Cross section of a maturing three-dimensional retinal organoid generated from human induced pluripotent stem cells. Cone photoreceptors are shown in green and Muller glia are shown in red.
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Dear Friends,

We are living in uncertain times – politically, economically and socially – and we may be tempted to become cynical about the prospects for a brighter future. I urge you not to surrender to this temptation, but to always stay hopeful and focused on better days to come.

What can we do today in order to create a better tomorrow? One answer is clearly found in continuing to add to the body of scientific knowledge through support of basic research. The scientific process isn’t at the mercy of the ebb and flow of the shifting sands of popular culture, and will ultimately provide many answers to the mysteries of disease and disability that challenge so many today.

Research takes time, in large part due to the nature of the rigorous scientific process. Studies are conducted at leading research institutes and universities under carefully controlled circumstances. These collaborative efforts, by scientists from various disciplines and diverse geographical backgrounds, result in papers that are published in scholarly and peer reviewed journals. This basic science research advances our understanding of both healthy and diseased states at the molecular and cellular level.

The pace of change in our everyday lives is accelerating, and that can leave us off-balance. Popular culture is frantic for instant results and looks only as far ahead as the next fad. We must have confidence in the timeless nature of the scientific process and trust that each discovery lays the groundwork for future discoveries. The knowledge gained will not be lost, and innovations in science bring true benefits to society.

Research goes on forever. As long as mankind has a brain, we will always want to move forward and discover new answers to unsolved problems – everlasting “hope” is a “bottomless bucket!”

With gratitude,

Alice McPherson, MD
President
Overview of Research - 2017

Retina Research Foundation supports an exemplary variety of programs in retina research around the world. The following is a brief recap of RRF research supported in 2017, which illustrates the wide scope of RRF activities.

RRF Pilot Study Grants – Investigation of New Research Topics

Baylor College of Medicine, Houston, TX
   Samuel Wu, PhD – Kayser Research Project
   Milan Jamrich, PhD – Lawrence Research Project
   Rui Chen, PhD – Manning Research Project
   Graeme Mardon, PhD – Miller Research Project
   Richard Hurwitz, MD – Wilson Research Project

University of Texas MD Anderson Cancer Center, Houston, TX
   Louise C. Strong, MD – Humble Research Project

University of Texas Medical Branch-Galveston, Galveston, TX
   Wenbo Zhang, PhD – Bovay Research Project

Texas A&M Health Science Center, Temple, TX
   Lih Kuo, PhD – Gueymard Research Grant

University of Wisconsin, Madison, WI
   Curtis Brandt, PhD – Murfee Macular Degeneration Project

Indiana University, Indianapolis, IN
   Timothy Corson, PhD – Basic Research Grant

University of Utah, John Moran Eye Center, Salt Lake City, UT
   Wolfgang Baehr, PhD – Basic Research Project

Case Western Reserve, Cleveland, OH
   Paul Shin-Hyun Park, PhD – Basic Research Project

RRF Cox Macula Society Research Grant – administered by The Macula Society
   Mary Elizabeth Hartnett, MD – Moran Eye Center, University of Utah, Salt Lake City, UT

Research Chairs – Ongoing Proven Research Projects

Baylor College of Medicine, Houston, TX
   Ching-Kang Jason Chen, PhD – RRF Research Chair

University of Wisconsin, Madison, WI
   Kevin W. Eliceiri, PhD – Helmerich Chair, Assoc. Director, McPherson Eye Research Institute
   Nader Sheibani, PhD – RRF Research Chair
   David Gamm, MD, PhD – Humble Distinguished Director, McPherson Eye Research Institute
   T. Michael Nork, MD – Murfee Chair, McPherson Eye Research Institute
   Christine Sorenson, PhD – Albert Chair, McPherson Eye Research Institute
Overview of Research - 2017

Research Professorships – Ongoing Proven Research Projects
University of Wisconsin, Madison, WI
Jeremy Rogers, PhD – Gamewell Professor, McPherson Eye Research Institute
Bikash Pattnaik, PhD – Matthews Professor, McPherson Eye Research Institute
Aparna Lakkaraju, PhD – Brown Professor, McPherson Eye Research Institute

Established Awards – Awards Recognizing Lifetime Achievement
RRF Award of Merit – presented by The Retina Society – Boston, MA – October 6
Michael L. Klein, MD – Casey Eye Institute, Portland, OR

RRF Kayser International Award – presented by International Society for Eye Research (ISER); will be presented again in 2018

RRF Pyron Award – presented by American Society of Retina Specialists (ASRS) – Boston, MA – August 13
Paul A. Sieving, MD, PhD – Director, National Eye Institute, Bethesda, MD

CL Schepens MD/AAO Award – presented by American Academy of Ophthalmology (AAO) and Schepens International Society (SIS) – New Orleans, LA – November 10
Frederick L. Ferris III, MD – National Eye Institute, Bethesda, MD

RRF Gonin Lecturer – presented by Club Jules Gonin; will be presented again in 2018

Gonin Medal – presented by International Council of Ophthalmology (ICO); will be presented again in 2018

Paul Kayser/RRF Global Award – presented by Pan-American Association of Ophthalmology (PAAO) – Lima, Peru – August 9
Jennifer Kang-Mieler, PhD - Illinois Institute of Technology, Chicago, IL

International Fellowships – Advanced Subspecialty Training
ICO – RRF Helmerich International Fellowships – administered by International Council of Ophthalmology Foundation (ICOF)
Linda Espinosa Cernichiaro Amejandra, MD - from Mexico to Bascom Palmer, Miami, FL
Nilufer Yesilirmak, MD - from Turkey to Bascom Palmer, Miami, FL

Gillingham Pan-American Fellowships – administered by Pan-American Association of Ophthalmology (PAAO)
Marcela A. Lonngi, MD - from Colombia to Jules Stein Eye Institute, Los Angeles, CA
Andrea Elizabeth Arriola-López, MD - from Guatemala to Bascom Palmer Eye Institute, Miami, FL

