VISUAL SYSTEM

Putting the visual cycle in the shade

In animals with colour vision, the retina contains at least two types of photoreceptor cell. Rod cells function optimally at low light intensities, whereas daylight vision is mediated predominantly by cone cells. Light causes visual pigments in the photoreceptors to undergo a chemical reaction, and for the cell to maintain its photosensitivity, the pigment must be recycled continually. An enzymatic pathway called the visual cycle was thought to be responsible for this process, but it has become clear that this pathway is too slow to maintain photosensitivity during constant exposure to light. Now, however, Mata *et al.* have identified a new, faster regeneration mechanism that seems to be exclusive to cone pigments.

The photosensitive component of the visual pigment is the vitamin A derivative retinaldehyde. When a photoreceptor is exposed to light, the 11-*cis* form of retinaldehyde is isomerized to the all-*trans* form, and to restore the photoreceptor to its resting state, it must be converted back to the 11-*cis* form. Mata *et al.* analysed retinas from the chicken and the ground squirrel, both of which contain a high proportion of cones. They found three previously unidentified enzymatic activities — an all-*trans*-retinol isomerase, an 11-*cis*-retinyl ester synthase and an 11-*cis*-retinol dehydrogenase — which form a pathway that catalyses the conversion of all-*trans*-retinaldehyde to the 11-*cis* form. Interestingly, the level of enzymatic activity was proportional to the percentage of cones in the retina, indicating that this pathway might be important for cone pigment regeneration. The rate of pigment regeneration through the new pathway was 20 times faster than that of the classical visual cycle, and the authors calculate that this should be sufficient to sustain vision in all but the brightest sunlight.

It seems surprising that this alternative pathway has gone unrecognized for so long, but this might be explained by the fact that previous studies on visual pigment regeneration have focused on rod-dominant retinas, such as those of the mouse or the cow. As this pathway has already been identified in two quite distantly related species, it is expected to be a common mechanism for all animals that use cones for daylight vision.

Heather Wood

References and links

ORIGINAL RESEARCH PAPER Mata, N. L. *et al.* Isomerization and oxidation of vitamin A in cone-dominant retinas: a novel pathway for visual-pigment regeneration in daylight. *Neuron* **36**, 69–80 (2002)

FURTHER READING Arshavsky, V. Y. Like night and day: rods and cones have different pigment regeneration pathways. *Neuron* **36**, 1–3 (2002)

WEB SITES

Encyclopedia of Life Sciences:
http://www.els.net/
visual cascade

IN BRIEF

LANGUAGE

Selective priming of syntactic processing by event-related transcranial magnetic stimulation of Broca's area.

Sakai, K. L. *et al. Neuron* **35**, 1177–1182 (2002)

Lesions of Broca's area cause aphasia, but it is not clear whether this effect is related to a syntactic or a semantic deficit. Sakai *et al.* used transcranial magnetic stimulation (TMS) to interfere transiently with the activity of Broca's area while subjects were required to judge whether a series of sentences were semantically or syntactically normal. They found that the effect of TMS was limited to syntactic decisions, highlighting the role of Broca's area in syntactic processing.

NEUROLOGICAL DISORDERS

Intracellular ataxin1 inclusions contain both fast- and slow-exchanging components.

Stenoien, D. L. *et al. Nature Cell Biol.* 30 September 2002 (doi:10.1038/ncb859)

Polyglutamine protein aggregates are dynamic.

Kim, S. *et al. Nature Cell Biol.* 30 September 2002 (doi:10.1038/ncb863)

These two papers highlight the dynamic nature of polyglutamine protein aggregates. In the first article, the authors used fluorescence recovery after photobleaching to identify two types of ataxin 1 inclusions — aggregates in which ataxin 1 is rapidly exchanged with the soluble pool, and aggregates in which such an exchange is slow. As slow-exchanging aggregates contain high levels of ubiquitin but not of proteasomes, the authors suggest that proteasomes might fail to recognize the ubiquitinated substrates in this type of aggregate. In the second paper, the authors used the same technique and a related method (fluorescence loss after photobleaching) to reveal that the association of the chaperone Hsp70 with huntingtin aggregates is not irreversible, as was previously thought, but transient. This finding challenges the assumption that polyglutamine disorders affect neuronal function by sequestering essential components of the cellular machinery. The dynamic nature of polyglutamine protein aggregates highlights the potential of therapeutic interventions that aim to promote their dissolution.

NEUROLOGICAL DISORDERS

A *Drosophila* fragile X protein interacts with components of RNAi and ribosomal proteins.

Ishizuka, A. *et al. Genes Dev.* **16**, 2497–2508 (2002)

Fragile X syndrome is a form of mental retardation that is caused by alterations in the function of the FMR1 protein. Studying the *Drosophila* homologue of FMR1 (Fmr1), the authors found that a complex of proteins that mediate RNA interference (RNAi) in the fly can interact directly with the Fmr1 protein. RNAi is an important gene-silencing mechanism that has been described mainly in *Drosophila* and plants. These findings raise the possibility that a regulatory mechanism of this type might also be related to human disease.