

# THIS WEEK IN Science

edited by Phil Szuromi

## Parallel Assembly

Designs for artificial bone scaffolds have generally focused on the remineralization issue—getting hydroxyapatite (HA) to grow at the organic-inorganic interface. However, bone is a complex mineral assembly with many higher levels of organization that contribute to its mechanical properties. Hartgerink *et al.* (p. 1684; see the news story by Service) designed a peptide amphiphile (PA) to use as a scaffold material that incorporated separate units for rigidity, HA adsorption, and cell adhesion. By varying pH to control the assembly and cross-linking of the PA, the authors were able to promote mineralization of HA as a series of parallel sheets. The HA could be redissolved by changing the pH, which weakens the linkages in the PA assembly.

## A Tale of Two Strategies

The net CO<sub>2</sub> uptake by forests can be estimated in two ways, either by measuring local changes in the concentration of CO<sub>2</sub> of air (a method called “eddy covariance flux”) or by taking inventories of biomass gain or loss. These approaches have not always agreed in the past, and the differences between them have resulted in conflicting estimates of regional carbon budgets, such as for North America. Barford *et al.* (p. 1688) compared 9 years of eddy flux measurements of carbon uptake in Harvard Forest to traditional inventory estimates and found close agreement between the values, an important validation of the eddy flux method. The substantial uptake at Harvard Forest is mostly due to prior land use. Climatic variations account for seasonal and interannual variations in CO<sub>2</sub> uptake.

## Asteroids Near and Far

The Lincoln Near-Earth Asteroid Research (LINEAR) project has been identifying and cataloging near-Earth asteroids (NEAs) over a small portion of the sky for several years. Stuart (p. 1691) used this data to estimate the size and shape of the NEA population for the full sky based on detection probabilities. He finds that the number of 1-kilometer-diameter asteroids should be about 1200 and that the population is more highly inclined to the ecliptic than previously thought. Asteroid families are thought to form by major collisions in the main belt, and their perturbed members make good candidate sources for NEAs. Michel *et al.* (p. 1696; see the cover) show that large family members can be made by gravitational reaccumulation after the main collision, which can explain the presence of large and small asteroids in observed families. Bottke *et al.* (p. 1693) show that these newly created asteroid families can spread out due to a thermal force called the Yarkovsky effect. Their simulations match observations of asteroid family distributions. Interestingly, the simulations also place some members on the edge of resonances, that is, regions that can eject main belt asteroid into near-Earth orbits.

## 1700 Truly Global Impact

The Cretaceous-Tertiary (K-T) extinction event is attributed to a massive bolide hitting the Yucatan peninsula of Mexico. In North America, there is evidence of massive deforestation by an impact winter or wildfires. Now, Vajda *et al.* (p. 1700; see the Perspective by Flannery) have found evidence for deforestation in New Zealand associated with an iridium anomaly. Thus, the impact event was global in its effects and caused significant terrestrial devastation in the Southern Hemisphere.

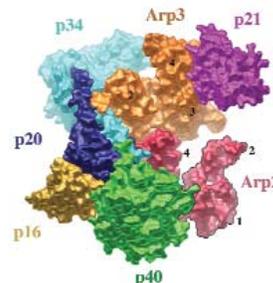
## Do Not Disturb Too Much

What causes the high species richness of trees in tropical rain forests? Arguments have increasingly focused on the role of disturbance, in the form of gaps in the canopy created by dead and fallen trees, in helping to maintain this richness. In a survey of selectively logged and unexploited forests in French

Guiana, Molino *et al.* (p. 1702) assessed the effects of larger scale impacts of logging in tropical forests compared to the smaller disturbances caused by naturally occurring canopy gaps. Their findings provide support for the hypothesis that intermediate levels of disturbance produce maximum species richness.

## Pushing Ahead

The leading edge of motile eukaryotic cells is pushed forward by a branched actin filament network. The seven-subunit Arp2/3 complex initiates the growth of branches on the sides of older filaments but only when activated by Wiskott-Aldrich syndrome protein (WASp). Robinson *et al.* (p. 1679; see the Perspective by Weeds and Yeoh) have determined the crystal structure at 2.0 angstrom resolution of the Arp2/3 complex. The two actin-related proteins (Arps) are not appropriately oriented to form two subunits of an actin helix, which explains why the complex is inactive. The authors propose that nucleation-promoting factors such as WASp, actin filaments, and adenosine triphosphate act by favoring the active conformation of the Arp2/3 complex.