Research Initiatives – Educational and Travel Scholarships
AAO Educational Trust Fund – administered by The Foundation of the American Academy of Ophthalmology (FAAO)
Retina-related educational research programs for clinical and basic science

RRF Lawrence Travel Scholarships – administered by The Association for Research in Vision and Ophthalmology (ARVO)
Twenty-two vitreoretinal scientists representing schools in 16 states traveled to the ARVO Annual Meeting to present their scientific research.
## RETINA RESEARCH SITES
### PAST AND PRESENT

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RRF provided funding for 12 pilot study research projects conducted at leading research institutions. Nine of the projects were named in recognition of generous support through gifts and years of exceptional service to the Foundation. Pilot studies are experimental studies designed “to test the waters” or break new ground. Findings may lead to larger ongoing studies in the future.

**Named Basic Research Projects**

**The Kathryn and Latimer Murfee Macular Degeneration Project**

**Curtis R. Brandt, PhD**  
Dept. of Ophthalmology and Visual Sciences  
McPherson Eye Research Institute  
University of Wisconsin, Madison, WI

*Gene therapy for retinal degenerative diseases*

The purpose of this project is to determine the mechanism of inflammation triggered by viral gene delivery vector injection in the non-human primate eye. In 2017, Dr. Brandt examined the expression of innate immune receptors, including Toll-like receptors and non-self nucleic acid receptors, as well as components of the inflammasome in non-human primate retina. He continues to examine inflammasome components expressed in non-human primate neural retina tissue and study their role in vector induced inflammation. In addition, he plans to determine whether non-human primate retina tissue expresses host restriction factors, as these proteins can negatively affect viral gene delivery vector transduction efficiency.

**Joe M. and Eula C. Lawrence Research Project**

**Milan Jamrich, PhD**  
Dept. of Molecular and Cellular Biology  
Baylor College of Medicine, Houston, TX

*Function of Rax in the specification, differentiation and survival of vertebrate retinal cells*

The goal of this project is to identify genes and processes that are responsible for normal and abnormal vertebrate retinal development, which will lead to a better understanding of eye diseases, and as a result, new diagnostic procedures and treatments will be developed. Rax is a gene that plays a key role in vertebrate eye formation. In 2017, Dr. Jamrich intended to identify the direct target genes of mouse Rax during retinal development. He made a knock-in strain of mouse in which the Rax protein is linked to a tag against which there are antibodies. In order to perform ChIP-seq, he isolated E14 eyes from the Rx/SBP/FLAG knock-in strain of mouse. A company that specializes in ChIP technologies generated a list of potential Rax target genes.
The W.O. Manning Research Project

Rui Chen, PhD
Dept. of Molecular and Human Genetics
Baylor College of Medicine, Houston, TX

Identification and functional analysis of genes involved in retina diseases and development

Dr. Chen’s long-term goal is to identify and conduct functional characterization of novel disease genes underlying inherited human retinal disorders. Results obtained from these studies can be directly translated into improving molecular diagnosis and form the basis of developing optimal treatment of human eye diseases, including gene therapy. In 2017, Dr. Chen’s group completed whole exome sequencing for a cohort of 900 LCA patients recruited worldwide, which led to the identification of several novel disease genes, including REEP6 and CWC27. In addition, mouse models have been established for these novel disease genes. Currently, Dr. Chen’s group is characterizing these mouse models for understanding the disease mechanisms and developing new therapeutic approaches.

The Paul Kayser Research Project

Samuel Wu, PhD
Cullen Eye Institute, Neurosensory Center
Baylor College of Medicine, Houston, TX

Pharmacological and genetic mechanisms underlying retinal cell death in glaucoma and age-related macular degeneration (AMD)

The objective of Dr. Wu’s research is to understand mechanisms underlying retinal synaptic dysfunction and cell death in glaucoma and age-related macular degeneration (AMD). He plans to use the newly developed eight-channel patch clamp recording system, which is the most powerful electrophysiological recording apparatus in the world that allows recording of eight retinal cells simultaneously for studying their interconnections and light responses in animal models of glaucoma and AMD. Dr. Wu’s lab published five papers and submitted four manuscripts in top international journals in 2017. These publications report Dr. Wu’s new discoveries on how rod and cone signaling pathways mediate light responses and receptive fields of various types of retinal ganglion cells (RGC), and how dysfunction of bipolar cell and amacrine cell synapses affect retinal degeneration in glaucoma, AMD and retinitis pigmentosa (RP).
Bertha and I.L. Miller Research Project

Graeme Mardon, PhD
Depts. of Pathology, Molecular and Human Genetics
Baylor College of Medicine, Houston, TX

Genetic and molecular analysis of retinal development

The long-term goal of this project is to improve our ability to prevent, diagnose, and treat human retinal diseases. Dr. Mardon recently developed animal models for a gene associated with congenital blindness, named \textit{Kcnj13}, which encodes a highly conserved potassium channel protein. In 2017, Dr. Mardon continued to focus on the mouse \textit{Kcnj13} gene and has made significant breakthroughs in his research. He found that conditional loss of \textit{Kcnj13}, specifically in the retinal pigment epithelium in the mouse retina, causes very early loss of photoreceptors, first detectable by 15 days of age, with severe vision defects by 21 days of age. By three months of age, there is complete loss of the photoreceptor layer. Dr. Mardon plans to further characterize his \textit{Kcnj13} mouse models to determine the molecular basis for disease pathology.

