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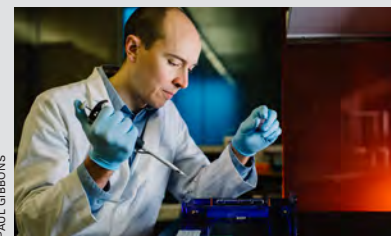
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On the cover:



RPB-supported research at the Emory University Department of Ophthalmology was the first to show that the Ebola virus, pictured here, can live in the eye for months after a patient is deemed Ebola-free.



Dr. Ethan Buhr uses RPB's Unrestricted Grant to the University of Washington School of Medicine to investigate the role of light on retinal physiology which supports the visual system.

MAKING A DIFFERENCE IN OPHTHALMOLOGY

On behalf of RPB, Chairman Diane S. Swift accepted the 2015 American Academy of Ophthalmology (AAO) Distinguished Service Award for ongoing notable service. She was joined by AAO President Russell N. Van Gelder, MD, PhD, left in photo, and AAO Chief Executive Officer David W. Parke II, MD.



LETTER FROM THE CHAIRMAN

Research to Prevent Blindness (RPB) has always had a bench-to-bedside mission. Our aim is to drive the U.S. vision research enterprise toward the delivery of cures and treatments for blinding disorders. It's a point worth emphasizing: While we operate in the realm of academic science, RPB's aim ultimately is to help patients. Thus, in the broadest sense, all of our activities are translational.

RPB's translational mission provides a framework for all of our efforts as we continue to refine and expand our Grants Program, leverage our resources through funding partnerships and join with other organizations in advocating for increased federal support of vision research.

In medical science, basic research takes place in the lab and generates the fundamental knowledge from which translational researchers develop treatment approaches for medical conditions. Clinical researchers examine the safety and effectiveness of those treatments, devices and diagnostic products intended for human use. RPB funds all three types of research, but there is a growing emphasis on the translational work in order to uncover treatment options as the world's population is at ever greater risk of vision loss due to aging or epidemic.

Translation is the theme of this Annual Report, and perhaps no scenario better illustrates RPB's nimble ability to impact translational eye research through its funding than the case of Dr. Ian Crozier, one of the earliest medical responders in the Ebola outbreak in West Africa, and an Ebola survivor. You probably encountered his story in the news when Crozier, an infectious disease specialist at Emory University, was airlifted to Emory in Atlanta, where

he was successfully treated. But there's more to that story, with broad public health implications and an important RPB connection.

Months later, after he was deemed disease-free, Dr. Crozier's left iris changed color, the eye pressure dropped to almost zero, and he developed acute, sight-threatening inflammation. The Ebola virus was found living in his eye. This posed a threat not only to Dr. Crozier and his ophthalmologists, but to the 17,000 African Ebola survivors and the health workers treating them.

The urgency of the situation demanded an immediate solution as well as immediate financial support which, in this era of tightly restricted budgets, can be very hard to come by. Using flexible funds from RPB's Unrestricted Grant to Emory's Department of Ophthalmology, Steven Yeh, MD, treated Dr. Crozier with corticosteroids and an experimental antiviral. Crozier's eye and sight gradually recovered, and Dr. Yeh developed a treatment protocol that is being rolled out in Africa, saving the sight of thousands of Ebola survivors and preventing an Ebola resurgence from a previously unrecognized cause.

Not every discovery is this dramatic, but the translational research findings described in this Annual Report have the same kind of potential to help thousands, if not millions, of people.



Diane S. Swift
Chairman



REPORT FROM THE PRESIDENT

It is no coincidence that, in 2015, and for the first time in the history of Research to Prevent Blindness, the number of translational studies reported by our grantees was greater than the number of basic science studies. It's a goal that has been implicit in RPB's mission to support research *"to develop treatments, preventives and cures for all conditions that damage and destroy sight"* ever since the organization was established.

The increasing emphasis from our researchers on studies that point toward treatments goes hand-in-hand with RPB's efforts to cultivate collaborations and partnerships to support the needs of those researchers. As you will see, 2015 was another robust year for Research to Prevent Blindness.

Second Convening of Vision Research Funders

In March, in Washington, DC, RPB hosted decision-makers from 17 organizations committed to vision research for a second, day-long meeting to advance discussions on possible collective action. The idea for these Convenings emerged from the ever-increasing challenges confronting researchers in obtaining funding from federal sources and the need to construct efficient, new models of vision research support. The enthusiasm of the participants to find ways to work together has been energizing for all of us.

Low Vision Research Initiative

At the Convening we rekindled a connection with Lions Clubs International, our partner in helping to create the National Eye Institute (NEI) in 1968. In follow-up meetings with their foundation (LCIF), we determined that our organizations'

interests overlapped in the area of Low Vision. The condition—which is defined as chronic vision impairment not correctable by eyeglasses, medicines or surgery—not only causes difficulty with everyday living but is associated with lifelong compromises such as reduced educational achievement and employment opportunities, loss of independence, long-term-care placement, depression and increased mortality risk.

Conservative estimates indicate that more than 3 million people in the U.S. suffer Low Vision, a number projected to reach more than 9 million by 2050. Yet there is a lack of research directed at developing treatments and accommodating/assistive technologies.

So, we proposed a co-funded, significant research grant that would have scientists uncover and hopefully harness the ways the brain responds to degraded visual input—and found a partner in LCIF. We then teamed with the Readers' Digest



NEI Director **Dr. Paul Sieving** made a compelling argument at the Convening for uninterrupted support for established vision scientists who have invested decades in pursuit of a specific goal. RPB Unrestricted Grants are uniquely available to qualifying departments of ophthalmology for gap funding for these researchers.

Partners for Sight Foundation (another Convening participant) to create an Innovations in Technology Low Vision Research Award to support early-stage research aimed at developing new assistive technology for people with low vision, particularly using computers and tablets.

With both awards, RPB's infrastructure allows us to handle all administration, communication and monitoring costs. Every dollar awarded by our partners goes directly to research and is matched by RPB. We are confident that the Low Vision Research Award grantees will be as productive as the recipients of last year's partnership award—the RPB/International Retina Research Foundation Catalyst Award for Stem Cell Approaches for Age-Related Macular Degeneration (see page 8).

Testing the Waters: International Collaborations

At the 2015 Association for Research in Vision and Ophthalmology conference, a poster caught our attention: "Global Impact of National Eye Institute (NEI) Funding: Research Directions and Potential Collaborations." The study measured the number of times NEI funding was acknowledged in publications by international collaborators (1,560), and also made note of the fact that RPB was the second most frequently cited funder (875), private or public, with more than four times as many citations as the next largest, a European funder, the nation of Germany.

