Mantle Flow, To and Fro

The relative motions of tectonic plates are well established, but the motion of the underlying mantle is poorly known. Silver and Holt (p. 1054) determined the motion of the mantle beneath western North America by combining observations of surface deformation with upper-mantle seismic-velocity anisotropy. The upper mantle is flowing to the east, opposite the westward motion of the North American plate. Thus, the upper mantle is decoupled from the plate and its flow is primarily related to the subduction of the Farallon plate.

Back at You

Many characteristics of volatile atmospheric aerosols, which have various impacts on climate and air quality, depend on aspects of their physical chemistry, such as the partitioning of elements between the surface and the interior of the particle. Krieger et al. (p. 1048) demonstrate that these profiles can be made nondestructively and in situ using Rutherford backscattering spectrometry for liquids and solids under conditions similar to those found in Earth’s atmosphere.

Spin Resonance in Single-Layer Cuprate

One way to explore the underlying nature of the pairing mechanism in high-temperature superconducting cuprates is to identify common features of the various compounds that would place restrictions on other theories that predict specific behavior only in specific compounds. One such feature is a spin resonance seen in neutron scattering that has so far been seen only in bilayer and trilayer compounds. The absence of this feature in the single-layer cuprates, particularly the highly studied $\La_{x-\delta}\Sr_x\Cu\O_2$, has provided formidable evidence that the spin resonance is present, thus indicating that any proposed theory must consider the spin resonance as an essential ingredient.

Magnetic X-ray Microprobe

Understanding antiferromagnetic behavior on the microscopic scale is becoming increasingly important because of applications in magnetic memory devices. Evans et al. (p. 1042) present a new technique based on microfocused x-ray beams that can be used to image the structure and evolution of individual domains. They studied the intriguing but little understood spin-flip transition in chromium in which the spins are rotated $90^\circ$ from their original orientation. The transition takes place near the domain wall and then works its way into the bulk of the domain.

Birds of Feather, Flocking Together

Tropical deforestation may be harming migratory bird species that breed in temperate latitudes and overwinter in the tropics. However, for most such species, it has proved difficult to differentiate among and track populations using different parts of the wintering range, and hence to pinpoint how these effects operate. Rubenstein et al. (p. 1062; see the Perspective by Hobson) use stable isotope signatures in the feathers of an American migrant songbird, the black-throated blue warbler, to show that birds from different parts of the breeding range have distinct migratory patterns. For example, birds from the northern part of the breeding range in North America wintered in Cuba and Jamaica, while those from the southern parts of the breeding range wintered in Hispaniola and Puerto Rico.

Incorporating Chlorine Naturally

Organic chlorine compounds found in the environment have been thought to derive primarily from industry and agriculture. Furthermore, identifying nonvolatile chlorinated organic species that are produced in soils in situ has been problematic, and most naturally occurring chlorine compounds were thought to be inorganic. Myneni (p. 1039; see the Perspective by Casey) has used near-edge x-ray absorption fine-structure spectroscopy to identify and characterize chlorine-containing compounds in a variety of forest soils and other natural samples. Chlorine-bearing organic compounds are produced rapidly in leaf litter and are more abundant than inorganic chlorine compounds.

And in Brevia ...

A comparison by Dubrova et al. (p. 1037; see the news story by Stone) of families exposed to nuclear fallout in Kazakhstan to control groups in similar but uncontaminated areas of the country revealed a roughly doubled germline mutation rate.

A Bucket-Brigade Defense

\textit{Mycobacterium tuberculosis} defends itself against oxidative attack (primarily peroxides and peroxynitrite) by sacrificing reducing equivalents in the form of the cysteine residues of alkyl hydroperoxide reductase (AhpC). Bryk et al. (p. 1073) show that these cysteines are regenerated with the aid of three other essential components drafted from basic intermediary metabolism. Analysis of the crystal structure of the protein AhpD, which is encoded by the open reading frame downstream of AhpC, suggested a similarity to thioredoxin. This insight led to the identification of dihydrolipoamide dehydrogenase (Lpd) and dihydrolipoamide suctinyltransferase (SucB) as go-betweens in conveying reducing equivalents derived from the oxidation of $\alpha$-keto carboxylic acids, such as pyruvate, to the adapter AhpD, and finally to the antioxidant defender AhpC.

