

A Lag in Global Warming

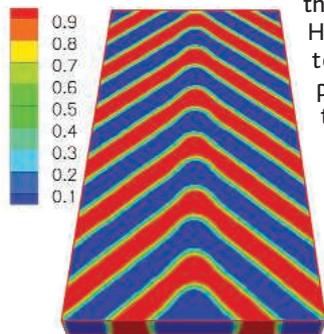
Earth's climate is thermally stable only when the amount of radiation it absorbs from the Sun is balanced by the amount emitted back into space. Hansen *et al.* (p. 1431, published online 28 April 2005) report results from a climate model and validate them with measurements of recent changes in the heat content of the ocean, which show that Earth now is absorbing 0.85 ± 0.15 watts per square meter more energy from the Sun than it is emitting to space. Their findings confirm that there is a lag in response of the climate system relative to the radiative forcing that drives it, and they predict that climate will continue to warm by more than half a degree Celsius even without further increases in atmospheric greenhouse gas concentrations because of the thermal inertia of the climate system.

Converting Biomass to Biodiesel

The conversion of the oxygenated hydrocarbons in biomass to saturated alkanes could provide a route to cleaner fuels from renewable sources. Recently, such conversions were demonstrated that produced volatile alkanes, such as hexane, from simple sugars. Huber *et al.* (p. 1446; see the Perspective by Rostrup-Nielsen) have now converted biomass-derived oxygenated hydrocarbons to liquid alkanes ranging from n -C₇ to C₁₅, which are in the range needed for diesel fuel and have the advantage of being sulfur-free. In this process, glucose or xylose is dehydrated over acid catalysts to aldehydes. These products, which may also be first cross-coupled to other aldehydes, are then hydrogenated and subjected to aldol condensations over solid base catalysts. Subsequent dehydration and hydrogenation reactions over bifunctional catalysts that contain acid and metal sites lead to the formation of alkanes.

Playing the Angles

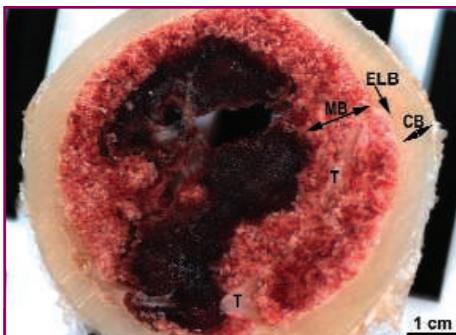
Block copolymers are extremely useful for making simple patterns such as stripes or checkerboards because the pattern and length scale can be readily controlled by altering the lengths of the two covalently linked polymers. However, every change in the pattern dimensions requires a new polymer, and there are limits to the extent to which basic patterns can be altered. Stoykovich *et al.* (p. 1442) show that by adding homopolymers of the two block components to the mix, they can create nonregular patterns, including angled features with good resolution.



Aluminum Takes Five

Aqueous metal salts play a significant role in the chemical processes of organisms that live in or drink the water. Aluminum in particular is studied because of its abundance and toxicity.

Trivalent aluminum binds six water molecules in strong acid and four in basic solution, but in the weakly acidic conditions, the most common in nature, the Al(III) ion has eluded definitive characterization. Among the many likely interconverting species, a



Is It a Bird, Is It a Dinosaur?

Female birds deposit a particular type of bone in their limbs, known as medullary bone, when laying eggs. This bone tissue provides a ready source of calcium for eggs. Schweitzer *et al.* (p. 1456) have identified bone tissues from the hind limbs of a *Tyrannosaurus rex* that closely resemble this medullary bone deposited by female birds. These data support the relation between tyrannosaurs and birds and provide a means of gender differentiation in dinosaurs.

28 April 2005; cover, see the Perspective by Wilcove) have conducted an intensive search of the Big Woods in eastern Arkansas and report the presence of at least one male bird. Repeated visual encounters and analysis of a video clip confirm the individual as an ivory-billed woodpecker. Extensive searches failed to locate additional birds elsewhere in the 220,000 hectares of bottomland forest, which indicates that the population density is extremely low.

Epithelial Escalator

The accelerated epithelial cell turnover observed in the cecum of mice infected with the nematode *Trichuris muris* may act as a mechanism of host defense against this enteric parasite and perhaps other enteric pathogens. Using mice resistant and susceptible to *T. muris* infection, Cliffe *et al.* (p. 1463) showed that crypt epithelial proliferation was increased in susceptible mice. Epithelial cell turnover, as measured by the movement of cells up the crypt, was faster in the resistant mice. Thus, crypt hyperplasia in susceptible mice reflects increased epithelial proliferation, without a matching increase in epithelial turnover.