This was a large and surprising statistic, since RPB grants only are available to U.S. institutions. In conversations with RPB-supported department chairs, it came to light that our Unrestricted Grants are frequently used to foster international collaborations.

Given our own emphasis on collaboration, this made eminent sense to us, and we decided to experiment with a new grant that would formalize support for this trend. The RPB/Stavros Niarchos Foundation International Research Collaborators Award, a multi-year funding partnership with one of the world's leading private international philanthropic organizations, will build and strengthen international collaborations through which researchers in the U.S. and outside the U.S. gain new knowledge and skills in exchanges to advance excellent vision science.

Creating a Voice for Emerging Vision Scientists

Back in DC, RPB continued to selectively strengthen its advocacy efforts by funding the first-ever Emerging Vision Scientists Day on Capitol Hill, which was coordinated by the National Alliance for Eye and Vision Research. Twenty-one young eye investigators from across the United States—all of whom had yet to



Left to right: **Jack Whalen III**, PhD, USC Eye Institute/Keck School of Medicine, University of Southern California, with NEI Deputy Director **Belinda Seto**, PhD, and RPB President **Brian Hofland**, PhD, in front of Dr. Whalen's poster featuring research on novel biomaterials for ophthalmic applications.

receive their first major federal research grant—received advocacy training and then presented their cutting-edge studies both at a well-attended Congressional reception and then in meetings with their U.S. Senators and Congresspersons and their staffs. The young researchers embodied their message: If the NEI budget is cut or held level, theirs are the careers, theirs is the hopeful research that will not flourish.

Days later Congress approved NEI funding at an operating budget of \$708 million, a 4.6 percent increase over its FY2015 operating budget, and the first time in four years that the NEI budget has exceeded the FY2012's \$702 million. To the extent that the advocacy of the young researchers played a role in this important outcome, we are proud.

New Web Site and New Digs

Last but not least, RPB launched our new web site (www.rpbusa.org) that elegantly reflects the intensity of activity in this report and provides a rich user experience for information about our grants, our grantees and their productivity. It gives us the capacity to create private web sites to facilitate the launch of new awards and serves as a hub for our partnerships. Visit our web site and visit us at our new office at 360 Lexington Avenue, New York City, where we now have easy-to-reach, contemporary space to host larger grant review panels and state-of-the-art communications technology at significantly lower overhead, all of which will enhance our grant making, collaborations and efforts to serve as a catalyst for vision research.

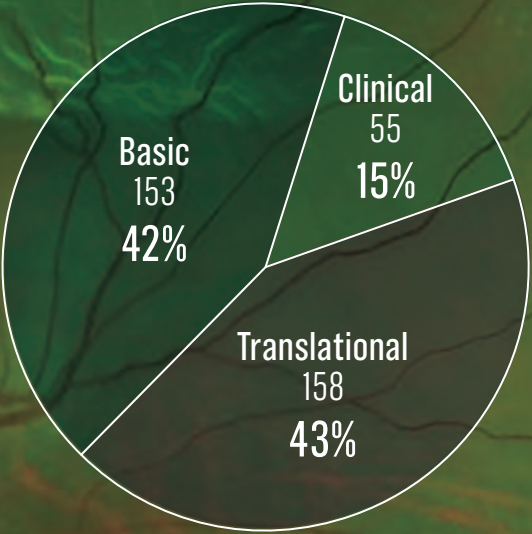
Brian F. Hofland, PhD
President

ADVANCES IN EYE RESEARCH 2015

In RPB’s early years, our grant support largely targeted basic research in order to establish a deeper and broader knowledge base about the causes and mechanisms of eye diseases. And RPB’s support for that work will continue because there is still so much to know about the visual system.

But, armed with what they do know, the probing minds of our scientists, coupled with advances in technology, are creating new opportunities to develop potential treatments for eye disorders that plague millions. The following RPB research highlights from 2015 are translational in nature, and share an exciting sense of hopefulness.

Investigations Reported by Active RPB Researchers in 2015*



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, and also may describe his/her research as basic, clinical, translational or any combination of the three.

Retinal detachment, shown here as a bright green, billowing shape, can lead to progressive vision loss due to photoreceptor cell death.

Retinal Detachment

As we age, the vitreous gel that fills the eye deteriorates, sometimes creating floaters and sometimes pulling the retina away from the one-cell-thick retinal pigment epithelium (RPE), causing what is called a retinal detachment. This separates the retina from its critical metabolic support provided by the blood vessel-rich tissue called the choriocapillaris. The photoreceptors of the retina can also become detached from the RPE due to trauma, retinal diseases like diabetic retinopathy or age-related macular degeneration (AMD). Extremely near-sighted people are at higher risk for retinal detachment because the shape of their eyeball is elongated.

Once the retina becomes detached, a cascade of events kicks in that leads to cell death and vision loss. Surgeries are available to reattach the retina, but vision loss progresses until the surgery can be performed.

Separate RPB-supported labs are developing approaches to minimizing the damage from retinal detachment before it goes too far.

Magali Saint-Geniez, PhD, Harvard Medical School, has shown that loss of oxygen and reduced glucose availability can affect photoreceptor metabolism and survival, and has identified novel genes potentially able to rescue photoreceptors’ metabolic stress.

In another lab at Harvard, Kip M. Connor, PhD, has shown that a component of the body’s immune system called the alternative complement pathway significantly contributes to photoreceptor cell death and that inhibiting the pathway is protective, preventing the initial photoreceptor cell loss and providing an extended therapeutic window for surgery. “Working closely with our colleagues in the clinic, our findings identify a new role of the innate immune system in retinal detachment by which the body selectively targets injured detached photoreceptors for removal,” says Connor. “What makes this research so exciting is the potential impact it can have on our patients.”

Cataract



Could cataract treatment without surgery become a reality? Several RPB-supported laboratories are collaborating to develop eye drops from compounds they have identified that can dissolve the clumped proteins in the lens that cause opacity. In fact, researchers have already partially reversed cataracts in dogs using a combination of eye drops and injections of lanosterol, an organic molecule found in the human body. The development could have far-reaching impact. By age 80,

more than half of all Americans either have a cataract or have had surgery to remove one, according to the National Eye Institute. Globally, cataracts are the leading cause of blindness, and the world’s aging population has been predicted to double the need for cataract surgeries over the next 20 years. People aside, most older dogs develop cataracts and the drops also could save the sight of nearly 70 million pet dogs in the U.S. alone!