Emmett A. Humble Research Project

Louise C. Strong, MD
Dept. of Genetics
University of Texas MD Anderson Cancer Center
Houston, TX

Genetic etiology of retinoblastoma

Dr. Strong’s goal is to provide a unique early cancer detection program for individuals with a hereditary cancer predisposition, specifically retinoblastoma and Li Fraumeni syndrome individuals. These tumors are a significant health problem as the most frequent cause of death in hereditary retinoblastoma patients is a second malignant neoplasm. In 2017, Dr. Strong continued to update her registry of hereditary retinoblastoma patients at risk for new non-ocular tumors and noted that most were not aware of the risk and were not undergoing any surveillance. It has been an ongoing aim of this project to maintain the registry of retinoblastoma patients and family members, with the relevant sample and history collection, and to provide sufficient education and guidelines for patients and family members seeking counseling and/or screening. Dr. Strong documents response, interest, barriers to participation, and clinically significant outcomes.
Adolphe G. and Josephine Roberts Gueymard Research Project

Lih Kuo, PhD
Depts. of Medical Physiology, Surgery, and Ophthalmology
Texas A&M Health Science Center, Temple, TX

Activation of endothelin-dependent RhoA/ROCK pathway elicits retinal arteriolar dysfunction in diabetic retinopathy

This project seeks to identify the mechanisms responsible for the initiation and development of diabetic retinopathy and to develop strategies for the prevention and treatment of this disease. Proper function of the retina depends on a sufficient supply of blood to the retina, and the dysfunction of retinal circulation can lead to disease development. Dr. Kuo has found that in the diabetic retina the synthesis of vasoconstrictor/inflammation agent endothelin-1 (ET-1) from endothelin converting enzyme (ECE) is elevated, and the RhoA kinase (ROCK) and arginase signalings are correlatively activated. He hypothesizes that activation of ECE/ROCK/arginase signaling contributes to the retinal vascular disorder and retinopathy. He has established a diabetes pig model, which resembles the human eye pathophysiology, to investigate the mechanism and signaling molecules involved in initiation and development of diabetic retinopathy.

Mary Ellen Wilson Research Project

Richard L. Hurwitz, MD
Dept. of Pediatrics, Ophthalmology, Molecular and Cellular Biology
Co-Director, Retinoblastoma Center
Texas Children’s Cancer Center
Center for Cell and Gene Therapy
Baylor College of Medicine, Houston, TX

Immune consequences of gene therapy for ocular disorders

Dr. Hurwitz’s hypothesis is that gene therapy protocols for both ocular and non-ocular disorders can be optimized based on understanding how the unique ocular environment influences the efficacy of the gene therapy treatment. He has previously published an association of the vitreous component hyaluronan with the enhanced expression of potentially therapeutic genes transferred by adenoviral vectors. Hyaluronan alone does not account for the entire effect observed. Dr. Hurwitz began to explore the contribution of another vitreous component, the large proteoglycan versican, and the initial results of experiments verifying a contribution of the versican G1 domain were published in 2017. The studies included the analysis of biochemical pathways influenced by the G1 domain and may provide useful in designing more efficient vectors and delivery systems to optimize gene therapy outcomes and limit toxicities, including immune consequences.
**Harry E. Bovay, Jr. Research Project**

**Wenbo Zhang, PhD**  
Department of Ophthalmology & Visual Sciences  
University of Texas Medical Branch at Galveston  
Galveston, TX

*Novel therapy for retinal neovascularization*

Ischemic retinopathies are caused by impaired retinal blood supply in various diseases such as diabetic retinopathy, retinopathy of prematurity, and retinal vascular occlusion. These conditions often result in irreversible vision loss due to the development and growth of abnormal new vessels after a period of retinal ischemia, a process referred to as retinal neovascularization. In a mouse model of ischemic retinopathy, Dr. Zhang showed that A2AR expression was significantly increased in retinas and retinal vessels during ischemic retinopathy, which were associated with increase in cAMP production. Dr. Zhang has shown that istradefylline treatment reduced cAMP production, Epac1 activation and retinal neovascularization in ischemic retinopathy. Istradefylline has been approved to treat Parkinson’s disease in Japan, and this work supports the possibility of treating ischemic retinopathy by repositioning istradefylline for ophthalmic use.

**Basic Research Projects**

**Timothy W. Corson, PhD**  
Eugene & Marilyn Glick Eye Institute  
Indiana University School of Medicine  
Indianapolis, IN

*Role of epoxy lipid metabolism in choroidal neovascularization*

The overall goal of this project is to develop therapies for diseases like wet AMD by showing how soluble epoxide hydrolase (sEH) is important for abnormal blood vessel growth. In previous years of RRF funding, Dr. Corson’s team developed a potent chemical called SH-11037, and found sEH as its cellular target. sEH is present at high levels in human and mouse eyes with AMD-like features. The Corson lab has shown that a substrate (input) of sEH is antiangiogenic, and characterized the molecular mechanism of how SH-11037 inhibits sEH. They showed this inhibition occurs in eye tissue, confirmed that the rod photoreceptor cells are the site of increased sEH in eyes undergoing new blood vessel growth, and found that known sEH inhibitors can block new blood vessel growth in the eye.


Wolfgang B. Baehr, PhD
Department of Ophthalmology and Visual Sciences
University of Utah Health Science Center
Salt Lake City, UT

Therapy in a mouse model of Joubert Syndrome

Dr. Baehr’s lab is interested in understanding mechanisms leading to retina disease and developing gene-based therapies for non-syndromic and syndromic ciliopathies, focusing mainly on the retina. This application studies the role of INPP5E, a phosphoinositide phosphatase present in photoreceptors, in pathogenesis of ciliated cells. INPP5E mutations are associated with Joubert syndrome, a syndromic ciliopathy. Common features of Joubert syndrome include ataxia (lack of muscle control), hyperpnea (abnormal breathing patterns), abnormal eye and tongue movements, polydactyly (more than 10 digits) and retinitis pigmentosa. Dr. Baehr studies the consequences of INPP5E deletion, specifically in retina photoreceptors, and devises gene-based therapies to ameliorate or cure disease. A retina-specific knockout has been generated, revealing a rapid degeneration of rods and cones.

