GEOLOGY

Andean Origins

The elevation of the Andes mountains has a tremendous influence on climate and ecology across South America, and their interaction with the atmosphere even tweaks Earth's rotation. Their past elevation and uplift history would have greatly influenced evolution and the development of ecosystems. The Andes were constructed by near-continuous subduction beneath South America for more than several hundred million years, and an uplift history might reveal or help elucidate specific tectonic events shaping the continent. Carrapa *et al.* compared dates from several techniques marking the original formation age and timing of rapid cooling of minerals now found in sedimentary rocks in the Central Andes. These ages reflect times of more rapid erosion of the Andes. The data are consistent with several episodes of uplift or exhumation including at about 350, 80 to 50, and 30 to 5 million years ago. Ehlers and Poulsen explored the relation between Andean uplift and paleoclimate of South America using a climate model and focusing on the past 10 million years or so. The simulations show that the lower Andes would have led to more drying of the Central Andes, but to more precipitation to the north. The magnitude of the results, while elucidating the importance of the Andes in climate, complicate the interpretation of stable isotope fossil plant data used to infer uplift history. — BH

Geology **37**, 407 (2009); *Earth Planet. Sci. Lett.* **281**, 238 (2009).

IMMUNOLOGY

T Cell Plasticity

$CD4^+$ T helper cells are important mediators of humoral immunity. Different types of infection induce distinct helper lineages with characteristic profiles of cytokine expression. During an infection, $CD4^+$ T cells interact with B cells in lymph node follicles where, through cell-cell interaction and cytokine secretion, they determine the classes of antibodies that B cells produce. $CD4^+$ T cells that induce B cell class switching, termed T follicular helper cells, express distinct phenotypic markers regardless of infection type and were thus thought to be a distinct lineage of helper cells; however, one lineage of cells can induce the different classes of antibodies associated with immune response to distinct classes of pathogens.

Three studies by Reinhardt *et al.*, Zaretsky *et al.*, and King and Mohrs address this issue in the context of a helminth infection, which generates a classical T helper cell 2 (T_H2) immune response associated with interleukin-4 (IL-4) production. Using IL-4 reporter mice, the authors demonstrate that in the lymph node, most IL-4–producing T cells localize to B cell follicles. These cells are similar in phenotype to T follicular helper cells and are required for B cell class switching, but they also express T_H2-associated genes such as GATA-3. In contrast, IL-4–producing cells outside of lymph nodes express T_H2-associated markers, but not T follicular helper cell–associated markers. These studies suggest that T follicular helper cells may not represent a distinct lineage, but rather differentiate from other T helper cell lineages and help to channel B cell responses via the secretion of lineage-specific cytokines. These studies also provide insight into how humoral and cellular immunity are coordinated because the same helper cytokines that induce humoral responses in the lymph node also drive cell-mediated immunity in the periphery. — KLM

Nat. Immunol. **10**, 385 (2009); *J. Exp. Med.* **206**, 10.1084/jem.20090303; 10.1084/jem.20090313 (2009).

ANIMAL BEHAVIOR

6 Heads Are Better than 2

A study of the gregarious house sparrow suggests that individuals in larger groups are swifter at solving new problems than those in smaller groups—findings that add a behavioral dimension to the ecological costs and benefits of group living. Using wild-caught birds that were then acclimatized to experimental aviaries, Liker and Bókony investigated whether group size affected the success rate at which birds figured out how to obtain seeds from a familiar feeder when access was blocked with a transparent lid. The larger groups, which contained six birds, were able to dislodge the lids roughly 10 times as quickly as smaller groups of two birds—a pattern that was consistent across all individuals in the groups. Also, birds from urban environments were faster than birds from rural backgrounds. Increased success at problem-solving in larger groups may reflect a wider diversity of experience and skill among the individuals in the group and may constitute an adaptive advantage in complex habitats. — AMS

Proc. Natl. Acad. Sci. U.S.A. **106,** 10.1073/pnas.0900042106 (2009).