Glaucoma

Some glaucoma patients have a hard time remembering to take their eye drops to lower intraocular pressure, or have difficulty getting the drops into their eyes. Even when taken properly, the drops only deliver five percent of their medicine load. In order to take the burden off of glaucoma patients, and to deliver the drugs more effectively, neuroscientists and chemists at Vanderbilt University School of Medicine are testing nanoparticle sponges, loaded with pressure-lowering drugs used in eye drop formulations,

as delivery vehicles for sustained release therapies. The nanoparticles are injected into the eye in a manner similar to the injections given to patients with wet AMD. According to the researchers, these nanosponge materials proved successful in reducing ocular pressure and maintaining it over several weeks. Ultimately, the nanosponges may be used to deliver drugs that protect retinal ganglion cells, which transmit visual information from the retina to the rest of the brain.

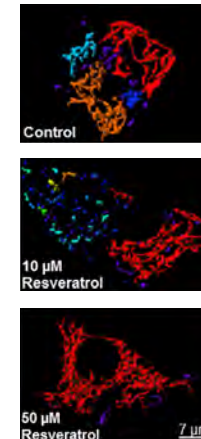
Age-Related Macular Degeneration

Near the end of 2014, the RPB/IRRF Catalyst Award for Stem Cell Research Approaches for Age-Related Macular Degeneration (AMD) went to three leading stem cell scientists in an effort to hasten stem-cell-based treatments for AMD. In 2015, all three reported significant progress.

Budd A. Tucker, PhD, University of Iowa Carver College of Medicine, has been pursuing a cell replacement strategy for the treatment of retinal degenerative diseases such as dry AMD, for which there is no currently available restorative therapy. His lab developed a clinical grade technique for growing and generating patient-derived stem cells which they have been able to differentiate into three types of cells that make up and support the outer neural retina: photoreceptor cells, retinal pigment epithelial cells (RPE) and choroidal endothelial cells. The Tucker lab uses tissue engineering-based approaches, including high resolution 3-D printing, to generate transplantable scaffolds for the cells.

According to Dr. Tucker: “These constructs are now being used to develop tissue-specific grafts for *in vitro* and subsequent *in vivo* testing.” To help scientists at other institutions develop similar programs, the team at Iowa updates its standard operating procedures, as they become available, free for access on the Tucker lab website, tuckerlaboratory.org.

David M. Gamm, MD, PhD, and collaborator Aparna Lakkaraju, PhD, University of Wisconsin-Madison School of Medicine & Public Health, are working on another piece of the retinal cell transplantation puzzle: trying to enhance the health of retinal pigment epithelium cells that have been derived from human induced pluripotent stem cells (hiPSC) in order to maximize their survival and function before and after they have been transplanted. Their hypothesis is that improving mitochondrial function will enhance metabolic capacity in these hiPSC-derived cells, which in turn will increase their chances of survival. Mitochondria are the energy-producing organelles in cells. So far, Drs. Divya Sinha and Kimberly Toops from the Gamm and Lakkaraju labs have determined that a common plant compound, resveratrol, may provide a means to strengthen mitochondrial vitality. According to this team: “The first task for donor cells after implantation into the retina is simply to survive. We believe that optimization of mitochondrial health is fundamentally important, but we also need to be sure that our strategies are compatible with human use.”



Compared to “control” untreated cells, stem cell-derived RPE cells treated with resveratrol had more highly interconnected mitochondria, which is a good indicator of their overall integrity.

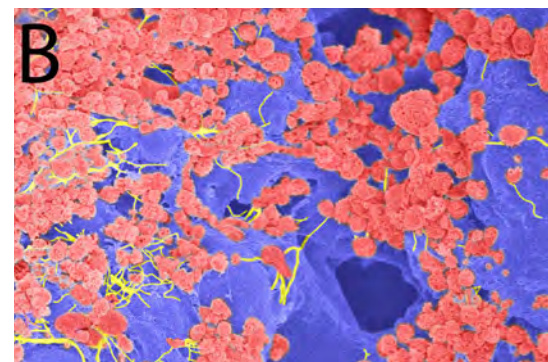
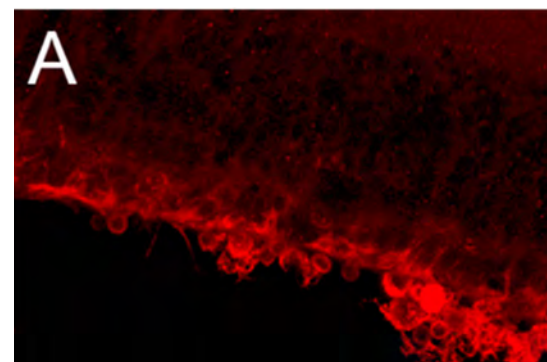
In addition to cell replacement therapies, hiPSCs can also be used as a tool to advance the development of pharmaceutical treatments for AMD, and this is where the third Catalyst awardee, Akiko Maeda, MD, PhD, Case Western Reserve University School of Medicine, has been making strides. In the Maeda lab, mini retinas, grown from patient-derived iPSC, are developed to accelerate patient-specific drug screening. According to Maeda, it can take upwards of 15 years to target, develop and run new drugs through clinical trials using existing methods. But, even at that point, individuals can have different reactions to drugs. “These 3D-optic cups will be used to test the effectiveness of patient-specific therapies, cutting down on the development period, as we move closer to personalized medical care for AMD patients.”

In a separate approach to accelerate the discovery of potential treatments for AMD, scientists are finding new uses for established drugs. By analyzing large sets of patient data, RPB-supported researchers found that patients who take the drug L-DOPA for Parkinson Disease, Restless Legs or other movement disorders are significantly less likely to develop AMD,

and, if they do, it is at a significantly later age. The investigators had been conducting basic research into albinism, which causes profound vision loss and changes in the structure of the eye, especially the macula. They also knew that lower risk for AMD is associated with darker pigmentation (Blacks have a five-fold lower risk for AMD than Whites), and that L-DOPA is made in pigmented tissues.

The researchers hypothesized that L-DOPA may be a factor influencing racial disparities in AMD incidence. They examined the health records of 37,000 patients at one clinic and found that, in patients who were given L-DOPA before being diagnosed with AMD, their AMD was diagnosed eight years later than those not taking L-DOPA. These results were then confirmed in a much larger data set of 87 million patients.

According to Brian S. McKay, PhD, Department of Ophthalmology and Vision Science, University of Arizona: “Our findings imply that L-DOPA may be repurposed to prevent or delay AMD. In the end, L-DOPA may not be the drug that ends the disease, but the pathway identified here is likely to be a key observation as the search for a cure continues.”

