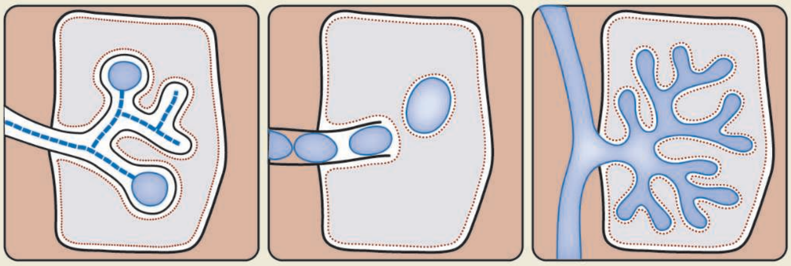
EDITED BY GILBERT CHIN AND JAKE YESTON

PLANT SCIENCE

At Root of the Matter



Intimate associations between plants and bacteria and fungi.

Many plant roots establish a symbiotic relationship with either bacteria or fungi in order to gain access to nutrients, such as fixed nitrogen or phosphate, respectively. Markmann *et al.* and Gherbi *et al.* have investigated the evolution of symbiotic relationships between plants and their symbionts and suggest that, on the basis of its nearly universal presence, a single signal transduction component, the leucine-rich-repeat, receptor-like kinase SYMRK, is essential for a host of angiosperms. Genetic knockdown in a member of the cucumber family (*Datisca glomerata*, a close legume relative) and in the tree *Casuarina glauca* showed that this protein was essential for bacterial nodulation; furthermore, it also affected fungal symbiosis. Additional investigation revealed that the protein is highly conserved in its ability to mediate these interactions and that this protein does not mediate the exclusive host/symbiont interactions found among species. In addition, three structural SYMRK versions exist among plants with different functional capabilities in the development of root/symbiont interactions, providing an evolutionary hypothesis for the origin of the highly derived nodules in legumes and their close relatives. — LMZ

PLoS Biol. **6**, e68; *Proc. Natl. Acad. Sci. U.S.A.* **105**, 10.1073/pnas.0710618105 (2008).

MOLECULAR BIOLOGY

SINEs of Repression

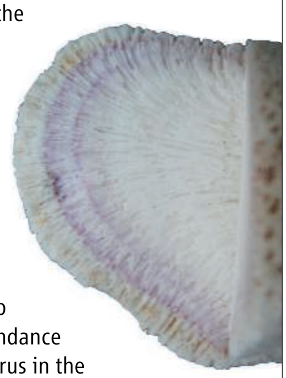
Mammalian genomes are packed to overflowing with a menagerie of repetitive DNA elements, many of which are derived from defunct transposons. Short interspersed elements (SINEs)—relic retrotransposons—are maintained in both mouse and human genomes. A clue to the basis for the persistence of these apparently "parasitic" DNA regions in the mouse comes from the observation that the noncoding (nc) RNA transcribed from B2 SINEs in response to heat shock can act to repress specific protein-coding genes by binding to and repressing RNA polymerase II (pol II).

The predominant SINEs in humans are Alu elements, similar in part to mouse B1 SINEs but evolutionarily unrelated to the other predominant mouse SINE, B2. Mariner *et al.* show that human Alu ncRNA, like mouse B2 ncRNA, can repress specific genes in response to heat shock, and that, like B2 RNA, it achieves this by binding to the RNA pol II pre-initiation complex, probably preventing appropriate interaction with promoter DNA. Human Alu RNA has a similar effect in mouse cells, and conversely, mouse B2 RNA in human cells. The mouse B1 SINE RNA is related to a processed short cytoplasmic RNA fragment of Alu (corresponding to the 5′ half of Alu ncRNA) and both can bind RNA pol II. Although neither can repress transcription in vitro, it is quite possible they also have related regulatory functions. Thus it would seem that humans do not have either of the B1 or B2 SINE family of repeats because the Alu repeats can by themselves carry out the function of both of the mouse SINE RNAs, and possibly supplanted them during evolution. — GR

Mol. Cell **29**, 499 (2008).

OCEAN SCIENCE

Phosphate Clues from Coral



Phosphorus is an essential macronutrient for marine organisms, and its availability probably exerts a major control on climate, due to its potential to affect the intensity of marine productivity and thereby contribute to regulation of the concentration of carbon dioxide in the atmosphere. Unfortunately, no direct method to determine the abundance of marine phosphorus in the productive surface ocean in the geological past has been found, so the relationship between phosphorus availability and paleoclimate remains uncertain. La Vigne *et al.* report that the phosphorus-to-calcium ratio of a scleractinian coral, *Pavona gigantea*, tracks variations in seawater phosphate concentration, thereby offering a possible solution to the dilemma of not being able to reconstruct the history of that nutrient in the past. If their method proves robust, coral skeleton P/Ca might be a reliable proxy record of nutrient availability on time scales of decades to millennia. — HJS

Geophys. Res. Lett. **35**, L05604 (2008).

