EDITORS' CHOICE

edited by Gilbert Chin

EVOLUTION

Genomics in Development

Female social insects exhibit polyphenism; that is, they exhibit various defined phenotypes (queens, workers, soldiers, etc.) according to their larval environment. No genomic differences are involved, only developmental switches resulting from different gene expression patterns triggered by worker-controlled nutritional and microenvironmental differences within the nest.

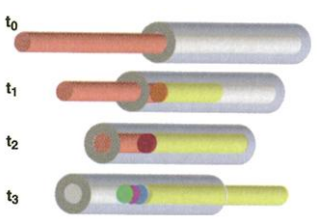
Evans and Wheeler characterize these expression patterns for a range of proteins in queen and worker honeybee larvae, showing divergences in expression during development. For instance, cytochromes from the CYP4 subfamily showed enhanced activity in workers after the third instar, while ATP synthase and cytochrome oxidase became overexpressed in fifth-instar queen larvae (the stage at which queen larvae grow at much greater rates than worker larvae). — AMS

Genome Biol., in press.

CHEMISTRY

Concentrating on the Target

Small neutral molecules (such as drugs or pollutants) are important targets for "labs on a chip." However, many analytical methods rely on general detection methods such as ultraviolet or visible absorption spectroscopy. For miniaturized systems, low concentrations, small sample volumes, and short path lengths for light can limit sensitivity.



As the sample plug (red) moves through the co-ion boundary (dark interface), analytes are "stacked" and separated (green, magenta, and blue disks).

Palmer *et al.* show that for capillary electrophoresis, sample plug injections (and thus the total amount of analyte) are not limited by the physical length of the capillary. Sample plugs longer than the entire capillary were injected by electroosmotic flow: a co-ion boundary with opposite ion mobility "stacks" (concentrates) the neutral analytes. This injection method is at least as sensitive, and approximately an order of magnitude faster, than previous injection methods, and could be used for a wide variety of neutral analytes with hydrophobic character, such as polycyclic aromatic hydrocarbons, small biomolecules, and environmental contaminants. — PDS

Anal. Chem., in press.

NEUROSCIENCE

Presynaptic Modulation by Cannabinoids

The cannabinoid receptor CB1 is found throughout the body, including the central nervous system, and is thus responsible for all of the central activities of the endocannabinoid system. Two studies apply specific CB1 receptor antagonists and agonists to investigate the mechanisms underlying the modulatory function of endocannabinoid receptor activation.

Gerdeman and Lovinger show that activation of CB1 receptors causes inhibition of glutamate release from afferent presynaptic terminals in the striatum. This inhibition is due to a decrease in release probability at a stage downstream from presynaptic action potentials and Ca^{2+} channels. By combining immunohistochemistry and electrophysiology, Robbe *et al.* find that in the nucleus accumbens CB1 receptors are localized on presynaptic excitatory fibers contacting GABAergic neurons. Activation of CB1 receptors, by modulating potassium channel conductances, reduces glutamatergic transmission. This reduced excitation results in decreased firing of the postsynaptic inhibitory cells and may lead in turn to stronger activation of mesolimbic dopamine neurons. — PRS

J. Neurophysiol. **85**, 468 (2001); *J. Neurosci.* **21**, 109 (2001).

CLIMATOLOGY

California's Decadal Records

Measurements of Pacific Ocean sea surface temperatures have revealed a pattern of decadal variability called the Pacific Decadal Oscillation (PDO). This variability has a strong influence on North American climate and appears to be related to the El Niño–Southern Oscillation. Unfortunately, the instrumental record extends back only to about 1900, which is too short for assessing whether the PDO is a persistent or regular feature of climate.

Biondi *et al.* have developed a tree-ring chronology from Southern and Baja California, an area well suited to investigate changes in the eastern Pacific Ocean, that they use as a proxy for the PDO for the past nearly 350 years. The major features of the tree growth record are closely related to those of the PDO index for the past 75 years, and the rings display a pattern of decadal variability, stronger during some periods than during others, throughout the interval they studied. Their PDO reconstruction shows that the largest shifts in regional climate occurred around 1750, 1905, and 1947, and that three of the four most significant decadal climate transitions of the past 330 years occurred in the twentieth century. — HJS

J. Clim. **14**, 5 (2001).

SOLAR PHYSICS

Helium-Rich Flares

Solar flares spew hot plasma at Earth, and this plasma interacts with the magnetosphere, ionosphere and atmosphere. Conspicuous manifestations of this interaction are space weather and aurorae.