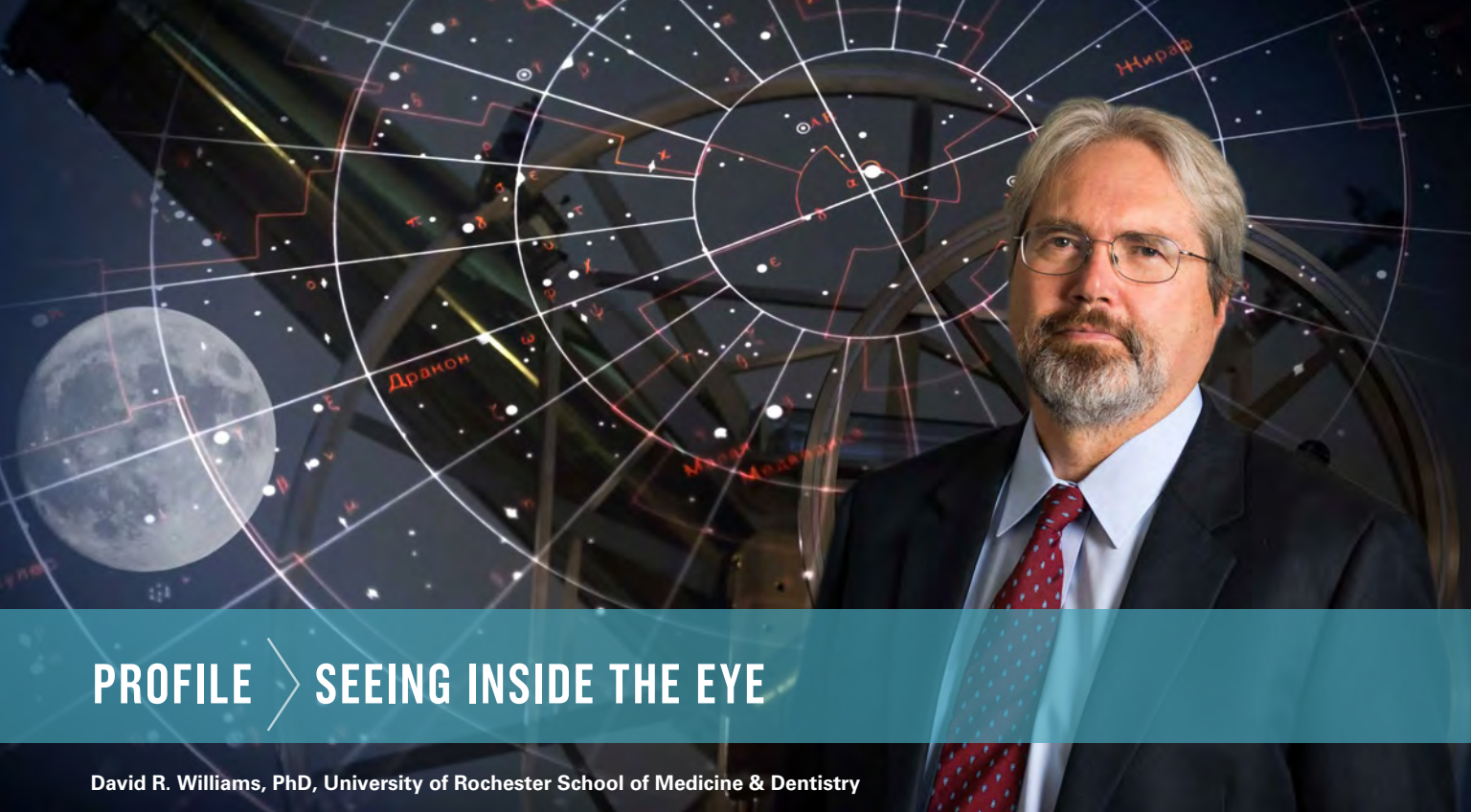


A) Replacement photoreceptor cells (red) rarely survive and do not integrate with degenerated host tissue when injected into the retina on their own. B) However, as these cells develop, they readily attach to porous, degradable polymer supports (blue) and show signs of uninterrupted differentiation towards early photoreceptor cells (e.g., axons, shown in yellow). Transplantation of photoreceptor cells on similar support materials has been shown to dramatically improve cell survival and integration with host retinal tissue.

Dry Eye

Our eyes are closed for roughly 10 percent of our waking hours just from blinking. We do not usually think of blinking as essential to sight, but if an eyelid’s muscles become paralyzed, which can happen due to facial palsy or nerve damage from injury, the exposed eye can develop severe corneal scarring or infection, because of the loss of the tear film, both of which can lead to blindness. Current treatments for a non-functioning eyelid include constant lubrication, eyelid taping, bandage contact lenses, or, in extreme cases, sutures to seal the eye.

RPB-funded researchers at Weill Cornell Medical College, are developing a magnetic system to close paralyzed eyelids. The system, which consists of small, silicone-encapsulated magnets, can be installed in the upper and lower eyelids, or the upper eyelid and the lower rim of a pair of glasses, and can be removed or adjusted. The goal, according to the researchers, is not only to restore protective elements of a blink, but to electromechanically link the blink rate to the fellow eye, creating a cosmetic improvement by giving the appearance of normal, simultaneous blinking.



PROFILE > SEEING INSIDE THE EYE

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

David R. Williams, PhD, has pioneered new technologies to measure and correct the optical defects of the eye far more accurately than has ever been possible. His innovations in adaptive optics (AO) have improved laser refractive surgery and the design of contact lenses. In 2014, Dr. Williams received a RPB Stein Innovation Award to refine a new retinal camera with which he is tracking early manifestations of diabetic eye disease.

How did you come to study vision?

I've always been a visually-oriented person. My father was a sculptor and an amateur astronomer who made his own telescopes. It was natural for me to begin building optical instruments to study how we see. My earliest training was as a psychophysicist, a branch of psychology that's all about understanding how perception comes about from the activity of neurons in the retina and the visual areas of the brain.

You are known for applying adaptive optics to the study of the eye. What was involved?

This was a technology that I borrowed from astronomy. In astronomy, light passes through space from a star unperturbed, but when it hits earth's atmosphere, the light gets distorted in a way that blurs the image on the telescope. The reason that stars twinkle when you look at them is because of the atmosphere.

Astronomers figured out that if they had a really nimble optical system that could change and adapt itself to the atmosphere at every instant, they could unscramble the light and get a sharp image. Today, most of the best telescopes on the planet use adaptive optics to sharpen their images.

