PLANTARY SCIENCE
Martian Magnetism Getting Hotter

While the world is focused on the rovers Spirit and Opportunity trundling across the surface, others are considering the structure and composition of the deep interior of Mars to determine if it ever had a magnetic field.

To generate a dynamo, Elkins-Tanton et al. assume a magma ocean on early Mars, a nearly completely molten planet caused by accretional heating. As the magma ocean crystallized, less dense layers would form beneath more dense layers, leading to an unstable stratification. Overturn of the unstable layers would bring colder materials down, causing conductive heating and initiating a brief but strong magnetic field.

In contrast, Williams and Nimmo suggest that the early core was hotter than the mantle because of rapid core formation. The temperature difference would produce enough entropy to drive a brief and early dynamo and a magnetic field that would magnetize the crustal rocks. In addition, the hot core should remain molten.

The molten mantle and molten core models are generally consistent with data from Martian meteorites. In time, data from the rovers may help to resolve these simmering debates. — LR

CHEMISTRY
Sensing Mercury

One aspect of environmental monitoring is the detection of low levels of heavy metal ions. Of these, mercury is a particular concern because it is highly toxic, and it accumulates through the activity of microorganisms in the form of methyl mercury. Palomeres et al. have constructed a simple detector based on mesoporous nanocrystalline titanium dioxide films. These TiO₂ films have both a high surface area and excellent optical transparency in the visible region of the spectrum. A ruthenium-based dye (N719) was adsorbed onto the films to give a color signal detectable by visual inspection (down to 20 µM concentrations) or by spectrophotometric means (down to 0.3 µM concentrations). Exposure of the sensor to mercury causes a shift in the absorption spectra toward the violet, but surprisingly no changes were observed for any of the other divalent metal ions that were tested. — MSL

ECOLOGY/EVOLUTION
Waiting for Nemo

In some animal societies, a group can consist of both breeding and nonbreeding adults. In such cases, non-breeder...
nants without dispersal and without a fight. The clownfish *Amphiprion percula* inhabits the tentacles of sea anemones in small size-ranked groups of up to six individuals, with a single breeding pair. Newcomers to the group join as larval settlers and ascend toward breeding status as individuals die further up the dominance hierarchy; queue-jumping by dispersal or contest is never observed. This patient behavior appears to maximize an individual's probability of assuming the breeding territory; in other words, nonbreeding status is tolerated because it confers a potential to realize future benefits. — AMS


**CELL BIOLOGY**

**Transcription in a Bind**

The transcriptional activity of a nuclear receptor depends not only on its dimerization with another nuclear receptor but also on the functional communication between four distinct domains within its ligand-binding domain (LBD). For example, the retinoid X receptor (RXR) heterodimer is differentially responsive to ligands through allosteric communication within the LBDs and across the dimerization interface. However, it is not clear how ligand binding propagates through the LBD to affect the sites that mediate cofactor, coregulator, and DNA binding; receptor dimerization; and transcription. Shulman *et al.* analyzed the LBD sequences of 250 nuclear receptors and identified a network of 27 residues that mediate allosteric communication. Certain residue pairs were energetically coupled and thus likely to have coevolved to maintain a specific function—global interaction between these pairs predicted the allosteric network.

Nettles *et al.* examined allostery in estrogen receptor subtypes that underlies their differential responses to ligands. Residues outside the ligand-binding pocket contributed to the subtype-specific positioning of bound ligands. The coactivator-binding pocket also affected ligand positioning through the conformation of a specific helix, suggesting that functional communication between these two regions of the LBD is bidirectional. — LDC


**Integrating Morphogenesis and Metamorphosis**

One of the most dramatic signaling events in biology is the developmental transition from larval to adult form in organisms that undergo metamorphosis. In insects such as *Drosophila*, the destruction of larval tissues and their replacement with adult forms is triggered by the steroid hormone 20-hydroxyecdysone. What other factors help coordinate transcriptional regulation with the wholesale tissue restructuring?

Chen *et al.* found that signaling through LIM-kinase (a protein kinase regulated by the small guanosine triphosphatase Rho) is involved in these transitions. Rho modulates cell shape by regulating actin polymerization, and these changes affect transcription mediated by the serum response factor (SRF) transcription factor. Rho works through LIM-kinase to modulate expression of ecdysone-regulated genes, including *Stubble*, a gene encoding a protease involved in remodeling of the extracellular matrix. Cultured *Drosophila* SL2 cells required Rho signaling through SRF to allow proper ecdysone-dependent gene expression. Rho thus appears to be well placed to coordinate tissue remodeling and gene expression through its effects on the cytoskeleton, the extracellular matrix, and ecdysone-dependent gene expression. — LBR