Mason *et al.* used the Advanced Composition Explorer spacecraft to measure the composition of some of the lowest energy particles in a flare. They measured extremely high $^3He/^4He$ in some flares and slight enrichments of Fe ions in all flares. The helium ratio is much higher than the average solar corona helium ratio, consistent with previous measurements at different energy ranges. The enrichment in ^3He in some flares may be related to a special acceleration mechanism that depends on the small charge-to-mass ratio of the helium isotope. These measurements indicate that a ^3He-enriched region combines with an iron-rich region and that the mixture is then accelerated in a solar flare in a two-stage formation process. — LR

Astrophys. J. **545**, L157 (2000).

APPLIED PHYSICS

Infrared Detectors Lose Their Cool

Infrared (IR) detectors have numerous applications ranging from thermal imaging to surveillance. Currently, detectors generally are based on a reversed-biased junction compris-

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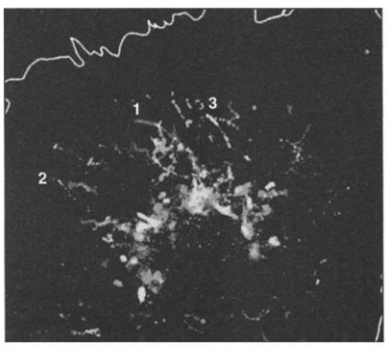
SOURCE: JAMES PALMER

ing a low-energy band gap semiconductor that separates and detects the photogenerated charge created by an absorbed IR photon. For high sensitivity, these materials must be maintained at low temperatures, and thus refrigeration hardware is needed.

New materials that do not require cooling are being developed for IR detection. Temperature-sensitive ferroelectric thin films exhibit a dielectric constant that is sensitive to temperature changes, producing a net charge transfer proportional to temperature when subjected to an applied electric field. Fuflyigin *et al.* prepared high-quality, free-standing ferroelectric thin films (lead scandium tantalum oxide) using a sol-gel technique and obtained a sensitivity of 20 to 45 nanocoulombs per square centimeter per degree Kelvin for films 200 to 300 nanometers in thickness. Moreover, the relatively low preparation temperatures (800°to 900°C) make them strong candidates as sensitive and cheaper thermal detectors. — ISO

Appl. Phys. Lett. **78**, 365 (2001).



Apical (green, track 2) and basolateral cargoes (red, 1) move along separate routes with occasional mixing (yellow, 3); multiple images were processed to reveal movement.

CELL BIOLOGY

Psychedelic Trafficking

Visualization of multiple proteins moving in live cells has become possible with the introduction of green fluorescent protein (GFP) variants. Keller *et al.* used GFP-fusion proteins and sophisticated image analysis to monitor the sorting of proteins upon exit from the Golgi apparatus. They found that cargo protein destined for the apical surface of polarized epithelial cells was segregated from basolateral cargoes in the Golgi and trans-Golgi network. Furthermore, these proteins were transported in separate carriers to their destinations without intersecting with incoming endocytic traffic, which had been suggested in earlier studies. Using total internal reflection microscopy, the authors could image the delivery and fusion of carrier vesicles with both apical and basolateral surfaces, and they observed that particular regions seemed to be particularly likely fusion sites. — SMH

Nature. Cell Biol. **3**, 140 (2001).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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(Hypo)Nasty Plant Mutation

A mutation in *Arabidopsis* may help define a role for double-stranded RNA binding proteins in mediating signals from multiple plant hormones. Lack of function of the HYPONASTIC (meaning movement bending the leaves inward and upward) LEAVES protein (HYL1) leads to a pleiotropic phenotype including decreased response to gravistimulation and reduced apical dominance that appears to reflect altered response to internal and external stimuli. Indeed, Lu and Federoff show that in *hyl1* mutants response to the hormones auxin and cytokinin is blunted, whereas plants are hypersensitive to abscisic acid. The *HYL1* gene was cloned and encodes a protein with two double-stranded RNA-binding motifs similar to those in human interferon-induced RNA-dependent protein kinase p68. The protein contains a nuclear localization sequence and is concentrated in nuclei. Although how HYL1 contributes to hormonal signaling is not yet clear, the authors propose several possibilities including function as a transcriptional coactivator or corepressor, or control of transcript stability. — LBR

Plant Cell **12**, 2351 (2000).

Wild-type (left) and *hyl1* plants.

CREDITS: (TOP) KELLER *ET AL. NATURE CELL BIOL.* **3**, 140 (2001); (BOTTOM) LU & FEDEROFF *PLANT CELL* **12**, 2351 (2000).