In the early '90s, we applied this technology to allow us to measure literally dozens of aberrations in all eyes. We use a deformable mirror. On the back are little pistons that push and pull on the mirror so it can be warped into just the right shape to correct the aberrations of the eye. With AO, you can look at the retina as though you're looking through a high-quality microscope.

What were you working on before you received the RPB Stein Innovation Award?

Most of the work that we have done in the past using adaptive optics—the core, shared technology in our Advanced Retinal Imaging Alliance group—has been primarily focused on

looking at how photoreceptors and the retinal pigmented epithelium are arranged in the living eye. More recently, we've been successful in imaging other cell classes in the retina, like retinal ganglion cells and horizontal cells. The big push now in our group is to augment these imaging tools so that we can learn about how these cells function, not just what they look like.

What is the focus of your recent, RPB-supported work?

Our group has been able to move in the area of non-invasive vascular imaging and diabetic retinopathy (DR) in a very aggressive way thanks to the RPB Stein Innovation Award.

The early stage changes that precede vision loss in diabetes are enigmatic because they are difficult to detect in today's clinical setting. We are using adaptive optics retinal imaging to overcome the aberrations of the eye that blur these tiny structures to better understand how and when vascular dysfunction begins within capillaries.

How is this technology going to help treat eye disease?

With AO, we can catalog the earliest vascular events associated with diabetes so that we can better time the delivery of future clinical therapies and target pharmaceutical research. By tracking changes in capillary flow and microvascular structure in the same patients over the course of months and years, we will better understand the chronology of the earliest events in DR and get a much richer description of how well any pharmacological intervention is performing.

It will also allow us to get a picture of the overall vascular health of an eye, and reduce the time it takes to do so. I have been collaborating with Jesse Schallek, PhD (see page 16), who has developed an automated way of looking at hundreds, perhaps thousands, of capillaries simultaneously in the eye and of measuring the blood flow in them. That's transformational in situations where you have a limited window of time to collect data but have to assess a patient's condition.

What is your RPB grant uniquely allowing you to do?

RPB's flexible grant support is allowing us to demonstrate, using diabetic retinopathy as a

We think this technology is going to have a direct and powerful impact – first in the lab and then in patients – on the understanding and management of diabetes and other diseases that compromise the microvasculature of the eye.

model, whether this technology is in fact going to be useful. It holds a lot of promise, and we've received a lot of recognition for inventing this capability, but the jury is still out on where it's going to be clinically useful. RPB is allowing us to move further along the pipeline from basic science and engineering, to a clinically useful product.

The RPB support is also leveraging an industry relationship. Thanks to the progress we have made under the RPB grant, we have a pathway to working directly with a company that has some ideas about how to address diabetic retinopathy with pharmacology. I think that's just what RPB wants us to be doing, not just making new claims about what happens in the progression of diabetic retinopathy, but actively seeking ways of addressing the disease itself.

On a personal level, my research until recently has almost exclusively focused on the neural mechanisms of vision, especially those related to the photoreceptor mosaic. The RPB Stein Innovation Award provides me with my first direct support for characterization of the microvasculature in diabetic retinopathy, which represents a distinct departure from my earlier work and is allowing our team to continue to diversify its efforts.

The fall cycle RPB Stein Innovation Awards open a path for non-ophthalmology scientists to receive RPB support. Was that important to you?

I passionately believe that disciplines need to look outside of themselves to find new ideas. RPB is accelerating that process with this award. It's not only allowing me, and others, to work on something that our labs weren't doing, it's creating a mechanism to reach into physical sciences and engineering, and translate concepts from those fields into new ideas that didn't exist in ophthalmology before.



PROFILE > IMPROVING QUALITY OF LIFE

Pradeep Y. Ramulu, MD, MHS, PhD, The Johns Hopkins University School of Medicine

With funds from a 2011 RPB Special Scholar Award and ongoing support from RPB's Unrestricted Grant to the Department of Ophthalmology at Hopkins, Dr. Pradeep Ramulu is breaking new ground in an area of vision research that examines the impact of vision loss beyond loss of sight. The goal of these studies is to improve or preserve quality of life for those with vision impairment, to create standardized quality-of-life measurements to help in patient assessments, and to provide evidence that adds urgency to find treatments for eye diseases.

After becoming a clinician with a specialty in glaucoma, how did you get into the science of exploring associations between vision impairment and reduced quality of life?

The shift in the focus of my work occurred when I began asking myself, "What is my career going to be like in five years?" and I didn't like what I saw in terms of the impact I might have on patients who needed help after manifesting serious complications of eye diseases which left them with long-term visual limitations, or "low vision."

It really struck me that we, as an eye health community, need to be proactive about improving the quality of life for our patients. So I applied for a grant from RPB because I knew I might find support for this sort of out-of-the-box thinking.

In this RPB-supported work, we have been measuring the scope of disabilities created

by vision loss to determine risk factors that are fixable. For example, to evaluate home risk factors that may lead to falls or other problems, we measured the amount of light in a house, the slipperiness of surfaces, the placement of furniture—in order to give patients recommendations on how to maintain their home. For people with low vision traveling outside the home, we are developing training programs on how to scan a scene with their available vision, or to improve balance or gait, which can allow them to function effectively despite their vision loss.

To a non-scientist, the limitations experienced by a person with vision loss may seem self-evident. Are there other concerns?

I think most people can appreciate that it is undesirable to have poor vision, but I don't think it is evident how much and how deeply it affects one's life.

For instance, we have found that age-related macular degeneration (AMD) and AMD-related vision loss are associated with greater fear of falling in the elderly, a sensation that permeates literally every step one takes. AMD, as we know, also affects central vision and visual acuity, which create difficulties in reading.

There's a similar story to be told in people with visual field loss due to glaucoma. We have found that they suffer from fear of falling and restrict how much they travel outside the home. Additionally, we have found that glaucoma patients have less reading ability and engage less frequently in a variety of different reading activities.

So, with AMD as well as glaucoma, you may find patients with restricted mobility, which leads to greater isolation, and then in isolation these patients have less of an ability to engage in an activity that can be important to their connection with the world. These diseases are aging-related, so they tend to be developed later in life.

There's another source of concern. In a recent, RPB-supported study that I was involved in, we found that individuals with late AMD engage in very little moderate-to-vigorous physical activity. Physical activity—which is an important predictor of health—is typically cut in half when visual acuity is less than 20/40. That's a drop-off greater than that brought about by stroke, arthritis or Chronic Obstructive Pulmonary Disease (COPD). And physical activity is one of the few things that improves just about every aspect of health: strength and fitness, sleep, mood and stress, and risk for diabetes and heart disease.