Paul Shin-Hyun Park, PhD
Department of Ophthalmology and Visual Sciences
Case Western Reserve University, Cleveland, OH

A potential neuroprotective role for GPR75 in the retina

GPR75 is an orphan G protein-coupled receptor that is localized in the brain and retina. The function of GPR75 in the retina is currently unknown, but initial studies indicate that this orphan receptor may have important neuroprotective properties. Several mutations in GPR75 have been detected in patients with age-related macular degeneration (AMD), thereby suggesting that defects in GPR75 can contribute to the pathology of this retinal degenerative disorder. The goal of this project is to test the hypothesis that GPR75 has a neuroprotective role in the retina and that defects in the receptor can lead to effects increasing the likelihood of AMD or other retinal degenerative disorders.

Grant Recipient from The Macula Society

The RRF Margaret and Mills Cox Macula Society Research Project

Mary Elizabeth Hartnett, MD
Moran Eye Center, University of Utah
Salt Lake City, UT

Novel Gene Therapy to Regulate Pathologic Neovascularization in AMD

Dr. Hartnett’s lab has identified a mechanism for pathologic signaling through vascular endothelial growth factor (VEGF) in retinopathy of prematurity (ROP) that leads to both avascular retina and intravitreal neovascularization. She studies ways to regulate VEGF signaling in order to safely inhibit pathologic neovascularization in both ROP and age-related macular degeneration (AMD). Dr. Hartnett has over 200 peer-reviewed articles and chapters, and is Editor-in-Chief for the highly acclaimed textbook, Pediatric Retina, now in its second edition.
RRF now supports a total of six chairs and three professorships in retina research, which provide funds to vision scientists engaged in original excellent research that has the potential to increase understanding of the retina or retinal diseases.

**RRF Research Chair**

**Ching-Kang Jason Chen, PhD**
Depts. of Ophthalmology, Biochemistry and Molecular Biology, Neuroscience
Baylor College of Medicine
Houston, TX

*A novel retinal oscillation mechanism in an autosomal dominant mouse model of retinitis pigmentosa*

The Chen lab at the Ophthalmology Department of Baylor College of Medicine currently investigates the mechanisms, function and utility of neuronal oscillation in mice where photoreceptor input to inner retinal neurons is disrupted permanently. Because retinal oscillation is synthetically driven, and not all neurons oscillate when deafferentation occurs, determining if and how a genetically marked neuron oscillates thus provides valuable knowledge on upstream synaptic connectivity of such a neuron. This approach is complemented by examining light response properties of similarly marked neurons in wild type mice and in mutant mice with manipulated gene expression. When completed, a catalog of genetically marked inner retinal neurons and their synaptic connections will be at hand to guide future investigations into retinal disease mechanisms as well as potential therapeutic interventions.

**Walter H. Helmerich Chair**

**Kevin W. Eliceiri, PhD**
Associate Director, McPherson Eye Research Institute
Director, Laboratory for Optical and Computational Instrumentation
University of Wisconsin, Madison, WI

*Computational Imaging of the Cellular Microenvironment*

Dr. Eliceiri’s research interests are in the areas of developing optical and computational approaches to study dynamic cellular processes such as those in the eye non-invasively. The overarching vision is that by applying these technologies to vision studies there will be opportunity to solve fundamental problems in eye and vision research. His current research focuses on the development of novel optical imaging methods and instrumentation for investigating the cellular microenvironment as well as the development of software for multidimensional imaging informatics. Specific interests include developing nonlinear optical approaches for deeper imaging and sensing of the cellular microenvironment, new technologies for metabolic imaging as well as computational algorithms for visualizing large multidimensional datasets with spatial and non-spatial components.
**Research Chairs and Professorships**

**RRF Research Chair**

**Nader Sheibani, PhD**  
Department of Ophthalmology & Visual Sciences  
University of Wisconsin, Madison, WI

*Regulation of ocular vascular development and neovascularization*

Dr. Sheibani’s work focuses on the mechanisms that regulate ocular vascular homeostasis. He showed vitamin D attenuates retinal neovascularization in a VDR depended manner by inhibiting the proangiogenic activity of pericytes. In collaboration with Dr. Murphy, Dr. Sheibani reported a versatile synthetic alternative to Matrigel for high throughput screening of vascular disrupting agents. In collaboration with Dr. Henkin, he reported the development of a novel nanocarrier for sustained intravitreal delivery of antiangiogenic peptides. In collaboration with Dr. Zhang, he showed metabolic changes in retinal vasculature occurs early during diabetes. He also showed antagonism of β2-adrenegic receptor suppresses VEGF and IL-6 expression mitigating CNV. Reported in: Plos one (Dec 2017), Nat Biomed Eng (July 2017), IOVS (Oct 2017), IOVS (Feb 2017), and IOVS (Jan 2017).

**Emmett A. Humble Distinguished Directorship**

**David M. Gamm, MD, PhD**  
Director, McPherson Eye Research Institute  
Department of Ophthalmology & Visual Sciences  
University of Wisconsin, Madison, WI

*Modeling and treating retinal disease with human induced pluripotent stem cells (hiPSCs)*

Dr. Gamm continues to work at the forefront of human pluripotent stem cell (hiPSC) technology, which his lab employs to both better understand and develop treatments for retinal degenerative diseases in children and adults. His lab’s pioneering stem cell studies on retinitis pigmentosa (RP) and inherited and age-related forms of macular degeneration (AMD) have helped launch projects to advance gene and cell therapies for these largely untreatable conditions. In addition, through his leadership role in Opsis Therapeutics (a subsidiary of FUJIFILM-Cellular Dynamics), Dr. Gamm and his colleagues are working toward clinical trials to test the safety and efficacy of photoreceptor replacement in late stages of RP and AMD.
**Kathryn and Latimer Murfee Chair**

**T. Michael Nork, MD, MS**  
McPherson Eye Research Institute  
Department of Ophthalmology & Visual Sciences  
University of Wisconsin, Madison, WI

*Functional and Cellular Mechanisms of Ischemic Retinal Injury*

The object of Dr. Nork’s basic laboratory research has been to understand how an inadequate blood supply (ischemia) to the retina affects its health. Much of his initial and ongoing studies have looked at the ischemic changes that he and others found in the outer retina (rods and cones) in glaucoma and what this might mean for the health of the cells that are most damaged in glaucoma—the retinal ganglion cells. Other retinal diseases such as retinal vascular occlusion are unquestionably the result of reduced retinal circulation. His lab is working with animal models of retinal blood supply restriction and as well as glaucoma. By applying advanced electrophysiologic and histopathologic examination, he hopes to better understand the underlying mechanisms of retinal cellular damage with the long-term goal of developing pharmaceutical and other interventions that might mitigate such injury.

