

Hotter Air

The tropopause is the transition zone between the troposphere and stratosphere. Changes in the thermal structure and static stability of the atmosphere have caused the tropopause to rise by several hundred meters during the past 30 years. **Santer *et al.*** (p. 479; see the Perspective by **Hoskins**) used the Department of Energy Parallel Climate Model to conduct a suite of different atmospheric simulations. Their analysis indicates that human-induced changes in ozone and atmospheric greenhouse gas concentrations account for more than 80% of the modeled rise in tropopause height between 1979 and 1999.

Taking a Second Moment to Pack

The optimum packing for a collection of spheres is the face-centered cubic arrangement, which minimizes the volume per sphere. However, when colloidal particles were extracted from drying emulsion droplets, **Manoharan *et al.*** (p. 483; see the cover and the Perspective by **van Blaaderen**) found that a different optimization factor controlled the packing. The spheres were arranged so that the second moment of the mass distribution was minimized. Clusters were produced with a packing that differs from that seen in bulk systems or those controlled by the minimization of potential energy, and one whose mathematics has only recently been described. These unusual clusters can be prepared consistently and in large quantities, so this process may also be used to create new colloidal building blocks.

Giant Pulses from the Crab

The radio signal from the Crab pulsar, a spinning neutron star, comes from coherent emission, whereas the optical signal comes from incoherent synchrotron emission. **Shearer *et al.*** (p. 493) observed and correlated giant radio pulses with giant optical pulses. The optical pulses peak about 90 microseconds before the radio pulses. These coherent and incoherent emissions are coming from the same region and most likely have an enhanced electron-positron plasma stream as their source.

Serpentine Vents

Serpentinization involves the water-driven alteration of olivine to serpentine and is a dominant process in the alteration of olivine-rich rocks, such as peridotites, on the seafloor. **Früh-Green *et al.*** (p. 495) determined the rate of serpentinization for the Lost City hydrothermal vent field and show that hydrothermal activity has persisted for at least tens of thousands of years. Such long-lived hydrothermal activity on the seafloor can alter the global geochemical cycle and affect the growth and stability of microbial communities.

Late Arrivals

The oldest generally accepted archaeological sites in the New World date to about 13,000 years ago and contain characteristic bifacial stone points that distinguish the Clovis culture. It is thought that these people migrated across the Bering Land Bridge about this time from eastern Siberia. The oldest known site in Siberia has been thought to be the Ushki complex in Kamchatka, which had initial dates of about 17,000 years ago. **Goebel *et al.*** (p. 501; see the news story by **Stone**) have now restudied and redated Ushki. They found numerous bifacial points and date its occupation to only about 13,000 years ago. These results imply that Beringia was occupied during the migration into the New World.

Way Fewer Whales

The management and conservation of natural populations require information about historic abundances, but information on past population sizes is difficult to construct. **Roman and Palumbi** (p. 508; see the news story by **Lubick**) reveal that historic populations of great whales are, for all species combined, at least five times larger than previously assumed. Using phylogenetic methods to analyze genetic variation, they calculate that up to 1 million fin, humpback, and minke whales were in the North Atlantic before commercial exploitation. The authors suggest that populations have not recovered to a level that would sustain commercial hunting.

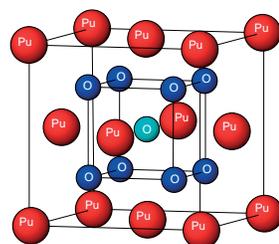
Lagging Productivity in Deep Tropical Lakes

Deep tropical lakes have good potential as indicators of climate warming trends because the deeper layers are generally insulated against the temperature fluctuations at the surface. Deep warming thus provides an integrated signal over annual time scales. **Verburg *et al.*** (p. 505; see the Perspective by **Livingstone**) describe the effects of climate warming on the pelagic ecosystem of Lake Tanganyika during the last century. A reduction in primary production in the lake was caused by an increased density gradient that slowed vertical mixing. If global warming continues, there will likely be further reductions in productivity in deep tropical lakes. **X**