CHEMISTRY

Sources of Static

Contact electrification can be a nuisance (as in a static electricity shock) but can also be harnessed in applications such as photocopying. Many issues about this process are still unresolved—

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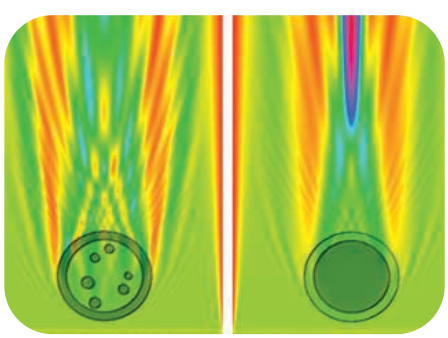
for example, in materials such as polymers, are the charges being transferred during rubbing electrons, or ions? Liu and Bard examined fresh samples of the thermoplastic poly(methyl methacrylate), or PMMA, which develops a positive charge if rubbed against Teflon. They found that the pristine PMMA tubing samples could undergo a number of reactions that are most readily explained as electron rather than ion transfers: plating out silver, copper, and palladium metal from ions in solution, for example, and reducing ferricyanide. Powdered samples increased the pH of aqueous solutions and generated hydrogen. The authors estimate that PMMA has a surface density of 5×10^{13} "cryptoelectrons," which could be recharged by contact with sodium amalgam, and further argue that the electrons occupy surface states created by damaged bonds, as opposed to states created by impurities. — PDS

J. Am. Chem. Soc. **131**, 6397 (2009).

CELL BIOLOGY

Nuclear Optics

In humans, the 3 billion nucleotides of DNA that constitute the genome would take up substantial cellular space if they were all stored in an open configuration; in a remarkable instance of molecular housekeeping, the DNA strands are instead packaged efficiently by the cell with proteins to form chromatin—a compressed material that can be straightforwardly confined to an approximately 10-μm-diameter membrane-bound nucleus. Some of the DNA needs to remain easily accessible to proteins and small molecules that together regulate gene expression and ensure the whole lot can be copied faithfully base by base, once per cell cycle. The vast majority of cells from both unicellular and multicellular organisms package transcriptionally inactive chromatin (heterochromatin) at the nuclear periphery and the more active chromatin (euchromatin) in the center. Although the function of this segregation is debated, the pattern correlates with the timing of replication, which during S phase is generally later for heterochromatin, and is altered by changes in gene activity, as occurs during development.



Light intensity (high, red/blue; low, green/orange) transmitted by conventional (left) and inverted (right) nuclei.

CREDIT: SOLOVEI *ET AL.*, *CELL* **137**, 356 (2009)

In mammals, rod photoreceptor cells display the opposite pattern, with euchromatin found at the nuclear periphery. Solovei *et al.* have analyzed chromatin organization in rod cells from more than 30 mammalian species, including deer, rabbits, and pigs. They found the inverted pattern predominantly in nocturnal animals, and they demonstrated that this inversion has the consequence of improving photon transmission through the retina. In fact, the heterochromatin regions had a higher refractive index than the euchromatin, and the rod cell nuclei acted as converging lenses, indicating that the large-scale organization of euchromatin and heterochromatin can be usefully exploited to achieve specialized cellular functions. — HP*

Cell **137**, 356 (2009).

MATERIALS SCIENCE

Of Grains and Glasses

Most crystalline materials do not naturally form single crystals, but instead form ordered regions separated by thin grain boundaries. Although the boundaries may occupy only a small fraction of the volume, they can substantially affect the mechanical and electrical properties. Zhang *et al.* use simulations to explore the boundaries at high temperatures, where less is known about them experimentally, and specifically probe how atom mobility changes with temperature. They find that the motion of the atoms resembles that in glass-forming liquids. In particular, both materials show the cooperative motion of strings of atoms, with similar behavior in the size and motion of the strings over a range of temperatures, including the formation at low temperature of cages that trap atoms into localized oscillations. The authors believe their model can explain why grain boundary behavior is dependent on the mode of an applied stress, something that is not captured by conventional grain boundary migration theories. The nature of the strain (tensile or compressive), for example, alters the average chain length, which in turn influences the mobility. Similarly, impurities can either disrupt or enhance the formation of atom chains, and thus render the boundary region either a stronger or weaker glass former. — MSL

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