**Daniel M. Albert Chair**

**Christine M. Sorenson, PhD**  
University of Wisconsin Dept. of Pediatrics  
McPherson Eye Research Institute  
Madison, WI

*Apopotosis in retinal vascular development and disease*

The focus of Dr. Sorenson’s research is to understand the apoptotic and non-apoptotic roles Bcl-2 and Bim play during postnatal retinal vascular development and pathologic neovascularization. She is interested in understanding how the fine-tuned regulation of Bim, Bcl-2 and VEGF expression impacts retinal vascularization and homeostasis. Her studies have novel impact in the design of antiangiogenic therapy.

**Edwin and Dorothy Gamewell Professor**

**Jeremy Rogers, PhD**  
McPherson Eye Research Institute  
Department of Biomedical Engineering  
University of Wisconsin, Madison, WI

*Optical instrumentation and technology platforms for the study and screening of retinal disease*

Dr. Rogers develops new imaging tools to aid in the treatment, prevention, and basic research of retinal disease. The ability to image and quantify structure and function of retinal cells in a clinical setting is crucial to advancing treatment and prevention options. Dr. Rogers is developing new imaging technologies that exploit the intrinsic light scattering properties of cells, making these methods suitable for clinical imaging. His laboratory is currently building an Adaptive Optics Scanning Light Ophthalmoscope (AOSLO) that will enable imaging of individual photoreceptors. By developing new imaging methods powered by computational light scattering simulations, he will be able to improve existing instruments and create new methods of imaging cellular function that are needed to develop and monitor future stem cell or gene therapies.
**Research Chairs and Professorships**

**M.D. Matthews Research Professor**

**Bikash Pattnaik, PhD**
McPherson Eye Research Institute  
Department of Pediatrics, Ophthalmology & Visual Sciences  
University of Wisconsin, Madison, WI

*Vision Loss Due to Ion-Channelopathy*

Dr. Pattnaik’s research focus is on the inherited blindness due to defective inwardly rectifying potassium (Kir7.1) channel present in the retinal pigment epithelium (RPE) cells in the back of the eye. Mutations in the gene KCNJ13, that encodes Kir7.1 protein, cause pediatric blindness. Dr. Pattnaik’s lab has generated induced pluripotent stem cells (iPSC) derived RPE cells from a Leber Congenital Amaurosis patient with KCNJ13 mutation. These cells, with a severe reduction in Kir7.1 function, were used to study biology of blindness and test gene and drug-based therapies as patient in-a-dish approach. His goal is to be able to manipulate defective gene in these cells through cutting age gene-editing technology as a possible treatment for pediatric blindness.

**Rebecca Meyer Brown Professor**

**Aparna Lakkaraju, PhD**
McPherson Eye Research Institute  
Department of Ophthalmology & Visual Sciences  
University of Wisconsin, Madison, WI

*Insight into the cellular basis of retinal degenerative diseases*

Research in the Lakkaraju laboratory builds on fundamental insights from retinal cell biology to develop effective therapies for inherited and age-related macular degenerations (AMD), which affect millions of people worldwide who have limited therapeutic options. To gain insight into disease mechanisms, her research team investigates critical pathways such as cellular clearance, mitochondrial function, inflammation, and immune privilege in the retina. Using state-of-the-art high-speed live imaging and mouse models of disease, they have recently identified clinically approved drugs that correct multiple dysfunctional pathways in a mouse model of early macular degeneration.
Established Research Awards

These awards were presented to renowned scientists in recognition of their lifetime achievement.

The Award of Merit in Retina Research

Michael Klein, MD
Casey Eye Institute
Oregon Health & Science University
Portland, OR

Genetics and Age-Related Macular Degeneration

In being chosen for the Award of Merit, Dr. Klein gave the Charles L. Schepens Lecture at the 50th Annual Scientific Meeting of The Retina Society in Boston, MA, which was held in October.

Dr. Klein’s clinical practice and research activities have focused on retinal diseases and surgery. He has been a Principal Investigator for several National Eye Institute (NEI) and industry-sponsored clinical trials and is author or co-author of numerous publications dealing with the etiology, natural history, risk factors, clinical-pathologic correlation, and therapy for macular and retinal vascular diseases. In recent years, he has been Principal Investigator of an NEI sponsored study of the genetics of age-related macular degeneration.

RRF Pyron Award for Outstanding Achievement in Retina Research

Paul A. Sieving, MD, PhD
Director, National Eye Institute
National Institutes of Health
Bethesda, Maryland

Considerations of Gene Therapy for Retinal Dystrophies

Dr. Sieving presented the RRF Pyron Award lecture at the 35th Annual Meeting of the American Society of Retina Specialists (ASRS), which was held in Boston, MA, in August.

