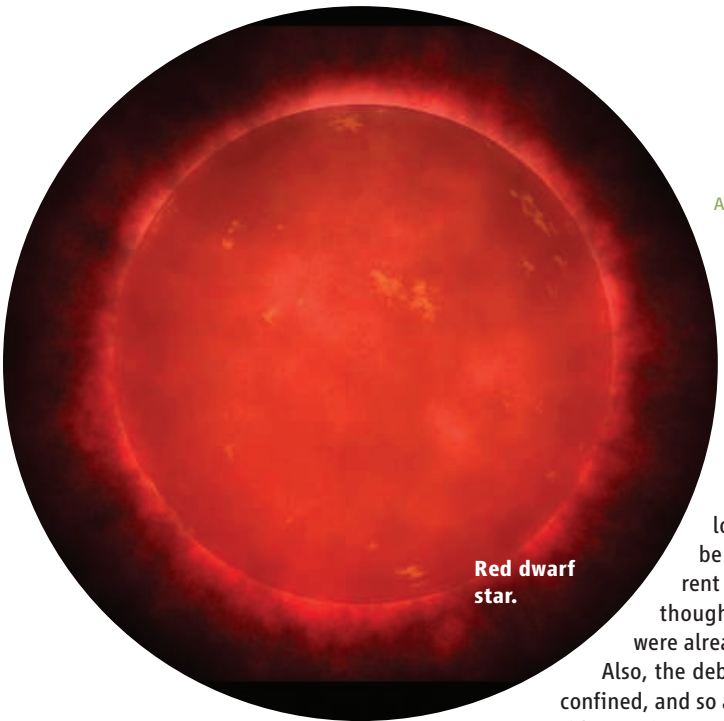

Red dwarf star.

ASTRONOMY

Not So Cozy

Habitable Earth-like planets must form just close enough to their parent star for liquid water—and hence life—to exist on their surfaces. Any closer and surface water would be boiled off; any further and it would freeze. Moreover, stars must be at least as long-lived as the Sun for habitable planets to form around them. Red dwarfs offer possible suitable sites: They are both the most common type of star in the Milky Way and also, being smaller than the Sun, exceptionally long-lived. However, Lissauer argues that red dwarfs may not be so hospitable after all. Because red dwarfs are faint, their current habitable zones lie very close to the star. Billions of years ago, though, the star would have been much hotter, and so if a planet were already in place then, its volatiles would have evaporated quickly. Also, the debris left over from disks around such star systems is relatively confined, and so any planets would have been buffeted by collisions with many asteroids, causing water and volatiles to be lost. — JB

Astrophys. J. **660**, L149 (2007)10.1111/j.1469-8137.2007.02103.x (2007).

ATMOSPHERIC SCIENCE

Sourcing Methane

Methane is a powerful trace greenhouse gas, second in importance only to carbon dioxide, and exerts an important influence on climate and atmospheric chemistry. Both anthropogenic and natural sources contribute substantially to the global methane budget. Recently, Keppler *et al.* claimed that terrestrial plants could produce large amounts of methane in aerobic conditions, an unexpected finding that, if true, would necessitate a major revision of our understanding of the methane cycle. Dueck *et al.* measured aerobic methane emissions from six different terrestrial plant species by employing a carbon-isotopic labeling technique for quantification. They found no evidence for substantial methane emission in any of the species, either instantaneously by continuous flow measurements or over the course of 6 days. They thus concluded that terrestrial plants are not an important source of aerobically produced methane on a global scale. — HJS

Nature **439**, 187 (2006); *New Phytol.* 10.1111/j.1469-8137.2007.02103.x (2007).

MICROBIOLOGY

Building from the Inside Out

The evolutionary origins of complex organs, which in their current state of assembly feature many distinct components that apparently have no function in isolation, have long been debated. Liu and Ochman have unraveled the history of the origins of bacterial flagella by using a phylogenetic profiling method applied across whole genome sequences to identify a set of 24 core genes in the common ancestor of bacteria. The members of this core set were probably derived from a single gene that had undergone a combination of successive duplication, loss, transfer, and diversification events. The evolution of the flagellar components apparently followed the present-day order of assembly, with the oldest proteins (the rotary motor) being those proximal to the bacterial inner membrane and the most recent (the filament monomers) being the most distal. Hence, the flagellum probably started life as a simple proton-driven transporter that evolved into a more elaborate secretory apparatus—of a sort still found in bacteria today in the form of the type III secretion system—and finally into the self-secretory motility organelle of modern species. — CA

***E. coli* flagella.**

Proc. Natl. Acad. Sci. U.S.A. **104**, 7116 (2007).

PSYCHOLOGY

Pas des Yeux

A dialogue, though generally understood to be a conversation between two people, allows for much more than the mere exchange of verbal information. Linguistic (for example, syntax) and nonlinguistic (for example, body postures) telltales develop and become synchronized as people talk and listen. Visual attention is another dimension in which behavior can become coordinated as when a listener's gaze is directed toward an object of mutual interest by pointing.