Taken together, our findings paint a picture of the profound ways that poor vision affects the individual.

You recently reported that vision loss is more strongly associated with not working than all but two other medical conditions: severe COPD and depression.

The numbers, based on examinations of large national databases, are fairly shocking. Among women with visual impairment, only 25 percent are working. Compare that to women with normal vision, of whom 63 percent are working. For men with visual impairment, a little bit more than half, about 60 percent, are working, compared to 76 percent of men with normal vision who are working. Vision loss really has a dramatic impact on the work status of women.

Falls are the leading cause of accidents in older adults, and our work will lead the way to prevent falls in the visually impaired.

Diabetics are also extremely affected. In our study sample, over 90 percent of diabetics who were visually impaired were not working—almost everybody. Diabetics may have other complications due to the disease—neuropathy, kidney complications—which may play a part in this as well.

What difference has RPB grant support made in your career?

Many of our investigations are based on examination of publicly available databases. It's hard to get government grants to look at these things without having any sort of funding to lay the groundwork. This is where funding from the RPB Unrestricted Grant to Johns Hopkins has been so critical.

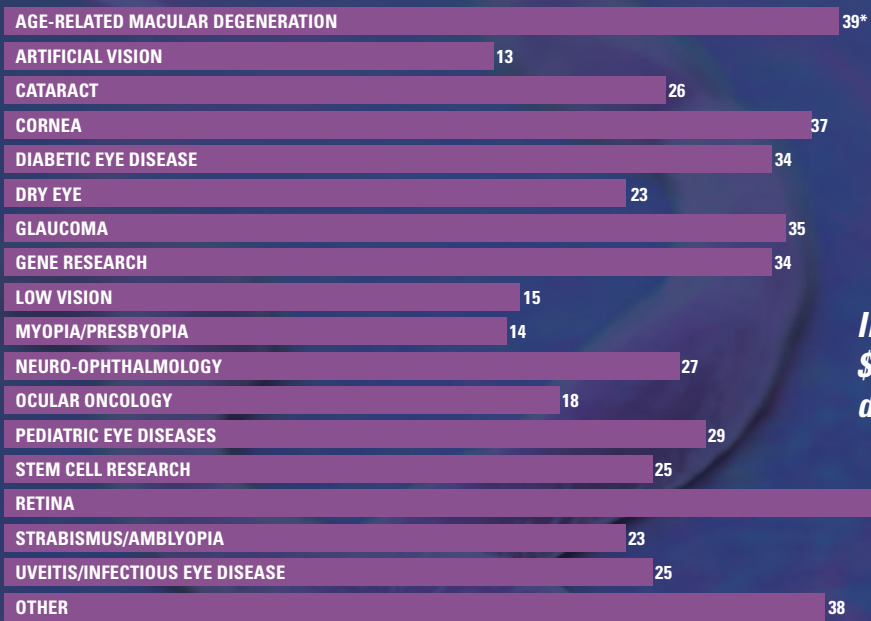
RPB's grant flexibility has also been critical in our ongoing study of 250 glaucoma patients who we have followed over three years to look at fall rate risk factors and intervention. Unlike most other grants, with RPB funds we were able to purchase specialized equipment that measures gait and other parameters regarding walking.

Essentially, RPB support is allowing us to pursue a new approach to care for certain vision-impaired patients. In the past, fall prevention programs have included vision screening. If someone was found to have poor vision, they were sent to an ophthalmologist. But, three or five years ago, if you were to ask an ophthalmologist, like me, "What are you doing to prevent your patients from falling?" I wouldn't have known what to say. It wasn't on my radar because during my training nobody ever mentioned the fact that people with poor vision can fall more. Yet patients expect us to do something.

We are in the business of improving people's vision or preventing future vision loss. But, while we are working towards cures and treating patients, we really ought also to be in the business of making their lives better. If it's by improving their vision, great! But to the extent that's not possible, we need to have other tools to give to them.

RPB GRANTS PROGRAM 2015

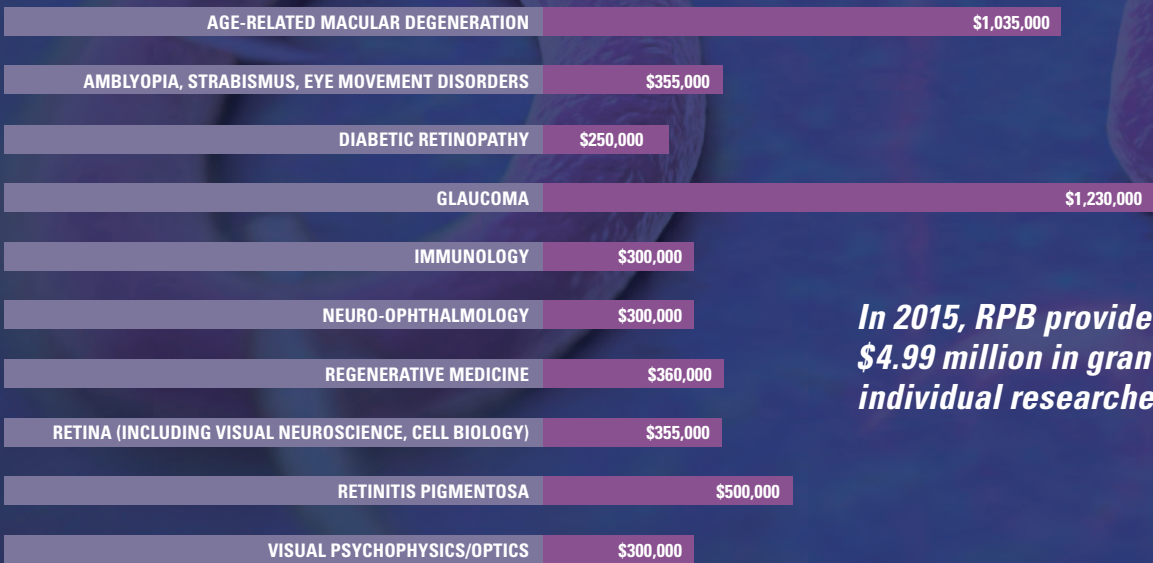
HOW RPB UNRESTRICTED GRANTS WERE APPLIED BY SCHOOLS IN 2015



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

In 2015, RPB provided \$5.25 million in unrestricted departmental support.

HOW RPB ALLOCATED GRANTS TO INDIVIDUALS IN 2015



In 2015, RPB provided \$4.99 million in grants to individual researchers.

