VISUAL SYSTEM

Written in the stars

Waves of spontaneous electrical activity in the developing retina are thought to provide important signals for the establishment of precise neuronal connectivity in the visual system. In a recent paper in *Neuron*, Zheng and colleagues explore how these 'retinal waves' are generated, and how they are shut down as the visual system reaches maturity. The authors identify a pivotal role for a network of amacrine interneurons called starburst cells.

Zheng *et al.* used a dual patch-clamp recording technique to analyse the connections between starburst cells in the perinatal rabbit retina. They found that the cells are reciprocally interconnected by GABA (γ-aminobutyric acid)-releasing and nicotinic cholinergic synapses. Moreover, individual starburst cells can co-release GABA and acetylcholine in a calcium-dependent manner. Although GABA is best known for its inhibitory actions, it functions as an excitatory neurotransmitter in the developing nervous system. Therefore, in the early starburst network, the cells are wired together by two types of excitatory synapse.

Previous studies have shown that retinal waves depend on nicotinic neurotransmission. Consistent with this idea, Zheng *et al.* obtained evidence that the waves are propagated through mutual excitation between starburst cells, which is mediated by the nicotinic synapses. It is still unclear how the waves are initiated, but, once set in motion, it seems that they can be driven entirely from within the starburst network.

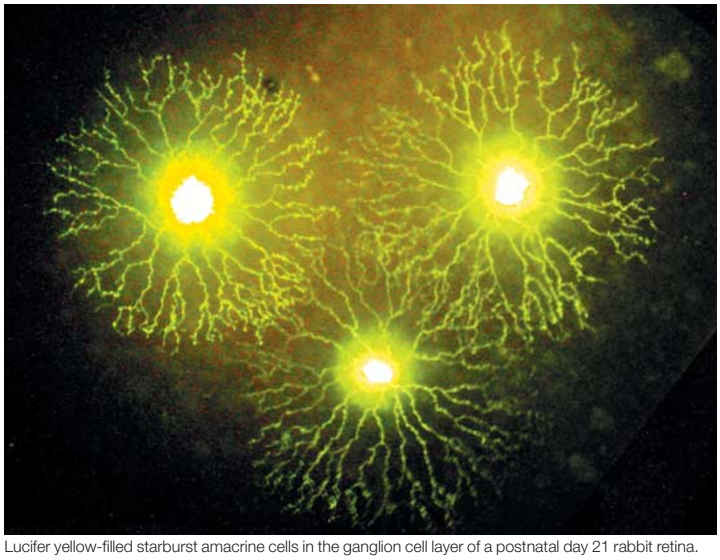
The authors also showed that profound changes occur in the connectivity of the starburst network in the first postnatal week, concomitant with eye opening and the onset of vision. The nicotinic synapses are lost, and the GABA-releasing synapses become inhibitory, thereby transforming the hyperexcitatory network into an inhibitory network. The inhibitory activity is evoked by light, indicating that it has an important role in vision. Previous studies have implicated starburst cells in the detection of motion direction, and Zheng *et al.* propose that this role is accomplished through lateral inhibition in the starburst network.

This study provides the first definitive evidence that the starburst amacrine cells initially form an excitatory network, which is important for the development of the visual system. As the visual system matures and begins to process real visual signals, excitation switches to inhibition, generating a mutually inhibitory network that is better adapted for the processing of visual information.

Heather Wood

References and links

ORIGINAL RESEARCH PAPER Zheng, J.-j. *et al.* A developmental switch in the excitability and function of the starburst network in the mammalian retina. *Neuron* **44**, 851–864 (2004)
FURTHER READING Ben-Ari, Y. Excitatory actions of GABA during development: the nature of the nurture. *Nature Rev. Neurosci.* **3**, 728–739 (2002) | Euler, T. *et al.* Directionally selective calcium signals in dendrites of starburst amacrine cells. *Nature* **418**, 845–852 (2002)



Lucifer yellow-filled starburst amacrine cells in the ganglion cell layer of a postnatal day 21 rabbit retina. Image courtesy of Q. Yang and Z. J. Zhou, University of Arkansas for Medical Sciences, Little Rock, Arkansas, USA.