## Muscling In on Atrophy

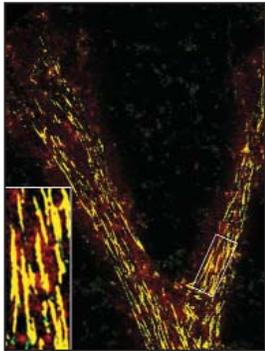
Muscle atrophy that occurs when physical activity is decreased results from enhanced breakdown of muscle protein by the ubiquitin proteasome pathway, but the precise molecular mediators are unknown. Using gene expression profiling methods and subsequent analyses of knockout mice, Bodine *et al.* (p. 1704) identified two muscle-specific ubiquitin ligases (enzymes that target protein substrates for proteolysis by the proteasome), called MAFbx and MuRF1, that are required for skeletal muscle atrophy. Identification of these proteins may lead to new therapies aimed at preventing the loss of muscle that often accompanies illness and aging. ✂

## Lesser Extent of the vCJD Epidemic

Predicting the magnitude of the variant Creutzfeldt-Jakob disease (vCJD) epidemic in the United Kingdom is difficult because we do

not know how many people are infected nor the mean incubation period; differing estimates of these quantities will lead to different predictions (see the Perspective by Medley). Nonetheless, two groups using statistical methods predict that incubation times are long and that total cases of the disease will at most be several thousands. Huillard d'Aignaux *et al.* (p. 1729  $\Sigma$ ; see the 26 October news story by Balter) used statistical back-calculation models, introduced for estimating HIV cases, to estimate the number of individuals infected with vCJD. The authors report that even if a very large number of persons are infected, the mean incubation period must be greater than 70 years. Valleron *et al.* (p. 1726) noted the low mean age for cases of vCJD (28 years) and present a model in which susceptibility for the disease is high through adolescence and then drops exponentially after age 15, and that all infections occurred between 1980 and 1989. They predict an incubation period of about 17 years.

### Free-Ranging Fibroblasts



The fibroblast has been the prototype cell for studying a range of phenomena, including cell proliferation, morphology, adhesion, and movement. Yet, our current understanding of fibroblast biology is based predominantly on observing these cells in two-dimensional (2D) culture. Cukierman *et al.* (p. 1708; see the Perspective by Geiger) have designed a 3D matrix system to culture fibroblasts and report some key biological differences compared to the traditional 2D culture system. A comprehensive description of cell-matrix adhesions reveals striking structural and morphological differences that may justify a re-evaluation of current models.

### A Second Polymerase for Prokaryotes

Eukaryotes have independent DNA polymerase enzymes,  $\delta$  and  $\epsilon$ , for copying the two different strands (leading and lagging) of DNA. The quintessential prokaryote *Escherichia coli* has only one essential DNA polymerase that copies both the leading and lagging DNA strands. Dervyn *et al.* (p. 1716) now find that a second polymerase gene in *Bacillus subtilis* is present in the replication complex and seems to play a role in second (lagging)-strand synthesis. Homologs of this polymerase are found in many other prokaryotes, suggesting that prokaryotes, like eukaryotes, generally have two DNA polymerases, one for each strand.

### More Similar Than We Thought

A single nucleotide polymorphism (SNP) occurs roughly every 600 base pairs within the human genome and represents a mutational event that occurred once in human history. The more ancient the mutation, the more common will be the SNP in a population. Groups of SNPs descended from a single ancestral chromosome define patterns of variation called haplotypes within the human genome. Patil *et al.* (p. 1719; see the Perspective by Kwok) have used high-density oligonucleotide arrays and somatic cell assays to estimate the extent of human diversity, and have found fewer haplotypes than anyone suspected. For chromosome 21, only 8% of the haplotypes were population-specific and 80% of a globally diverse set of chromosomes could be characterized by three common haplotypes.

### Exposing Culprit Genes in MS

Multiple sclerosis (MS) results from immune-mediated loss of the myelin sheath that surrounds nerves. Using large-scale sequence analysis of complementary DNA libraries constructed from brain tissue of MS patients, Chabas *et al.* (p. 1731) identified a number of genes that were substantially increased in their expression in MS. Among these was osteopontin (OPN), a known factor that influences inflammatory T cell responses. Expression analysis revealed up-regulation of OPN adjacent to lesions observed in brain tissue of MS patients, as well as in rodents that develop an experimental form of the disease. Induction of disease and expression of inflammatory cytokines by T cells was greatly reduced in mice lacking the *OPN* gene.