By every measure, RPB casts a wide net over the U.S. vision research community. Our grants address all conditions that compromise sight and are awarded to promising, productive researchers working within the most fertile research environments while pursuing high-risk/high-gain breakthroughs. Every RPB grant is unrestricted, providing the flexibility investigators require to respond to discoveries.

We also encourage collaboration, which is why the number on this page that holds great interest for us is 875. As noted in the President’s Report, a recent study conducted for the National Eye Institute revealed that, out of more than 1,000 funding agencies credited, RPB is the second leading funder of international research collaborations, surpassed by the NEI, and exceeding the nation of Germany. With the 2016 rollout of the RPB/Stavros Niarchos Foundation International Research Collaborators Award we will cast our net wider.

2,093

studies published in 2015, in U.S. and foreign scientific journals, citing support from RPB

3,761

grants awarded by RPB for eye research since 1960

875

studies published by U.S. and international collaborators citing RPB support 2008-14, making RPB the world’s second leading funder of international collaborations

336

dollars, in millions, awarded by RPB for eye research since 1960



RPB Career Development Awards

Jesse Schallek, PhD

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.

- Alex Huang, MD, PhD**, David Geffen School of Medicine, University of California, Los Angeles
To develop aqueous angiography (an imaging technique) as a tool to improve basic understanding of fluid flow in the normal eye, as well as following minimally invasive glaucoma surgeries (MIGS).
- John D. Hulleman, PhD**, University of Texas Southwestern Medical Center at Dallas
To use protein engineering to test the hypothesis that selective activation of a specific oxidative stress response will protect the retinal pigment epithelium cell layer from the initiating events of AMD.
- Marc Harris Levin, MD, PhD**, University of California, San Francisco, School of Medicine
To identify mechanisms that lead to optic nerve inflammation in neuromyelitis optica and other disorders.
- Jesse Schallek, PhD**, University of Rochester School of Medicine & Dentistry
To use a use a custom-built, high resolution camera (adaptive optics scanning light ophthalmoscope) to study how blood cells interact with the capillary endothelium in the retina in the early stages of microvasculopathy in diabetes.
- Ruchira Singh, PhD**, University of Rochester School of Medicine & Dentistry
To use patient-derived retinal stem cell models to understand the effect of the environment (blue light, cigarette smoke, free iron) on the development and progression of AMD.
- Shandiz Tehrani, MD, PhD**, Oregon Health & Science University School of Medicine
To develop a method to locally deliver therapeutic molecules to the optic nerve head in vivo, to prevent axonal injury in experimental glaucoma.



RPB Stein Innovation Awards

Michael P. Stryker, PhD

This new award was developed to uncover and encourage fresh, high-risk/high-gain vision science research that 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.

- Douglas Dean, PhD**, University of Louisville School of Medicine
To investigate central vision rescue in retinitis pigmentosa by restoring rod dependent cone function via rod precursor cell transplantation.
- Paul L. Kaufman, MD**, University of Wisconsin-Madison School of Medicine and Public Health
To expand glaucoma therapeutics by using micro-invasive glaucoma surgical techniques to deliver viral vector gene therapy constructs directly to tissues of the outflow pathways in the eye.
- Anders M. Naar, PhD**, Harvard Medical School / MEEI
To investigate gene regulation of cholesterol/lipid homeostasis in the development of age-related macular degeneration (AMD).
- David W. Sretavan, MD, PhD**, University of California, San Francisco, School of Medicine
To develop a novel, nanosensor method of intraocular pressure (IOP) tracking, using light and a highly miniaturized implant for the ongoing, automated monitoring of IOP in glaucoma patients.
- Michael P. Stryker, PhD**, University of California, San Francisco, School of Medicine
To reveal which cortical circuits are altered in amblyopia in order to target and stimulate signaling mechanisms which could promote recovery during adulthood.
- Elias T. Zambidis, MD, PhD**, The Johns Hopkins University School of Medicine
To develop mature human retinas in mice by injecting human induced pluripotent stem cells into mouse blastocysts (cluster of cells from which an embryo arises).



RPB Nelson Trust Awards for Retinitis Pigmentosa

Jacque L. Duncan, MD (left in photo)

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

Jacque L. Duncan, MD, University of California, San Francisco, School of Medicine
To use adaptive optics scanning laser ophthalmoscopy to probe photoreceptor structure and function in eyes with retinitis pigmentosa at the earliest stages of disease.

Rong Wen, MD, PhD, University of Miami Miller School of Medicine
To carry out pre-clinical studies on treatment strategies for retinitis pigmentosa, including pharmacological therapy, gene therapy, and neuroprotective therapies.

RPB Physician-Scientist Awards

The purpose of these three-year \$300,000 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.

Kenneth S. Shindler, MD, PhD, University of Pennsylvania School of Medicine
To evaluate novel therapies that prevent retinal ganglion cell (RGC) damage and visual loss in optic neuritis, including modulating iron uptake.

David Zacks, MD, PhD, The Regents of the University of Michigan School of Medicine
 Sybil B. Harrington AMD Investigator
To define dysregulation of the mechanisms underlying photoreceptor cell death and degeneration during retinal disease and how activation of compensatory pathways reduces the rate of degeneration.



RPB Special Scholar Awards

Kayarat Saidas Nair, PhD

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.

Akrit S. Sodhi, MD, PhD, The Johns Hopkins University School of Medicine
 Ernest & Elizabeth Althouse Scholar
To identify and validate safe and effective targets for the treatment of abnormal leaky blood vessels in wet AMD.

Kayarat Saidas Nair, PhD, University of California, San Francisco, School of Medicine
 William & Mary Greve Scholar
To make mammalian Müller cells more amenable for retinal regeneration, with the potential to restore vision.

Heather E. Moss, MD, PhD, University of Illinois at Chicago College of Medicine
 Sybil B. Harrington Scholar
To define how changes in blood vessels in the eyes, in the structure of the optic nerve and in the electrical activity of the eyes in idiopathic intracranial hypertension (IIH) patients can be used to measure disease development and treatment success, and to predict future vision loss.

Magali Saint-Geniez, PhD, Harvard Medical School / SERI
 Dolly Green Scholar
To characterize the effect of retinal detachment on photoreceptor metabolism and evaluate the therapeutic benefits of cell metabolic regulatory factors.



RPB Medical Student Eye Research Fellowships

Daniel Diaz-Aguilar

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.