Dr. Sieving is known internationally for studies of human retinal neurodegenerative diseases, termed retinitis pigmentosa. He originated the “NEI Audacious Goals Initiative,” a 15-year effort in regenerative medicine to replace photoreceptors and retinal ganglion cells lost from disease. Dr. Sieving continues clinical and research engagement as a tenured Senior Investigator in the NIH Intramural Research Program, and he has published some 260 peer reviewed papers in ocular genetics and the pathophysiology of retinal neurodegenerative diseases.
Established Research Awards

Charles L. Schepens, MD/AAO Award

Frederick L. Ferris III, MD
National Eye Institute
Bethesda, MD

Clinical Trials in Ophthalmology:
Advances in Treating Diabetic Retinopathy

In being selected for the Charles L. Schepens, MD/AAO Award, Dr. Ferris gave the Charles L. Schepens, MD/AAO Lecture at the Retina Subspecialty Day of the American Academy of Ophthalmologists (AAO) Annual Meeting in New Orleans, LA, on November 10.

Dr. Ferris has been Director of the Division of Epidemiology and Clinical Applications at the National Eye Institute (NEI) since 1994 and was Clinical Director at NEI from 2000 to 2017. He has participated in many clinical trials during his NEI career; notably, he was Project Officer of the Diabetic Retinopathy Study, Co-Chairman of the Early Treatment Diabetic Study and Chairman of the Age-Related Eye Disease Study. Dr. Ferris has published 295 manuscripts in peer review journals and is actively involved in AREDS2, CATT, DRCR.net studies and multiple intramural clinical studies at NEI as well as being a senior editor of JAMA-Ophthalmology.

Schepens Award 10th Anniversary:
Dr. Alice McPherson and Schepens Medalists
Dr. Rick Ferris (2017), Dr. Jerry Shields (2014), Dr. Mark Blumenkranz (2015), Dr. Harry Flynn (2016), and Dr. Larry Yannuzzi (2013)

Paul Kayser / RRF Global Award

Jennifer Kang-Mieler, PhD
Illinois Institute of Technology
Chicago, IL

A novel microsphere-hydrogel ocular drug delivery system for anti-vascular endothelial growth factors (anti-VEGFs)

Dr. Kang-Mieler was chosen as the third Paul Kayser / RRF Global Awardee and delivered the award lecture at the 33rd Pan-American Congress in Lima, Peru, on August 9. Her research interests include translational research such as ocular drug delivery, nitric oxide sensor development, retinal imaging, electroretinography, retinal blood flow and modeling to name few. This award, presented every two years, recognizes outstanding achievement in visual science with preference given in the specialized field of research on the retina and vitreous.
RRF funds two programs of international fellowships, one a 12-month fellowship and the other a six-month fellowship.

**ICO - RRF Helmerich International Fellowships**

The International Council of Ophthalmology (ICO), in cooperation with the International Council of Ophthalmology Foundation (ICOF), and Retina Research Foundation, has established two international fellowships with income from an endowment created by Walter H. Helmerich, III. This year two, 12-month fellowships provide advanced subspecialty training for young ophthalmologists from developing countries who are recommended by the head of a teaching or public service institution and are committed to returning to a position at a teaching institution or public service hospital in their home country following the fellowship.

**Linda Espinosa Cernichiaro Amejandra, MD,** from Mexico, for training in retinopathy of prematurity (ROP) and pediatric retina with Dr. Audina Berrocal at Bascom Palmer Eye Institute, in Miami, FL. Following her training, Dr. Cernichiaro will return to the Asociación para Evitar la Ceguera en México in Mexico City as a member of the medical staff.

**Nilufer Yesilirmak, MD,** from Turkey, for training in cornea and external diseases with Dr. Ellen Koo at Bascom Palmer Eye Institute in Miami, Florida. Dr. Yesilirmak will return to Ankara Training and Research Hospital in Ankara, Turkey, as a cornea specialist following her fellowship.

**Gillingham Pan-American Fellowships/PAAO**

This program is administered for RRF by the Pan-American Association of Ophthalmology (PAAO). Two, six-month fellowships were awarded this year to Latin American ophthalmologists for training at leading institutions in the United States.

**Andrea Elizabeth Arriola-López, MD,** from Guatemala City, Guatemala, to Bascom Palmer Eye Institute, Miami, Florida, for training in uveitis with Dr. Thomas Albini and Dr. Eduardo Alfonso.

**Marcela A. Lonngi, MD,** from Bogotá, Colombia, to Jules Stein Eye Institute, Los Angeles, CA, for training in pediatric ophthalmology and strabismus with Dr. Joseph Demer.
Research Initiatives

RRF has endowed gifts with earnings applied to translational research and education to bring laboratory knowledge to the clinical level.

American Academy of Ophthalmology Educational Trust Fund

This educational program is administered for RRF by the American Academy of Ophthalmology, and upgrades clinical research skills in the field of retina. The 2017 funding for this program was $50,000.

RRF Lawrence Travel Scholarships

This program is administered by the Association for Research in Vision and Ophthalmology (ARVO) and is made possible by a gift to RRF from Joe M. and Eula C. Lawrence. A total of $20,000 was funded to provide travel expenses for young vitreoretinal scientists to attend the ARVO Annual Meeting to present their papers or posters. This year the meeting was held in May in Baltimore, MD.

In 2017, twenty-two ophthalmology students were selected from these schools:

University of Texas Medical Branch, Galveston, TX
Louisiana State University School of Medicine, New Orleans, LA
University of Pennsylvania, Philadelphia, PA
Doheny Eye Institute UCLA, Arcadia, CA
Indiana University, Indianapolis, IN
Medical College of Wisconsin, Milwaukee, WI
Vanderbilt University, Nashville, TN
Duke University, Durham, NC
Michigan State University, East Lansing, MI
New York University School of Medicine, New York City, NY
University of Iowa Hospitals & Clinics, Iowa City, IA
National Institutes of Health, Bethesda, MD
University of California, San Diego, CA
University of California, Irvine, CA
Tufts Medical Center, Boston, MA
SUNY, New York City, NY
University of Alabama at Birmingham, AL
Oregon Health and Sciences University, Portland, OR
Warren Alpert Medical School of Brown University, Providence, RI
Eight RRF Board members traveled to Madison, Wisconsin, on April 27 and 28, 2017, for events hosted by McPherson Eye Research Institute at University of Wisconsin-Madison.