The Epigenetic Sins of the Father

Chemotherapy, irradiation, and environmental toxins can cause DNA damage that, unless repaired, can be transmitted to the

short-lived five-coordinate structure has been proposed and would help to explain the occurrence of that geometry in solid minerals. However, there is little precedent for pentacoordination among other aqueous metal ions. Swaddle *et al.* (p. 1450, published online 28 April 2005) have now found support for five-coordinate Al(III) in water by measuring the pressure-dependent exchange rates of free and bound water ligands at Al(III) between pH 4 and 7 and comparing their results with theoretical simulations.

Caught on Video

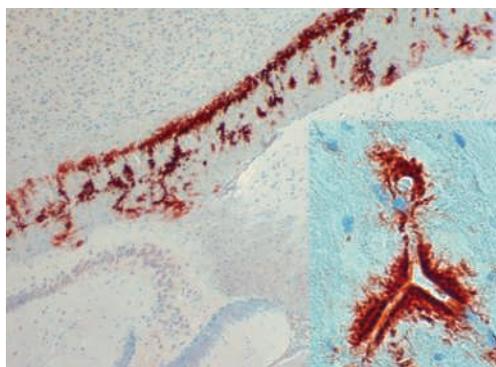
The ivory-billed woodpecker was once found in mature forests across the southeastern United States, but there had been no conclusive evidence for its survival in continental North America in more than 50 years. Fitzpatrick *et al.* (p. 1460, published online

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next generation. Although effects have been seen in the first generation (F_1) after exposure, it is uncertain whether subsequent generations are affected. **Anway *et al.*** (p. 1466; see the news story by **Kaiser**) now show that when rats are exposed to endocrine disruptors at a critical stage of embryonic development, downstream generations (from F_1 to F_4) display decreased fertility. The transgenerational male fertility defect correlates with changes in DNA methylation, as opposed to DNA base mutation. Thus, endocrine disruptors have a transgenerational effect on male fertility, and the mechanism may involve epigenetic alteration.

Anchors and Amyloid Effects

It is not known whether amyloid deposited in the brain during protein misfolding diseases such as prion diseases and Alzheimer's disease is directly responsible for the neurotoxicity associated with these neurodegenerative syndromes. **Chesebro *et al.*** (p. 1435; see the Perspective by **Aguzzi**) describe scrapie infection experiments using transgenic mice expressing glycosylphosphatidylinositol (GPI)-negative prion protein (PrP), which is secreted from the cells where it is produced. Although the scrapie agent infected these mice and disease-associated protease-resistant prion protein (PrP-res) was produced, no clinical disease was detected during an observation period of more than 600 days. Lack of clinical disease correlated with PrP-res deposited in brain as amyloid plaques rather than as the diffuse PrP-res usually seen in mouse



scrapie and human sporadic Creutzfeldt-Jakob disease, and the neuropathology at the ultrastructural level was similar to that of Alzheimer's disease. These marked differences in brain pathogenic effects of amyloid versus nonamyloid PrP-res suggest that amyloid PrP-res is actually less toxic than nonamyloid PrP-res. Furthermore, the PrP GPI anchor influences the pathogenic effects of scrapie infection and amyloid generation in vivo during prion disease.

Signaling Bone Formation

Improvements in mass spectrometry now allow global quantitation of phosphorylated proteins from cultured cells and comparison of signaling networks. **Kratchmarova *et al.*** (p. 1472) immunoprecipitated tyrosine-phosphorylated proteins (and associated proteins) and determined the relative abundance of peptides in the mixture to characterize the spectrum of signals initiated by two related receptor tyrosine kinases—the epidermal growth factor (EGF) receptor and the platelet-derived growth factor (PDGF) receptor. Human mesenchymal stem cells were induced to differentiate into bone-forming cells by EGF, but not by PDGF, and comparison of the two signaling networks revealed that the PDGF activated the phosphatidylinositol 3-kinase (PI3K) pathway whereas EGF did not. When the PI3K pathway was inhibited, PDGF could promote bone differentiation as effectively as EGF.

Insights into Tuberculosis Drug Resistance

Fluoroquinolone antibiotics are increasingly being used in the treatment of tuberculosis. They act by inhibiting DNA gyrase through binding to the enzyme-DNA complex in *Mycobacterium tuberculosis*. Genetic selection in *M. smegmatis* identified a protein, MfPA, that confers resistance to fluoroquinolones. **Hegde *et al.*** (p. 1480; see the news story by **Ferber**) have determined the structure of MfPA from *M. tuberculosis* to 2.0 angstrom resolution. It adopts a fold, the right-handed quadrilateral β -helix, that mimics double-helical DNA in size, shape, and charge distribution so that the protein competes with DNA for binding to DNA gyrase.