Disinclined to Yield

When a metal is plastically deformed, networks of dislocations (translational defects in the atom positions) are created and make successive deformation processes more difficult. This “work hardening” is commonly used to make tough, fine-grained metals. However, disclinations, which are rotational defects, can also form. In a high-resolution transmission electron microscopy study of heavily deformed iron, Murayama et al. (p. 2433; see the Perspective by Ovid’ko) observed wedge-shaped regions of arrays of dislocations, which they believe make up a partial disclination dipole. They propose a mechanism for the formation of this dipole that helps explain how materials deform under severe plastic shear strain.

Off the Walls

The amorphous silica walls of diatoms exhibit intricate species-specific patterns. Are these patterns the result of a complex and highly regulated assembly of cell organelles and vesicles or of physicochemical interactions? Sumper (p. 2430) presents evidence for the latter in the pattern formation in the diatom Coscinodiscus, in which he assumes that repeated phase-separation events during wall biogenesis produce self-similar patterns at smaller and smaller scales. High-resolution scanning electron microscopic images of three different Coscinodiscus species provide support for this model. Species-specific patterns would result from the constraints introduced by different wall-to-wall distances, which dictate the next level of pattern formation.

Earth’s Dynamo and Orbital Dynamics

Changes in the intensity of Earth’s magnetic field are recorded in magnetic minerals trapped in layers of sedimentary rocks and provide clues to how the geodynamo works. Changes in Earth’s orbit and climate have both been weakly correlated with magnetic field changes. Now, Yamazaki and Oda (p. 2435) have measured a 100,000-year periodicity in the inclination and intensity of the magnetic field in a 2.25-million-year section of a sedimentary marine core from the West Caroline Basin. The 100,000-year periodicity is correlated with orbital eccentricity, not climate, and the periodicity varies with the strength of the axial dipole field.

Taking Nanorods to Solar Cells

Solar cells based on conducting polymers should be less expensive than inorganic devices because of lower processing costs, but inefficient transport of charge carriers within the polymers greatly limit their efficiency. Adding inorganic semiconducting particles such as CdSe should improve charge transfer because these particles are good electron acceptors and the polymers are good electron donors. Huynh et al. (p. 2425) show that when CdSe nanoparticles are formed as high-aspect ratio nanorods and are well dispersed in the polymer poly(3-hexylthiophene), thin-film photovoltaic devices show high external quantum efficiencies (~7% for illumination at 515 nanometers and 1.7% for simulated solar emission). Electron microscopy reveals that the rods tend to align such that they facilitate charge transport.

And in Brevia ...

Silent earthquakes creep without producing measurable seismic shaking; Miller et al. (2423) show that eight such events have occurred since 1992 along the Juan de Fuca plate subduction zone in the Pacific Northwest and that a new creep event started on 7 February 2002.

Irregular Rise

One of the most dramatic events of the last deglaciation was a large (~20 meters) and rapid (~500 years) increase in sea level that occurred about 14,000 years ago. This event, called meltwater pulse 1A (mwp-1A), was the result of the injection of fresh water from melting continental ice sheets into the ocean. Which ice sheets produced this water? Clark et al. (p. 2438; see the Perspective by Sabadini) used the highly nonuniform patterns of global sea level change to define the global sea level “fingerprints” for various melting scenarios. As a test of this method, they used estimates of sea level change at Barbados and Sunda Shelf to show that southern Laurentide ice could not have been the sole source of mwp-1A and that melting from the Antarctic is consistent with existing sea-level records.

Too Much TV

At what point does television viewing by young children have a harmful effect? Johnson et al. (p. 2468; see the Perspective by Anderson and Bushman) found that extensive television watching during adolescence and young adulthood is associated with subsequent aggressive behavior. To gather this data, 707 families with a child between the ages of 1 and 10 were interviewed and studied for 17 years. Increases in aggression were documented in 14-year-old boys who watched 1 to 3 hours of television per day in comparison to those who watched less than 1 hour per day.