Richardson *et al.* show that the eyes of conversants—who are looking at the same scene but are not within sight of each other—tracked the same objects within the scene for several seconds, starting from the time at which the speaker began to fixate on the object before talking about it and including the time taken by the listener to saccade to the object after hearing what the speaker had begun to say. Another important contribution to the coordination of visual attention comes from having a common ground of understanding. Conversants looking at a Salvador Dalí painting were more likely to exhibit synchronized eye movements if they had previously heard the same introduction, either to the painting itself or to Dalí's life, as compared to pairs of conversants in which one had heard about the painting and the other about his life. — GJC

Psychol. Sci. **18**, 407 (2007).

Continued on page 801

CREDITS (TOP TO BOTTOM): NASA; CDC/PEGGY S. HAYES

Continued from page 799

CHEMISTRY

Shaped by a Protein

Hydrogels consist of water-soluble cross-linked polymers that can change properties such as their degree of swelling in response to changes in temperature, acidity, or ionic strength. Murphy *et al.* explored the use of a protein, calmodulin, as the active component of their gel systems. In the presence of calcium ions, calmodulin adopts an extended dumbbell shape that collapses upon the binding of certain ligands. The authors engineered a calmodulin variant with the tyrosine residues at the ends of the dumbbell motif replaced by cysteines. The two cysteine residues were separated by 50 Å in the extended configuration but only by 15 Å in the collapsed form. The engineered calmodulin was then incorporated through reaction of the cysteine side chains into a poly(ethylene glycol) (PEG) hydrogel. By treatment with a peptide ligand and subsequent washing, the incorporated protein could be cycled repeatedly between the two conformations, leading to an overall gel volume change on the order of 10 to 20%. Although this change is comparatively small in the hydrogel context, the authors note that the system was far from optimized, and that there are more than 200 well-characterized protein motions that might be adapted into functional gels. — MSL

Calmodulin hydrogel.

CREDIT: MURPHY *ET AL.*, *ANGEW. CHEM. INT. ED.* **46**, (2007)

Angew. Chem. Int. Ed. **46**, 3066 (2007).

CELL BIOLOGY

Full to Bursting

Peroxisomes are membrane-bounded intracellular organelles that carry out important oxidative reactions in lipid metabolism. In order to adequately supply daughter cells, peroxisomes must multiply and divide throughout the cell cycle. Guo *et al.* have examined the maintenance and division of peroxisomes in yeast—specifically, how peroxisomal membrane lipids and proteins are dynamically and spatially regulated during the cell cycle. They find that as peroxisomes mature, they accumulate larger quantities of the enzymes involved in lipid metabolism. One of these, acyl-CoA oxidase, is primarily localized to the matrix (the interior of the peroxisome) in immature organelles but is partly found in association with the inner surface of the peroxisomal membrane in mature organelles. Once at the membrane, acyl-CoA oxidase binds to the protein Pex16p; this interaction activates the transformation of endogenous lipids into components that induce bending of the outer leaflet of the membrane, which, in turn, activates peroxisomal membrane proteins that mediate division of the organelle. Thus, peroxisomes have an internal sensing mechanism that triggers their own multiplication as they grow. — SMH

J. Cell Biol. **177**, 289 (2007).

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<< Just the Right Amount of Guidance

Dysfunctional signaling by the neurotransmitter serotonin (5-HT) is associated with psychiatric illnesses such as anxiety disorders and depression. These conditions may reflect abnormal signaling at synapses in the adult brain or changes that have occurred during brain development, when serotonin is present and influences pathfinding by thalamocortical neurons. Bonnin *et al.* provide mechanistic insight into how changes in serotonin signals can disrupt axon migration. In cultured explants from the dorsal thalamus of mice, axons are normally attracted to HEK-293 cells that have been engineered to express the axon guidance protein netrin-1. But when the explants were treated with serotonin, the axons reversed their response and were repelled from cells producing netrin-1. This response was caused by decreased synthesis of the second messenger cAMP in the serotonin-stimulated dorsal thalamus neurons. Pharmacological inhibition of the cAMP-dependent protein kinase could reproduce the effect of serotonin, whereas activation of the kinase blocked the serotonin effect. To show the importance of this effect in vivo, the authors used targeted electroporation in developing mouse embryos, thereby causing the cells of the dorsal thalamus to express either more serotonin receptors (to enhance signaling) or fewer receptors (to limit signaling). Increasing and decreasing serotonin signaling produced opposite effects, and both manipulations caused abnormal migration trajectories of the thalamus axons. Thus, the authors propose that developmental abnormalities in serotonin signaling—either too much or too little—may alter the circuitry of thalamocortical axons and may contribute to mental health disorders. — LBR

Nat. Neurosci. **10**, 588 (2007).

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