Restoring Vision to the Blind

The Lasker/IRRF Initiative for Innovation in Vision Science

Table of Contents

Restoring Vision to the Blind: Project Background and Acknowledgements ........................................... i
Restoring Vision to the Blind: Introduction .................................................................................................. 1
Chapter 1 Restoring Vision to the Blind: The New Age of Implanted Visual Prostheses ........................... 3
Chapter 2 Restoring Vision to the Blind: Optogenetics ............................................................................. 14
Chapter 3 Restoring Vision to the Blind: Gene Therapy for Vision Loss: The Road Ahead ..................... 23
Chapter 4 Restoring Vision to the Blind: Stem Cells and Transplantation ............................................. 33
Chapter 5 Restoring Vision to the Blind: Endogenous Regeneration ....................................................... 42
Chapter 6 Restoring Vision to the Blind: Neuroprotection ...................................................................... 48
Chapter 7 Restoring Vision to the Blind: Advancements in Vision Aids for the Visually Impaired .......... 54
Chapter 8 Restoring Vision to the Blind: Evaluating Visual Function, Endpoints .................................... 63
Restoring Vision to the Blind: Concluding Remarks .................................................................................. 70

Appendix 1
Joint Advisory Board and Collaborating Executives

Appendix 2
Steering Committee

Appendix 3
Participants

Project Background and Acknowledgements

The Albert and Mary Lasker Foundation (Lasker) and the International Retinal Research Foundation (IRRF) entered into a 10-year collaboration that began July 15, 2008 with the goal of identifying knowledge gaps in vision research and developing innovative strategies to advance retinal research and accelerate discovery of sight-saving treatments and prevention of retinal degenerative diseases. Restoring Vision to the Blind is the third report by the Lasker/IRRF Initiative for Innovation in Vision Science. The Initiative’s first report, Astrocytes and Glaucomatous Neurodegeneration, was published in November 2010. The Initiative then examined diabetic retinopathy, one of the leading causes of visual impairment and blindness in the world, and issued its report, Diabetic Retinopathy: Where We Are and A Path to Progress, in November 2012.

John E. Dowling, Gordon and Llura Gund Professor of Neurosciences at Harvard University, chairs the Initiative, with the guidance of a Lasker/IRRF Joint Advisory Board and collaborating executives (Appendix 1), and each study is undertaken using a Steering Committee (SC) of bench and clinical scientists with expertise in interdisciplinary fields and the combined skills, knowledge, and experience necessary to identify key issues and hurdles confronting vision scientists. The SC identifies leaders in diverse fields to participate in workshops during which key impediments to research progress are identified. These workshops are followed by a plenary session at which small groups focus on specific targeted areas and develop a framework of innovative multidisciplinary approaches to accelerate discovery and its translation to clinical application. The results of these sessions are published by the Initiative for wide distribution within the research community and to potential funders and other organizations interested in advancing research in retinal degenerative diseases.

In the fall of 2012, the Initiative undertook a bold new investigation of potential breakthroughs to restore vision lost as a result of retinal degenerative disease. The Initiative chose to explore the major question of which approaches are most promising and most likely to benefit the greatest number of blind individuals. Given the breadth and complexities of this
topic, the Initiative invited a small group of scientists, who later formed the SC (Appendix 2), to meet at the Institut de la Vision in Paris. There, they looked at all of the major research efforts underway and clarified the objectives of this effort: how best to exploit the newest insights and cutting edge technologies to re-establish light sensitivity, and restore visual perception damaged or destroyed by retinal degeneration. The SC also identified the key scientists who participated in this Initiative (Appendix 3). Two workshops were subsequently held in Woods Hole, Massachusetts in the summer of 2013, followed by a plenary session in March 2014.

We were honored to be joined at the opening of the plenary meeting by Sanford D. Greenberg and his wife Susan. Following a colorful introduction by Peter McDonnell, Director of the Johns Hopkins’ Wilmer Eye Institute, Mr. Greenberg gave a compelling keynote address to the Initiative participants, sharing his inspirational journey from the despondent days following his loss of sight while an undergraduate at Columbia to his uncompromising achievements in academia, government, business, and philanthropy. With that same determination, he is now focused on galvanizing global research efforts toward the goal of ending blindness forever. Mr. Greenberg’s presentation can be downloaded at https://www.dropbox.com/s/qyiie2wenje1w9q/SandyG.mp4.

The Initiative thanks the Boards of Directors of the Albert and Mary Lasker Foundation and the International Retinal Research Foundation for their support; the Initiative’s Joint Advisory Board and SC, for their counsel; the Discussion Leaders who guided the development of the key issues discussed in this report and the scribes who recorded the discussions and drafted chapter texts; and all participants, for their energy, expertise, and lively discourse. Special thanks go to Karen M. Wright, Project Administrator for her diligent and essential administrative direction; to Meredith Graves, Project Manager, for her logistical support; and to Sandra Blackwood, Executive Director of the IRRF, and Claire Pomeroy, President of Lasker, for their constancy and contributions to this endeavor.

The Initiative is most appreciative to José-Alain Sahel, and his staff at the Institut de la Vision, Paris, for so memorably hosting the October 2012 planning session. The Initiative gratefully acknowledges both the Howard Hughes Medical Institute for its very generous in-kind contribution by making available the facilities at its Janelia Farm Research Campus in Ashburn, Virginia, for the Initiative’s plenary session, and the staff of the National Academy of Sciences’ J. Eric Jonsson Center in Woods Hole, Massachusetts, for their gracious hospitality during the two summer workshops.

This chapter is part of the Restoring Vision to the Blind report by the Lasker/IRRF Initiative for Innovation in Vision Science. The full report, Restoring Vision to the Blind, including a complete list of contributors, is available in the Supplementary Material.

Correspondence: See Appendix 2 in the Supplementary Material.