

# Book Review

## Animal Models in Eye Research

*Edited by Panagiotis A. Tsonis*

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The eyes have it! From the first glimpse of *Animal Models in Eye Research* comes the realisation that it is not a typical monograph. As well it shouldn't be. Eyes are, after all, special. It is human nature to be drawn to eyes. So, too, will readers be drawn to this book. The cover is a work of art, with a collage of eyes representing rabbits, toads, mouse embryos and flatworms overlaid on a background of a fly eye imaginal disc being converted into a retinal lattice tessellation by the passage of the morphogenetic furrow. These are not simply drawings or photographs in tones of grey, but full colour images in stunning greens, orange and blues, reds and golds and purple. The visual appeal of the cover makes this a handsome piece to enhance any library and is sure to encourage the reader, scientist and non-scientist alike, to investigate further.

What Dr Tsonis assembles inside is an impressive group of 14 chapters emphasising the strengths of a wide assortment of experimental animal models and how these can be exploited better to understand the processes of ocular development, function and regeneration. The book commences with a short chapter by Elke Buschbeck in which the physical limitations, evolutionary origins and morphological variety of present day eye types are introduced, serving as an appropriate appetiser for the subsequent buffet of ocular diversity. The remaining chapters are arranged phylogenetically, beginning with a chapter on light perception in unicellular organisms based on rhodopsin phototransduction variations found in prokaryotic halophilic Archaea and cyanobacteria, as well as in the eukaryotic green alga, *Chlamydomonas reinhardtii*. Although these organs do not have the ability to use light to form visual images, they can quantify light intensity so as to coordinate movement to their preferred environmental illumination. Amazingly, each of these unicellular organisms shares a seven-transmembrane helix protein as the base molecule

of photoperception in common with the visual pigments present throughout the animal kingdom. The book concludes with two rather clinically orientated chapters on cataract surgery in rabbits and non-human primates. The intervening chapters introduce the experimental virtues of planarians, *Drosophila*, the Antarctic toothfish, *Xenopus*, newts, chicks, mice and rats.

Given the expertise of the editor, it is not surprising that regeneration is a recurrent theme in many of the chapters. This theme is introduced by Saló and Batistoni in a fascinating chapter on planarians, which are able to regenerate an entire organism, including the eyes, from only a small body fragment. This particular chapter is laced with molecular and mechanistic insight into eye formation in this species and includes an impressive table of genes comparing eye-relevant orthologous genes in planarians, vertebrates and *Drosophila* with corresponding planarian RNA interference knockdown phenotypes. The *Xenopus* chapter rightly begins by reminding the reader of the historical significance of amphibians to the understanding of development and regeneration, and quickly moves into modern justifications to focus on *Xenopus* for eye research. The completed sequence of the *Xenopus tropicalis* genome, coupled with the vast array of molecular tools and the ability to use both morpholino and transgenic approaches to manipulate gene expression, make *Xenopus* an attractive vertebrate model to understand the mechanisms of both eye development and regeneration. The regeneration theme continues with a chapter on mechanistic insights into the molecular basis of retina and lens regeneration in the newt, the undefeated champion of vertebrate regeneration. The chapter on the chick describes a newer model of retina regeneration, focusing on experimental manipulations including the use of surgical and chemical manipulations and mechanisms of gene transfer, including the RCAS retrovirus, *in ovo* electroporation and lipid-based transfection. These are used to probe the genetic mechanics of two distinct sources of retina regeneration — namely, that from transdifferentiation of the retina pigment epithelium and that from retinal stem cells present in the ciliary margin. Although there are no mammalian models of retina regeneration appearing in the text, the regeneration theme concludes with lens regeneration in rabbits following cataract surgery, when the lens capsule remains in place, offering the hope that one day autologous lens regeneration in human patients may be a medically viable procedure.

Other sections of the book include a review of *Drosophila melanogaster* eye development by Sprecher and Desplan, focusing on photoreceptor specification and the conserved genetic interplay of the retinal determination network. Not typically included in such chapters is an interesting section on the fly larval eye development, which, in contrast to the adult eye, does not require *Drosophila Pax6* orthologs *ey* or *toy*. The Antarctic toothfish, sporting a face only a mother toothfish could love, is the subject of an interesting chapter by Andor Kiss. It describes genetic adaptations of crystallin protein genes that permit the lenses of these fish to remain clear at environmental temperatures that would opacify those of terrestrial organisms and non-polar fish. The remaining chapters cover rodent models of eye research, among which modern conditional and inducible genetic manipulations possible with mice are summarised in a chapter by Song and Lang. The use of mouse genetic models to understand corneal development and pathogenesis and lens cataracts in Chapter 11 includes two comprehensive tables with referenced lists of available mouse strains for corneal and cataract studies. Tsonis has also included a chapter by Lovicu and McAvoy, which provides detailed information on the preparation and processing of mammalian lens epithelial explants. Although a comprehensive chapter on

mouse models of retina development and function is missing, a very interesting chapter on irradiance detection in the mammalian retina is a fascinating and insightful inclusion in this work. The presence of intrinsically photosensitive retinal ganglion cells and their role in influencing the mammalian circadian clock in the presence and absence of rod and cone photoreceptors makes captivating reading.

What Tsonis undertakes is to introduce those familiar and unfamiliar with eye research to a wide array of experimental models and approaches—each with intrinsic advantages and difficulties—to understanding eye evolution, development and function. This is accomplished through the inclusion of both classically expected and surprisingly unique chapters interwoven with brilliant, colourful illustrations and photographs throughout. James Russell Lowell once said: ‘The eye is the notebook of the poet.’ This text demonstrates, in colourful detail, that there is poetry inherent in eye development, structure and function. In this case, you can indeed judge the book by its cover.

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