Genes for Systemic RNA Interference

One unusual aspect of RNA interference (RNAi)—the ability of short double-stranded RNA molecules to shut down expression of sequence-related messenger RNAs—is that it can be systemic, and thus spread from one cell or tissue to another. For example, in plants, RNAi is used to combat viral infection. Winston et al. (p. 2456) have isolated three genes in the nematode worm Caenorhabditis elegans that are required for the systemic RNAi effect. One of these loci, sid1, encodes a transmembrane protein, which is also present in mouse and humans, that may function as an act for a putative intercellular RNA signal.

At the Hub

Posttranslational modification of proteins is an important strategy used in controlling protein function during development. Dittmar et
al. (p. 2442) discovered a modification termed Hub1 related to ubiquitination. The addition of Hub 1 to target proteins was found to be important in regulating polarized morphogenesis in yeast. Cells unable to link Hub1 to target proteins were defective in mating—a process that requires formation of a polarized mating projection, the shmoo.

**Protection from Senescence**

Primary human cells can divide only so many times, and this state of growth arrest, or replicative senescence, is triggered by shortening of telomeres (the nucleoprotein complexes at the ends of chromosomes; see the news story by Marx). Karlseder et al. (p. 2446) show that senescence of primary human cells can be delayed by overexpression of a protein that protects chromosome ends, called telomere protection factor (TRF2). This result is incompatible with the long-standing view that senescence is triggered by the absence of telomeric DNA through a DNA-damage pathway.

**On the Slopes**

Understanding the balance between the assembly and disassembly of microtubules during the formation of the mitotic spindle requires a knowledge of the levels of a variety of assembly factors around the chromosomes. Kalab et al. (p. 2452) have directly visualized a concentration gradient of the small guanosine triphosphatase (GTPase) Ran in its GTP-bound conformation emanating from the chromosomes in mitotic extracts derived from *Xenopus* eggs. Such a gradient should promote the release of proteins from the chromosomes that could regulate microtubule dynamics.

**Moving from A to B**

Neurons in the medial superior temporal (MST) region participate in the encoding of various visual parameters. Some encode a location map of the environment and are called place cells, and others encode a direction of movement, derived from the expanding or contracting visual scene, and are called heading cells. Froehler and Duffy (p. 2462; see the Perspective by Bradley) describe a third kind of neuronal activity in the monkey MST that corresponds to an integration of heading and place, carried out by a path cell.

**Neurons Switch Their Preferences**

When we are awake, our eyes perform small rapid movements and jump from one fixation point to another. These saccades occur several times a second. Thiele et al. (p. 2460; see the news story by Barinaga) compared neuronal activity in two movement-specialized brain areas, area MT and area MST, during saccade-induced image motion and during passive viewing. Some cells suppress their response selectively during saccades while still being sensitive to such speed in passive conditions. More remarkably, they describe a neuron that shows an inversion of its direction preference during saccades. These changes in tuning, which seem to occur very rapidly, do not have a retinal origin but are mediated by an internal signal.

**Undesirable Recruitment**

Tamoxifen is a highly effective drug for the treatment and prevention of breast cancer, but concerns have been raised about its widespread use because it also appears to increase the risk of endometrial cancer. Tamoxifen acts by binding to the estrogen receptor and modulating its transcriptional activity; however, the mechanism underlying its anti-estrogenic activity in breast tissue and estrogenic activity in endometrial tissue is poorly understood. Cell culture studies by Shang and Brown (p. 2465; see the Perspective by Katzenellenbogen and Katzenellenbogen) reveal at least a partial explanation for the drug’s tissue-specific effects. In endometrial cells—but not in mammary cells—tamoxifen stimulates the recruitment of a transcriptional coactivator protein (SRC-1) whose expression is necessary for the drug’s estrogenic activity. This mechanistic insight will likely accelerate the development of better drugs for breast cancer, osteoporosis, and other diseases where estrogen plays a major role.