Shedding Light on Clocks

Rods and cones are not the only photoreceptor cells in the mammalian retina (see the news story by Barinaga). Berson et al. (p. 1070) have identified a subset of retinal ganglion cells that are...
also sensitive to light and directly innervate the central circadian pacemaker in the brain. Hattar et al. (p. 1065) further show that the intrinsic photosensitivity of these cells depends on their expression of the photopigment melanopsin. The findings solve the long-standing puzzle of whether circadian photoreceptors underlie the light-dark cycle entrainment mechanism of mammals.

Glaucoma Gene in Sight

Glaucoma affects nearly 70 million people worldwide and is the second leading cause of blindness. One of the major subtypes of this disorder, primary open-angle glaucoma (POAG), is manifested clinically as a gradual loss of peripheral vision and at the cellular level by the death of retinal ganglion cells. Rezaie et al. (p. 1078; see the Perspective by Friedman and Walter) identified the gene responsible for a hereditary form of adult-onset POAG. The culprit gene, located at chromosome 10p14, codes for optineurin, a 66-kilodalton protein of unknown function that has previously been implicated in the tumor necrosis factor–α signaling pathway and may be playing a neuroprotective role.

Lifting the Veil

Veil-like projections at the leading edge of moving cells, the lamellipodia, are propelled by the dynamics of actin filaments. Watanabe et al. (p. 1083) used sophisticated fluorescent microscopy techniques to analyze the precise details of actin polymerization and breakdown. Contrary to previous expectations, the majority of actin filaments within the lamellipodia are generated away from the very tip, which raises questions about how the leading edge is actually pushed forward.

Getting into Shape

The cofactor complexes such as ARC (activator-recruited cofactor) and CRSP (cofactor required for Sp1) share several common subunits and mediate interactions between activators and the basal transcription apparatus. Taatjes et al. (p. 1058; see the Perspective by Meisterernst), using biochemical assays and electron microscopy, found that the larger complex ARC is composed of two multisubunit complexes, ARC-L and CRSP, and that transcriptional activity is only observed with CRSP. Structural determinations indicate that distinct conformations are induced in the CRSP complex by various activators. Therefore, different activators may allow for different transcriptional readouts based on the specific conformations that form.

Small by Design

The search for effective small molecule inhibitors of protein-protein interactions is a major goal in pharmaceutical research. Gadek et al. (p. 1086) describe the design of a small molecule that mimics an epitope of the ligand of the integrin LFA-1. The lead compound (ortho-bromobenzoyl tryptophan), originally identified as inhibiting LFA-1, was optimized using information gained from the separate evolution of a noncontinuous peptide epitope of ICAM-1. The final result of the modifications led to a compound that retained characteristics of the small molecule and bound LFA with high affinity. The compound also effectively blocked lymphocyte proliferation and contact hypersensitivity in mice.

Overcoming Rejection

Shortages in human organs for transplantation has led to consideration of other species as possible donors. The ability to use pig organs has been hampered by the presence of galactose α(1,3) galactose residues on the surface of pig cells, which result in their rejection by primate recipients, who lack the enzyme that creates this linkage. Lai et al. (p. 1089) knocked out one allele of the α(1,3) galactosyltransferase in fetal fibroblasts in vitro and then used these cells to clone transgenic pigs by nuclear transfer. The next step will be the creation of a homozygous pig that completely lacks these residues. In addition to their eventual impact in the field of xenotransplantation, these pigs serve as models for genetic modifications of the porcine genome for other medical and agricultural purposes.