A Doubly-Unstable Oxide

Recent experimental studies have indicated that plutonium in the form of the PuO_2 is not in its highest oxidation state, and thus could continue to oxidize and generate explosive hydrogen gas under long-term storage conditions. Theoretical studies of Pu chemistry are not straightforward, however, because it lies in the middle of the actinide sequence, and chemical interactions during compound formation can shift the extent of localization of its f electrons. First-principles calculations



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that allow for changes in f orbital localization by **Petit *et al.*** (p. 498) indicate that the oxidation state of PuO_2 is in a delicate balance. The authors suggest that rather low barriers exist to either slightly oxidizing or reducing PuO_2 by introducing oxygen in interstitial sites or vacancies in the lattice, respectively.

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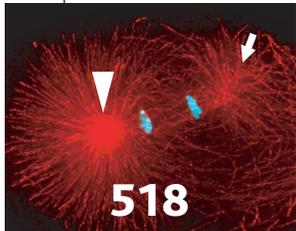
mice that had the gene for α -sarcoglycan knocked out resulted in partial morphological, biochemical, and functional recovery of downstream muscles. The high levels of engraftment of these stem cells into muscle after migrating through the capillary network distinguishes this approach from other cellular therapies. **X**

Cannibalism in Starving Bacteria

Bacillus subtilis is a spore-forming bacterium that can persist for years in a resistant state. When faced with starvation, bacteria instead enter the complex developmental pathway of spore formation. **González-Pastor et al.** (p. 510; see the Perspective by **Engelberg-Kulka and Hazan**) have found that bacteria en route to sporulation produce a toxin (sporulation-killing factor) similar to peptide antibiotics that lyses sibling cells not committed to sporulation. The killing operon also produces its own export pump and confers resistance to the killing peptide. The nutrient boost from the lysed cells allows the surviving cells to postpone sporulation, to escape its energetic costs, and to continue replication. A signaling factor (sporulation delaying protein) mediates this escape from sporulation via a transcription factor that stimulates lipid oxidation and adenosine 5'-triphosphate production to restore energy reserves. **X**

Lying in Wait

Activated oligomers of the BAX protein promote apoptosis (cell death) by enhancing permeabilization of the outer mitochondrial membrane. An inactive monomeric form of BAX appears to be sequestered in the mitochondrial membrane. **Cheng et al.** (p. 513) found that a particular isoform of the mitochondrial voltage-dependent anion channel, VDAC2, interacted with BAX in vivo. VDAC proteins are thought to contribute to regulation of mitochondrial metabolic functions as well as to provide a protein-conducting pore for release of apoptotic factors into the cytoplasm.



Unfair Partitioning

During early development in the nematode worm, *Caenorhabditis elegans*, zygotes divide unequally because the first mitotic spindle is displaced off-center by the pull of stronger forces on its posterior end. **Grill et al.** (p. 518) investigated whether this asymmetry is caused by differences in strength, number, or spatial positioning of the force generators (presumably cortical motors) that pull on the microtubules. They determined the distribution of force generators in a living *C. elegans* embryo while the spindle was becoming displaced to one side of the embryo by destroying the centrosome and analyzing the movement of resulting aster fragments toward the cortex. They found that more force-generating elements are available for the posterior spindle pole.

Wiring the Thalamus to the Cortex

The visual cortex of the brain receives inputs from the thalamus, and the cortical cells that respond are organized into patterns in response to certain types of inputs. **Kanold et al.** (p. 521) found that, in cats, the organization of cortical neurons that respond to visual orientation depends on a transient developmental phase in which subplate neurons mediate connections between the thalamus and the cortex. Maturation of both cortical anatomy and synaptic connections are affected by the absence of subplate neurons.

Back-Up Lighting Systems

Specific ganglion cells in the mammalian retina regulate non-image-forming responses to light, including entrainment of the circadian clock. However, genetic studies in mice have suggested that this response to light remains largely intact even in the absence of these photoreceptors. **Panda et al.** (p. 525) now report that the photoreceptors in mice of the classical image-forming visual system (rods and cones) also regulate light input into the non-image-forming photoresponse process. This finding indicates that light inputs from multiple photoreceptor types are integrated in the control of processes such as circadian rhythm. **X**

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