This Week in The Journal

● Cellular/Molecular

DRG-Derived BDNF and Myelination

Benjamin K. Ng, Lian Chen, Wilhelm Mandemakers, José M. Cosgaya, and Jonah R. Chan

(see pages 7597–7603)

Although neurotrophic factors are usually considered to be target-derived secretory products that are then retrogradely transported to their site of action, this week Ng et al. provide more proof that BDNF can move in other directions. The authors examined the source of BDNF necessary for Schwann cell-mediated myelination of sensory nerves. BDNF expression increased soon after purified Schwann cells were cocultured with dorsal root ganglion (DRG) neurons. The expression was greatest prior to myelination. Using Campenot chambers, the authors report that BDNF was secreted from the compartment containing DRG axons as well as the cell body compartment, consistent with anterograde transport and secretion from the surface of the axons. Viral-mediated gene transfer of myc-tagged BDNF into DRGs was later detected in Schwann cells, consistent with transfer of BDNF from DRG to Schwann cell. Overexpression of BDNF in DRGs also led to anterograde transport, secretion, and enhanced myelination.

DRGs were cultured in Campenot chambers, which allowed analysis of BDNF secretion from cell bodies and axons. See the article by Ng et al. for details.

▲ Development/Plasticity/Repair

Making Shaft Synapses

Jason Aoto, Pamela Ting, Bita Maghsoodi, Nanjie Xu, Mark Henkemeyer, and Lu Chen

(see pages 7508–7519)

Although excitatory synapses on dendritic spines seem to get most of the experimental attention, a subset of excitatory synapses end up on dendritic shafts. In some cells after all, such as many interneurons, there are no dendritic spines. Synapses on shafts are predicted to have distinct impacts on cell excitability based on differences in synaptic size and the electrotonic properties of dendrites. This week, Aoto et al. show that the formation of shaft synapses in cultured hippocampal pyramidal cells depends on so-called reverse ephrinB3 signaling. Reducing postsynaptic ephrinB3 by RNA interference decreased shaft synapses, whereas overexpression of ephrinB3 increased them. The effects of ephrin B3 knockdown were reversed by overexpression of the glutamate receptor-interacting protein 1 (GRIP1). Reverse ephrin signaling contrasts with forward ephrin signaling in which presynaptic ephrinBs promote spine synapse formation as a result of activation of postsynaptic EphB receptors.

■ Behavioral/Systems/Cognitive

Sensorimotor Integration in C. elegans

Christopher V. Gabel, Harrison Gabel, Dmitri Pavlichin, Albert Kao, Damon A. Clark, and Aravinthan D. T. Samuel

(see pages 7586–7596)

This week, Gabel et al. show that worms have a good understanding of high school physics even without reading the textbook. The authors placed worms within an electric field and observed, as expected, that the worms crawled toward the negative pole. The threshold field strength was about 3 V/cm. However, rather than going directly for the pole, the worms followed an angular path that corresponded to the force lines in the electrical field. Time-varying fields caused the worms to reverse and turn. For example, steady rotation of the field caused worms to crawl in perfect circles for hours, perhaps similar to rotary traffic during a Boston rush hour. Laser ablation of amphid sensory neurons, particularly ASJ or ASH, disrupted this electrosensory behavior. These neurons were sensitive to the direction and strength of electric fields as measured by calcium imaging of immobilized worms. The behavior may provide a useful model system for sensorimotor integration.

♦ Neurobiology of Disease

$GABA_A$ Receptor Localization in Epileptic Mice

Nianhui Zhang, Weizheng Wei, Istvan Mody, and Carolyn R. Houser

(see pages 7520–7531)

The subunit composition of $GABA_A$ receptors determines in part whether GABA-mediated inhibition is phasic or tonic. For example, δ and α4 subunits are often expressed in $GABA_A$ receptors that mediate tonic inhibition at perisynaptic or extrasynaptic locations. In contrast, γ2 subunits are generally located at synapses and are involved in phasic inhibition. This week, Zhang et al. examined the location of these $GABA_A$ receptor subunits in mice rendered epileptic by pilocarpine treatment, a standard animal model of temporal lobe epilepsy. Postembedding immunogold labeling confirmed a perisynaptic decrease in the δ subunit in dentate granule cell dendrites within the molecular layer. However, physiological studies found that tonic inhibition was still present. The γ2 subunits shifted toward perisynaptic locations in the epileptic mice in parallel with a decrease in phasic inhibition. The authors suggest that receptors containing α4 and relocated γ2 may underlie tonic inhibition in the epileptic mice.