The 5th Annual McPherson Endowed Lecture
This year’s McPherson Lecturer was Dr. José-Alain Sahel of University of Pittsburgh Medical Center and Institut de la Vision, Pierre et Marie Curie Medical School, Paris. He gave a very well-received talk titled “Shooting in the Dark: Maintaining cone function in retinal degenerations.” Dr. Sahel is focused on identifying the mechanisms underlying cone functional loss in blinding diseases so that new therapies can be designed to preserve or restore vision in these patients. A reception and dinner, hosted by McPherson ERI, were held that evening.

Meeting of the McPherson ERI Advisory Board
Dr. David Gamm, Humble Director, McPherson ERI, spoke to the MERI Advisory Board and the RRF Board members about how vision research is changing and how McPherson ERI can maximize its talent and resources to be most effective. He described how scientists of today work in multi-disciplinary teams, share equipment and resources, and have high budget requirements. Federal grants are most desirable because they come with funds for institutional (indirect) support in addition to the research funds.

RRF supports four Chairs and three Professorships at McPherson ERI, and one Chair at the Dept. of Ophthalmology and Visual Sciences, UW-Madison. This trip was an excellent opportunity for RRF Board members to become more familiar with the current research activities of the Institute.
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RRF 48th Anniversary Luncheon, May 17, 2017

Arthur “Tim” Garson, Jr, MD  
Director, Health Policy Institute  
Texas Medical Center, Houston, Texas

RRF Lecturer “Texas Medical Center: What’s New and What’s Coming?”

Dr. Frank Eggleston and Dr. Alice McPherson

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$14,999
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Ginger Kanaly, Millicent Mason and Patricia Boyd

Carre Constans and Wendy Ballard

Lewis Gissel and Henry Gissel
### Combined Statement of Financial Position

**December 31, 2017**

*with summarized financial information as of December 31, 2016*

<table>
<thead>
<tr>
<th>Assets</th>
<th>General Funds</th>
<th>Endowment Funds</th>
<th>2017 Total All Funds (Memorandum Only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash and cash equivalents</td>
<td>989,490</td>
<td>$ - $ 937,264</td>
<td>$ 2,038,754 $ 6,309,783</td>
</tr>
<tr>
<td>Contributions receivable</td>
<td>39,705</td>
<td>- $ 10,010</td>
<td>$ 54,715 $ 31,000</td>
</tr>
<tr>
<td>Investments</td>
<td>1,421,686</td>
<td>3,498,318</td>
<td>53,857,960</td>
</tr>
<tr>
<td>Furniture and equipment, net</td>
<td>20,516</td>
<td>$ 20,516</td>
<td>45,661,412</td>
</tr>
<tr>
<td>of accumulated depreciation of</td>
<td>12</td>
<td>- $ 12</td>
<td>13,495</td>
</tr>
<tr>
<td>$8,414</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intangible assets</td>
<td>12</td>
<td>- $ 12</td>
<td>12</td>
</tr>
</tbody>
</table>

| Total assets                  | $ 2,471,409   | $ 3,498,318     | $ 55,971,957 $ 52,015,702              |

| Liabilities and net assets    |               |                 |                                        |
| Accounts payable             | $ - $ $ 68,958 $ - $ 68,958 | $ 68,958 $ 50,031 |

| Commitments and contingencies |               |                 |                                        |
| Net assets                   | 2,471,409     | $ 3,498,318     | $ 55,902,999 $ 51,965,671             |

| Total liabilities and net assets | $ 2,471,409 | $ 3,498,318 | $ 55,971,957 $ 52,015,702 |

*Note: Tables represent financial information for General Funds and Endowment Funds, with a comparison to 2016 totals.*
# RETINA RESEARCH FOUNDATION
## COMBINED STATEMENT OF ACTIVITIES AND CHANGES IN NET ASSETS

For the year ended December 31, 2017
(with summarized financial information for the year ended December 31, 2016)

<table>
<thead>
<tr>
<th></th>
<th>General Funds</th>
<th>Endowment Funds</th>
<th>2017 Total All Funds (Memorandum Only)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unrestricted</td>
<td>Temporarily Restricted</td>
<td>Total</td>
</tr>
<tr>
<td><strong>Revenues</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contributions</td>
<td>$210,291</td>
<td>$150,098</td>
<td>$360,389</td>
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<tr>
<td>Interest, dividend and distribution income</td>
<td>44,437</td>
<td>-</td>
<td>44,437</td>
</tr>
<tr>
<td>Realized and unrealized gains on investments, net</td>
<td>93,336</td>
<td>-</td>
<td>93,336</td>
</tr>
<tr>
<td>Mineral interest income and other income</td>
<td>19,879</td>
<td>-</td>
<td>19,879</td>
</tr>
<tr>
<td>Change in value of split-interest agreement</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Income transferred from Endowment Fund investments</td>
<td>1,300,284</td>
<td>75,000</td>
<td>1,375,284</td>
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<tr>
<td>Net assets released from restrictions - satisfaction of program restrictions</td>
<td>154,098</td>
<td>-</td>
<td>154,098</td>
</tr>
<tr>
<td><strong>Total revenues</strong></td>
<td>1,822,325</td>
<td>71,000</td>
<td>1,893,325</td>
</tr>
<tr>
<td><strong>Expenses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research projects and grants</td>
<td>1,198,740</td>
<td>-</td>
<td>1,198,740</td>
</tr>
<tr>
<td>Public education</td>
<td>36,000</td>
<td>-</td>
<td>36,000</td>
</tr>
<tr>
<td>Career development and awards</td>
<td>85,731</td>
<td>-</td>
<td>85,731</td>
</tr>
<tr>
<td><strong>Total program services</strong></td>
<td>1,320,471</td>
<td>-</td>
<td>1,320,471</td>
</tr>
<tr>
<td>Management and general</td>
<td>103,400</td>
<td>-</td>
<td>103,400</td>
</tr>
<tr>
<td>Fundraising</td>
<td>35,304</td>
<td>-</td>
<td>35,304</td>
</tr>
<tr>
<td><strong>Total supporting services</strong></td>
<td>138,704</td>
<td>-</td>
<td>138,704</td>
</tr>
<tr>
<td><strong>Total expenses</strong></td>
<td>1,459,175</td>
<td>-</td>
<td>1,459,175</td>
</tr>
<tr>
<td><strong>Changes in net assets</strong></td>
<td>363,150</td>
<td>71,000</td>
<td>434,150</td>
</tr>
<tr>
<td><strong>Net assets, end of year</strong></td>
<td>$2,471,409</td>
<td>$117,000</td>
<td>$2,588,409</td>
</tr>
</tbody>
</table>