PHYSICS

A Matter of Extended Coherence

The splitting and subsequent re-overlapping of a coherent light beam provides the basis for exquisitely sensitive detection of path-length differences; this technique of optical interferometry finds applications ranging from stellar observations to holographic imaging and characterization of optical components. Analogously, the cooling of a cloud of bosonic atoms into a Bose-Einstein condensate, a state in which all the atoms share the same quantum state, is described in terms of a coherent matter wave. Because atoms sense gravity, the interference of matter waves can then be used to provide a sensitive gravity detector, with a comparably diverse set of applications ranging from testing relativity to detecting underground bunkers. Unlike photons, however, which do not interact much with each other, the atoms in the

CREDITS (TOP TO BOTTOM): MARKMANN *ET AL.*, *PLOS BIOL.* **6**, E68; LA VIGNE *ET AL.*, *GEOPHYS. RES. LETT.* **35**, L05604 (2008)

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trapped cloud do interact by way of collisions. These collisions then give rise to losses and induce shifts in the phase of the matter wave, thereby limiting the sensitivity of any atom interferometer. Gustavsson *et al.* and Fattori *et al.* present setups in which the interaction strength between the atoms in the condensate (cesium and potassium, respectively) is tuned via magnetic field so that the scattering between the atoms is significantly reduced. The resulting extension of the matter-wave coherence time leads to improved sensitivity of the atom interferometers. — ISO

Phys. Rev. Lett. **100**, 080404; 080405 (2008).

CELL BIOLOGY

Resection and Repair

When the outer membrane of a eukaryotic cell is damaged (for instance, by ripping), a calcium-dependent repair process involving the fusion of lysosomal membrane with the plasma membrane is set in motion. Bacterial toxins can also perforate the plasma membrane, but do so by forming protein-delimited holes. How does a cell repair this kind of puncture? Idone *et al*. show that, in addition to patching the portion of damaged membrane using exocytosis, the cell arranges for the removal of the perforated areas from the cell surface via a process of calcium-stimulated endocytosis. Treating cells with the bacterial toxin streptolysin, which forms stable membrane-embedded pores, induced a calcium- and sterol-dependent form of endocytosis that cleared the pores from the plasma membrane, leading to the rapid (in less than a minute) resealing of the cell; independently stimulating endocytosis also promoted membrane repair. Thus, cells use two mechanistically linked pathways, which are both stimulated by high levels of extracellular calcium, to activate membrane repair after physical injury. — SMH

J. Cell Biol. **180**, 905 (2008).

CHEMISTRY

O Flow Dims Glow

In a polymer electrolyte membrane (PEM) fuel cell, hydrogen is oxidized at the anode to form protons that migrate through a membrane and then react with the oxygen being reduced at the cathode. Efficient operation relies in part on optimizing interactions of the respective isolated electrodes with flowing hydrogen and oxygen gas. Toward this end, Inukai *et al.* have devised a technique for visualizing oxygen flow as PEM fuel cells operate. They disperse a phosphorescent chromophore in a polymer matrix and apply the resulting oxygen-permeable film to specially constructed transparent fuel-cell elements. Because oxygen quenches the phosphorescence, the authors can track oxygen flow by monitoring emission intensity after excitation of the dye-impregnated film with 407-nm light. The scheme offers 300-µm spatial resolution and 500-ms temporal resolution. — JSY

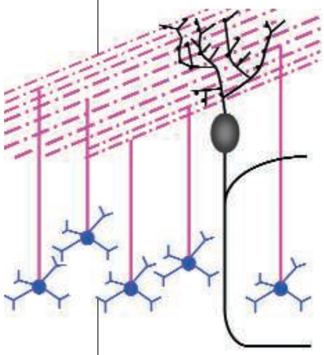
Angew. Chem. Int. Ed. **47**, 10.1002/anie.200705516 (2008).

NEUROSCIENCE

Time Is on Our Side

The cerebellum is a highly ordered brain structure, with the axons of small numerous granule cells projecting to the dendritic tree of large Purkinje cells in a stereotyped way. All of the daughters of individual granule cell precursors connect to the same horizontal layer within the Purkinje cell dendrites, although their cell bodies are not grouped together. How does this structure assemble so precisely?

By tracing the lineal descent and migration of granule cells with a method that visualizes their axonal and dendritic projections, Espinosa and Luo have revealed that it occurs by application of a straightforward principle. All of the offspring of each precursor granule cell exit the cell cycle within a narrow time window and synchronously connect their axons to the top surface of the layer containing the Purkinje cell dendrites. Each clonally related family of granule cells takes its turn to differentiate and connect to the Purkinje cell dendrites, resulting in their axons stacking in the dendrites in chronological order from deep to superficial. This sequential maturation of granule cells coincides with the ordered arrival of their mossy fiber inputs, which arrive from other brain areas at different times. Inputs from each brain region would therefore target a different region of the Purkinje cell dendritic tree and so have a distinct influence on computation. Thus, the developing brain uses the simple principle of temporal sequencing to assemble a precise and complex computational machine. — KK



The axons (fuchsia) of granule cells (blue) innervate the Purkinje cell dendrites (black).

J. Neurosci. **28**, 2301 (2008).

CREDIT: ESPINOSA AND LUO, J. NEUROSCI. 28, 2301 (2008)

Science

A Matter of Extended Coherence

Ian S. Osborne

Science **319** (5870), 1590.
DOI: 10.1126/science.319.5870.1590d