA	University of Pennsylvania School of Medicine	445,000#	6,083,500
	University of Pittsburgh School of Medicine	115,000	4,513,372
SOUTH CAROLINA	Medical University of South Carolina	115,000	2,512,500
TENNESSEE	University of Tennessee Health Science Center	415,000#	3,070,000
	Vanderbilt University School of Medicine	115,000	2,860,500
TEXAS	Baylor College of Medicine	115,000	4,469,060
	University of Texas Southwestern Medical Center at Dallas	115,000	4,231,000
UTAH	University of Utah Health Sciences Center	215,000	5,550,300
WASHINGTON	University of Washington School of Medicine	115,000	3,672,638
WISCONSIN	University of Wisconsin-Madison School of Medicine	465,000	5,093,750

*Includes commitments for special grants to: The Association of University Professors in Ophthalmology, the Heed Ophthalmic Foundation, the Alliance for Eye and Vision Research and the Institute of Medicine.

**Includes a four-year \$300,000 Research to Prevent Blindness Career Development Award, payable at the rate of \$75,000 per year.

Includes a \$300,000 Research to Prevent Blindness Stein Innovation Award, payable in two equal installments of \$150,000.

Schools that received RPB support but no new grants in 2014: State University of New York Downstate Medical Center, University of Texas Health Science Center at Houston, University of Missouri-Kansas City School of Medicine, New York University School of Medicine.

The RPB grant approval process is highly competitive. A standing Scientific Advisory Panel (SAP) and rotating Ad Hoc Committees convene each spring and fall to review all grant applications. Ad Hoc Committees are comprised of selected ophthalmology department chairs whose recommendations are forwarded to the SAP for further evaluation. The SAP includes distinguished scientists representing a broad range of scientific disciplines and interests. Their recommendations are presented to the RPB Board of Trustees for final approval.

2014 RPB SCIENTIFIC ADVISORY PANEL

Robert Eugene Anderson, MD, PhD

*Professor, Departments of Cell Biology & Ophthalmology
Dean McGee Professor of Ophthalmology
George Lynn Cross Research Professor
University of Oklahoma Health Sciences Center
Director of Research, Dean McGee Eye Institute*

Jeffrey L. Goldberg, MD, PhD

*Professor, Department of Ophthalmology
Director of Research, Shiley Eye Institute
University of California, San Diego, School of Medicine*

Roderick R. McInnes, CM, MD, PhD, FRSC

*Director, Lady Davis Research Institute
Jewish General Hospital
Canada Research Chair in Neurogenetics
Alva Chair in Human Genetics
Professor of Human Genetics
Professor of Biochemistry
McGill University*

Anthony Moore, MA, FRCS, FRCOphth, FMedSci

*Professor, Department of Ophthalmology
University of California, San Francisco
School of Medicine*

Krzysztof Palczewski, PhD

*Professor & Chair, Department of Pharmacology
Case Western Reserve University*

John S. Penn, PhD

*Phyllis G. and William B. Snyder Professor
and Vice Chairman
Department of Ophthalmology and Visual Sciences
Associate Dean for Faculty Affairs
Vanderbilt University School of Medicine*

Sheila West, PhD

*Professor, Vice Chair for Research
Wilmer Eye Institute
The Johns Hopkins School of Medicine
Department of Epidemiology, The Johns Hopkins
Bloomberg School of Public Health*

Janey L. Wiggs, MD, PhD

*Paul Austin Chandler Associate Professor, Department
of Ophthalmology
Vice Chair for Clinical Research, Ophthalmology
Co-Director, Glaucoma Center of Excellence
Associate Director, Ocular Genomics Institute
Associate Director, Howe Laboratory, MEEI
Harvard Medical School*

RPB AD HOC COMMITTEES

Jay S. Duker, MD

Tufts University School of Medicine

Steven E. Feldon, MD, MBA

*University of Rochester Medical Center School of
Medicine and Dentistry*

Frederick W. Fraunfelder, MD, MBA

University of Missouri-Columbia School of Medicine

Ronald L. Gross, MD

West Virginia University School of Medicine

Mark S. Juzych, MD, MHSA

Wayne State University School of Medicine

Todd P. Margolis, MD, PhD

Washington University School of Medicine

Timothy W. Olsen, MD

Emory University School of Medicine

Randall J. Olson, MD

University of Utah School of Medicine

Sanjay V. Patel, MD

Mayo Clinic College of Medicine

Nelson R. Sabates, MD

University of Missouri-Kansas City School of Medicine

Joel S. Schuman, MD, FACS

University of Pittsburgh School of Medicine

James C. Tsai, MD, MBA

Icahn School of Medicine at Mount Sinai

Erik van Kuijk, MD, PhD

University of Minnesota Medical School

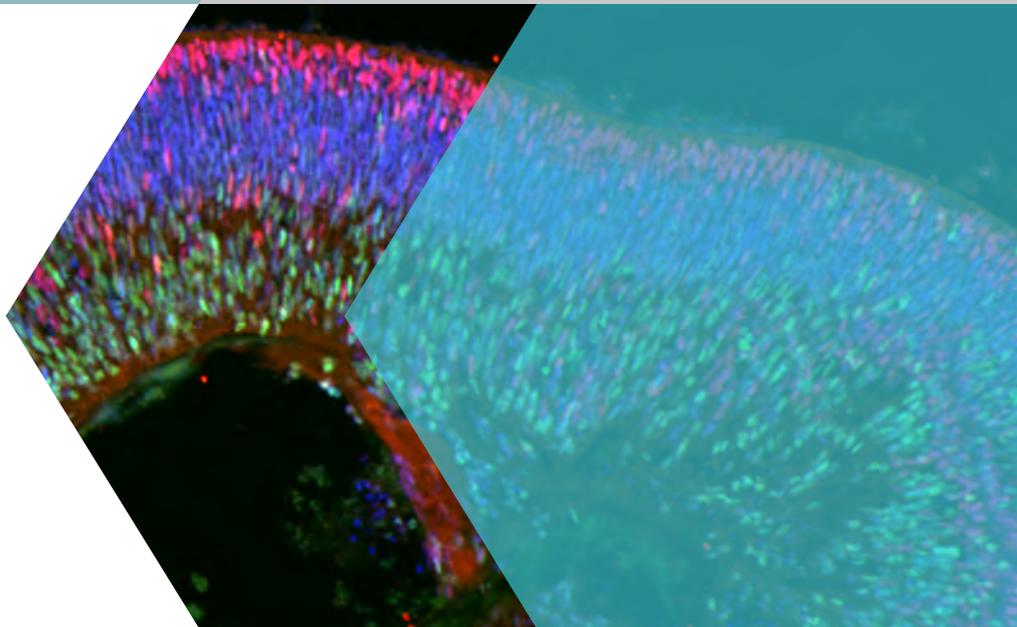
Rohit Varma, MD, MPH

*Keck School of Medicine at University of Southern
California*

SCIENTIFIC ADVISOR TO THE RPB BOARD OF TRUSTEES & STAFF

John E. Dowling, PhD

*Gordon and Llura Gund Professor of Neurosciences
Department of Molecular and Cellular Biology
Harvard University*



Research to Prevent Blindness

RPB's mission is to preserve and restore vision by supporting research to develop treatments, preventives and cures for all conditions that damage and destroy sight.