**ECOLOGY/EVOLUTION**

**Biomes!**

The distributions of plant species and vegetation zones in the Northern Hemisphere have shifted and fluctuated dramatically in response to changes in climate. Reconstructing these spatial and temporal migrations from fossil pollen assemblages has become routine for paleoecologists and has revealed the dynamism and impermanence of plant communities and their species compositions.

In a synthesis of vegetation dynamics of North America using data from 759 fossil pollen sites deposited in the North American Pollen Database, Williams et al. track the changes that have taken place since the last glacial maximum, 21,000 years ago. Their data visualization (www.ngdc.noaa.gov/paleo/pubs/williams2004/williams2004.html) shows in detail how plant species respond individualistically—such that many species associations tend to be ephemeral—and it shows how these shifts scale upwards to biomes: large-scale entities defined as associations of plant functional types (e.g. steppe, tundra, deciduous forest). Biomes exhibit considerable dynamism, too, emerging and vanishing with the passage of time. —AMS


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**IMMUNOLOGY**

**Seeking Alternative Pathways**

Cell-surface receptors in the signaling lymphocyte activation molecule (SLAM) family play diverse roles in the lives of T and B lymphocytes, NK cells, dendritic cells, and macrophages. Members of this family use the adaptor protein SAP, which helps recruit other intracellular signaling proteins. Individuals with a mutation in SAP develop severe X-linked lymphoproliferative syndrome; similarly, deletion of SAP in mice leads to dysregulation of T helper type 2 (TH2) cell–mediated immunity.

Wang et al. examined the specific contribution of the SLAM pathway, versus that mediated by other SAP-associating proteins, by generating SLAM-deficient mice. The absence of SLAM signaling led to decreases in TH2 cell and macrophage function, affecting innate as well as adaptive immunity. Lee et al. observed that mice lacking the NK-specific inhibitory SLAM receptor 2B4 had augmented NK cell activity, suggesting that SAP-associating receptors can operate differently in different cell types, possibly as a result of differential expression of SAP or related adaptor proteins. —SJS


**PHYSICS**

**Waving Current Standards**

The ability to pump a discrete and known amount of charge around a system is the basis for quantum current standards such as those built on single-electron transistors and acoustic waves (SAWs). Without the need for an applied bias, the SAWs effectively deform the confining potential of the quantum dot, so that discrete packets of charge squeeze through it in each cycle. Being somewhat simpler and able to operate at high frequency (3 GHz here), the technique should find application in the developing field of quantum current standards. —ISO


**CHEMISTRY**

**Taste, Then Season**

In dispersion polymerization, initiators, stabilizers, and monomer are all combined in one pot, and, as the ingredients are cooked, the product polymer drops out of solution in the form of particles with diameters of 1 to 15 µm. The reaction pathway consists of a fast, finicky nucleation stage, followed by a slow, simmering growth stage. This method is good for producing a single uniform distribution of particles, but it is difficult to make the particle size in one batch the same as in the next and to maintain a narrow distribution of particle size when comonomers or cross-linking agents are included.

Song et al. decided to wait to add the flavoring agents until after the nucleation stage. By varying the amount of comonomer in the second stage, they were able to vary the particle size without broadening the size distribution. They also were able to add up to 3% of a dye comonomer or to create cross-linked particles without running into the problems caused by particle coagulation, and they could even add comonomer and cross-linking agents at the same time. —MSL


**BIOMEDICINE**

**Seeing Drugs Work**

Most new cancer drugs are designed to target signaling pathways critical to tumor cell growth. One of the challenges researchers face in evaluating these drugs in both preclinical and clinical settings is their limited ability to assess

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whether the drugs reach their molecular targets in sufficient quantities to kill the tumor cells. A potent drug may show poor efficacy in animals or patients simply because the dose, schedule, and delivery method have not been optimized.

New molecular imaging technologies may remove much of the guesswork in this important stage of drug development. Smith-Jones et al. studied a drug that induces degradation of HER2, a growth factor receptor that is aberrantly activated in certain tumors. By administering a HER2 antibody fragment labeled with 68Ga to tumor-bearing mice, they were able to measure HER2 expression—and thus drug activity—with positron emission tomography (PET). Zhang et al. used bioluminescent imaging to monitor the activity of cancer drugs that target a cyclin-dependent kinase (Cdk) by measuring the levels of a luciferase “reporter” protein whose expression level changed in response to Cdk inactivation. In principle, both imaging methods can be adapted to monitor the pharmacodynamics of a wide range of candidate drugs. — PAK

**ASTROPHYSICS**

**The Sky is Not Falling**

Near-Earth asteroids (NEAs) have the potential to hit us, and Chapman reviews what we know about NEA hazards. There are about 170 recognized terrestrial impact craters, and the impact rate has remained relatively constant except for a brief period about 4 billion years ago called the Late Heavy Bombardment, when the rate was a thousand times higher. About 2670 NEAs have been identified, of which about 600 are considered potentially hazardous.

A rare collision (one every 10 to 100 million years) with a 3-km-diameter body would create a 1-million-megaton explosion [about 100 times less energetic than the K-T (cretaceous-tertiary) impact event], whereas a more frequent (once per century) 40-m-diameter object would create a 10-megaton explosion (similar to the Tunguska event in 1908). When the Spaceguard Survey has completed their catalog of all 1-km or larger NEAs in 2008, the worldwide impact event mortality, averaged over a very long time, should be reduced to 100 deaths per year. — LR


**EDITORS’ CHOICE**

**Fighting Fat**

Obesity might seem a relatively tractable problem that could be solved by reduced intake of food. However, endocrine homeostatic mechanisms act to reduce weight loss during periods of fasting or low caloric intake by reducing the basal metabolic rate, so that less energy is consumed and less fat goes away. Maglich et al. propose that this compensatory pathway might be disabled. The orphan nuclear receptor CAR, previously shown to function in sensing xenobiotics and in regulating expression of detoxifying enzymes and transporters, also has a role in regulating thyroid hormone metabolism, which is important because a decrease in circulating concentrations of thyroid hormones leads to a reduced metabolic rate. Wild-type mice treated with pharmacological activators of CAR showed reduced concentrations of thyroid hormones in serum, but no such change was seen in Car<sup>−/−</sup> knockout mice, and mice fasted for 24 hours showed reduced amounts of circulating thyroid hormones, but Car<sup>−/−</sup> mice exhibited a significantly smaller reduction. When subjected to a weight-loss regimen in which caloric intake was reduced by 40% for 12 weeks, Car<sup>−/−</sup> animals lost 2.5 times as much weight as did the wild-type animals. This raises the possibility that inhibitors of CAR action could uncouple metabolic rate from food intake, thus promoting weight loss when caloric intake is restricted. — LBR

Taste, Then Season
Marc S. Lavine

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