- Daniel Diaz-Aguilar**, conducting research at Harvard Medical School / MEEI
Mentor: Kip M. Connor, PhD
- Zachary Michael Dong**, conducting research at University of Pittsburgh School of Medicine
Mentor: Gadi Wollstein, MD
- Clifford Kim**, conducting research at Harvard Medical School / MEEI
Mentor: Kip M. Connor, PhD
- Khiem Vu**, conducting research at University of Texas Southwestern Medical Center at Dallas
Mentor: John D. Hulleman, PhD

Jules and Doris Stein RPB Professorship Extension

The Jules and Doris Stein RPB Professorship fosters translational research over a possible seven-year period by recruiting outstanding basic scientists to conduct clinically relevant research in a department of ophthalmology. If approved, the Stein Professorship Extension provides support for the sixth and seventh years, bringing the potential grant total to \$1,025,000.

David Antonetti, PhD, The Regents of the University of Michigan School of Medicine
To restore diabetes-damaged blood vessels, to repair the retinal vascular network, and prevent vision loss.



Special Grants for Partnerships and Collaboration

The first-ever class of 21 Emerging Vision Scientists to participate in the RPB-sponsored AEVR/NAEVR events on Capitol Hill included four RPB grantees, reflecting the breadth of vision research.

RPB supports strategic alliances through selected special grants to help advance the entire field of U.S. vision research.

Alliance for Eye and Vision Research (AEVR): \$50,000

To enhance AEVR’s public education efforts about the value of federally funded vision research. Some of these activities, all within AEVR’s dedicated program entitled Decade of Vision 2010-2020 Initiative, included, but were not limited to: Congressional briefings; an “Emerging Vision Scientists” initiative; an update of the “The Cost of Military Eye Trauma Study”; educational brochures; and various other events.

Association of University Professors of Ophthalmology (AUPO): \$150,000

To fund AUPO’s mission: to serve, strengthen, and represent academic departments of ophthalmology; to provide support, information and leadership opportunities to departmental chairs, program directors, and other faculty members; to promote excellence in ophthalmic education; to foster vision research and to promote ethical practice and excellence in eye care in order to ensure the best possible vision for the public. RPB’s 2015 AUPO grant included additional funding for AUPO’s 50th Anniversary event.

The Heed Ophthalmic Foundation: \$32,000 (\$16,000 per year for Resident Retreats in 2016 and 2017)

To co-sponsor the 11th and 12th annual Heed Foundation Residents Retreats in 2016 and 2017. Thirty to 35 residents—selected from among those nominated by their department chairs and residency program directors—and 25 faculty, including recent K-awardees, mid-career and senior faculty, gather over two days to foster careers in academic ophthalmology. During the informal sessions, residents mingle with academic ophthalmologists just a few years their senior to learn about how young faculty members made the transition from trainee to academic faculty position.

2015 RPB APPROVED GRANTS TOTAL: \$10,577,000*
U.S. medical schools receiving new 2015 departmental and/or individual investigator awards

STATE	RPB GRANTEE INSTITUTIONS	TOTAL GRANTS 2015	TOTAL SUPPORT INCLUDING 2015
ALABAMA	University of Alabama at Birmingham School of Medicine	\$ 115,000	\$ 4,185,000
CALIFORNIA	David Geffen School of Medicine at UCLA	415,000**	9,290,750
	University of California, Irvine, School of Medicine	115,000	680,000
	University of California, San Diego, School of Medicine	115,000	3,515,000
	University of California, San Francisco, School of Medicine	1,175,000**#	9,059,256
	Keck School of Medicine of the University of Southern California	115,000	5,388,500
COLORADO	University of Colorado School of Medicine	300,000	848,000
CONNECTICUT	Yale University School of Medicine	115,000	3,517,224
FLORIDA	University of Florida College of Medicine	115,000	4,535,600
	University of Miami Miller School of Medicine	215,000	4,962,700
GEORGIA	Emory University School of Medicine	115,000	3,937,100
ILLINOIS	Northwestern University Feinberg School of Medicine	115,000	3,310,000
	University of Illinois at Chicago College of Medicine	170,000	4,441,712
INDIANA	Indiana University School of Medicine	115,000	2,769,000
IOWA	University of Iowa Carver College of Medicine	115,000	5,007,425
KENTUCKY	University of Louisville School of Medicine	415,000#	4,374,800
LOUISIANA	Louisiana State University Health Sciences Center in New Orleans	115,000	2,832,100
MARYLAND	The Johns Hopkins University School of Medicine	490,000#	9,590,140
MASSACHUSETTS	Harvard Medical School	500,000#	9,610,315
MICHIGAN	The Regents of the University of Michigan School of Medicine	665,000	8,133,050
	Wayne State University School of Medicine	115,000	4,143,000
MINNESOTA	Mayo Medical School	115,000	3,284,600
MISSOURI	Washington University in Saint Louis School of Medicine	500,000	7,709,981
NEBRASKA	University of Nebraska Medical Center	115,000	2,240,000
NEW YORK	Albert Einstein College of Medicine	115,000	2,207,500
	Columbia University College of Physicians & Surgeons	115,000	6,148,167
	Weill Cornell Medical College	115,000	5,123,700
	University of Rochester School of Medicine & Dentistry	715,000**	3,885,250
	SUNY at Buffalo School of Medicine & Biomedical Sciences	115,000	1,130,000
NORTH CAROLINA	Duke University School of Medicine	115,000	7,400,150
	University of North Carolina at Chapel Hill School of Medicine	115,000	1,860,500
OHIO	Case Western Reserve University School of Medicine	115,000	3,992,500
	Cleveland Clinic Lerner College of Medicine	115,000	3,265,000
	University of Cincinnati College of Medicine	115,000	1,940,250
OKLAHOMA	University of Oklahoma Health Sciences Center	115,000	5,241,600
OREGON	Oregon Health & Science University School of Medicine	415,000**	5,427,150
PENNSYLVANIA	University of Pennsylvania School of Medicine	415,000	6,498,500
	University of Pittsburgh School of Medicine	145,000	4,658,372
TENNESSEE	University of Tennessee Health Science Center	115,000	3,185,000
	Vanderbilt University School of Medicine	115,000	2,975,500
TEXAS	Baylor College of Medicine	115,000	4,584,060
	University of Texas Southwestern Medical Center at Dallas	445,000**	4,676,000
UTAH	University of Utah Health Sciences Center	115,000	5,665,300
WASHINGTON	University of Washington School of Medicine	115,000	3,787,638
WISCONSIN	University of Wisconsin-Madison School of Medicine	415,000#	5,508,750

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

**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 2015: University of Missouri-Kansas City School of Medicine and 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.

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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.