The accompanying notes are an integral part of these combined financial statements.
<table>
<thead>
<tr>
<th>Board of Directors</th>
<th>Advisory Trustees</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2010s</strong></td>
<td></td>
</tr>
<tr>
<td>Harry E. Bovay, Jr</td>
<td>Eveline T. Boulafendis/A. A. Margolin</td>
</tr>
<tr>
<td>Jake Kamin</td>
<td>June Bowen/Kent H. McMahan</td>
</tr>
<tr>
<td>Herbert A. Lesser, PhD</td>
<td>William E. Carl/Charles P. Moreton</td>
</tr>
<tr>
<td>Carl G. Mueller, Jr</td>
<td>James T. Cox/Helen Record</td>
</tr>
<tr>
<td>Cecil C. Rix, PhD</td>
<td>Peggy Duggan/John Van Ramshorst, Jr.</td>
</tr>
<tr>
<td></td>
<td>James A. Elkins, III/Martha Rix</td>
</tr>
<tr>
<td></td>
<td>Helen Fourmy/Herbert A. Lesser, PhD</td>
</tr>
<tr>
<td></td>
<td>Aileen Gordon/William E. Harreld, Jr.</td>
</tr>
<tr>
<td></td>
<td>Walter H. Helmerich, III/J. Donald Squibb</td>
</tr>
<tr>
<td></td>
<td>Fred L. Landry/Lillian B. Wallace</td>
</tr>
<tr>
<td><strong>2000s</strong></td>
<td></td>
</tr>
<tr>
<td>Thomas D. Anderson</td>
<td>Dorothy Adams/Michael Halbouty</td>
</tr>
<tr>
<td>Harry Austin</td>
<td>Samuel Brochstein/Esther Janca</td>
</tr>
<tr>
<td>August Bering, III</td>
<td>Donald E. Brown/Willard M. Johnson</td>
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<tr>
<td>Miles Glaser</td>
<td>Earl A. Brown/Eleanor McCollum</td>
</tr>
<tr>
<td>Saunders Gregg</td>
<td>Lillian Cooley/Vaughan Meyer</td>
</tr>
<tr>
<td>E.J. Hagstette</td>
<td>Lucyle Rowan Dawson/Charles Milby</td>
</tr>
<tr>
<td>Baine Kerr</td>
<td>Vernon W. Frost/Anthony Mierzwa</td>
</tr>
<tr>
<td>Bertha Miller</td>
<td>Margaret Gillingham/Rush Record</td>
</tr>
<tr>
<td></td>
<td>Harry B. Gordon/Richard Rolle</td>
</tr>
<tr>
<td></td>
<td>Ellen Gover/Katherine Tyson</td>
</tr>
<tr>
<td></td>
<td>Adolphe G. Gueymard/JP Watson</td>
</tr>
<tr>
<td><strong>1990s</strong></td>
<td></td>
</tr>
<tr>
<td>James M. Barr</td>
<td>Buck Arnold/Winona Loeffler</td>
</tr>
<tr>
<td>Laura Lee Blanton</td>
<td>Faith Bybee/William O. Manning</td>
</tr>
<tr>
<td>Ted Bowen</td>
<td>Norman A. Binz/Harold J. McKenzie</td>
</tr>
<tr>
<td>E.C. Japhet</td>
<td>Jack Cooley/Robert E. Moroney</td>
</tr>
<tr>
<td>Alfred Knapp</td>
<td>Marcus Ginsburg/James R. Ording</td>
</tr>
<tr>
<td>Fred Wallace</td>
<td>Mona Griswold/Milton Potts</td>
</tr>
<tr>
<td>Henry Weaver</td>
<td>Claire L. Johnson/Hattie Le Red</td>
</tr>
<tr>
<td></td>
<td>Elizabeth Jobst/George Reed</td>
</tr>
<tr>
<td></td>
<td>Albert P. Jones/Selma Scheps</td>
</tr>
<tr>
<td></td>
<td>Max Levine/Tom H. Wharton</td>
</tr>
<tr>
<td></td>
<td>Lee Loeffler/Herbert W. Varner</td>
</tr>
<tr>
<td><strong>1980s</strong></td>
<td></td>
</tr>
<tr>
<td>John C. Dawson, Sr</td>
<td>Valient Baird/Aubrey C. Martindale</td>
</tr>
<tr>
<td>Arthur A. Draeger</td>
<td>Harry I. Battelstein/Latimer Murfee</td>
</tr>
<tr>
<td>Donald Griswold</td>
<td>Herbert R. Gibson, Sr/R. Bryon Robins</td>
</tr>
<tr>
<td>Frank R. Jobst</td>
<td>Opie B. Leonard</td>
</tr>
<tr>
<td><strong>1970s</strong></td>
<td></td>
</tr>
<tr>
<td>Knox Tyson</td>
<td>Harold Link</td>
</tr>
<tr>
<td></td>
<td>Joseph W. Robertson</td>
</tr>
<tr>
<td></td>
<td>John H. Miracle</td>
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