

EDITORS' CHOICE

edited by Gilbert Chin

CHEMISTRY

Cross Coupling with Copper Nanoparticles

Many of the most useful organic reactions are catalyzed by noble metals, which not only are expensive but also can be hazardous if released into the environment. One example is the Suzuki-Miyaura reaction, in which the cross coupling of an aromatic halide and an arylboronic acid is catalyzed by a Pd(0) complex or supported catalyst. Thathagar *et al.* explored the use of nanoparticles (typically 1.6 to 2.1 nanometers in diameter) of copper, noble metals (ruthenium, palladium, and platinum), and copper-noble metal alloys. For the simplest example, which produces biphenyl, pure

Cu nanoparticles were active and stable catalysts, although the yields and reaction rates were lower than for pure Pd particles. However, a Cu-Pd alloy was actually more active than pure Pd. These results outline a potential compositional space for exploration of alternative catalysts for this reaction. — PDS

J. Am. Chem. Soc. 10.1021/ja027716+

IMMUNOLOGY

Ventilation Regulation

During an asthmatic episode, aberrantly reactive type 2 T helper (T_H2) cells aggressively recruit an assortment of leukocytes that induce airway hyper-reactivity (AHR). Current models of asthma have been influenced

by evidence that AHR may arise from an insufficiency of T_H1 cells relative to T_H2 cells. One idea is that this imbalance may have been promoted by cleaner childhood environments, because T_H1 cells are known to mediate resistance to most viral and bacterial infections. Work from two groups presents an alternative scenario in which AHR may be the outcome of a breakdown of direct immune suppression by regulatory T (T_R) cells.

Akbari *et al.* observed that T cells cocultured with pulmonary dendritic cells (DCs) presenting an artificial allergen (ovalbumin) produced the characteristic T_R cytokine interleukin-10 (IL-10). After receiving DC-boosted T_R cells, ovalbumin-sensitized mice did not display AHR when reexposed to ovalbumin. This alleviation of AHR could be blocked with antibodies to IL-10. Using a similar model of ovalbumin sensitization and challenge, Zuany-Amorim *et al.* demonstrated inhibition of AHR in mice pretreated with a killed preparation of *Mycobacterium vaccae* (SRP299). Here too, induction of IL-10 expression by SRP299 was required for T_R cell-mediated inhibition of AHR. These studies suggest that asthma, and perhaps other allergic conditions, may be amenable to manipulation of regulatory T cell circuits. — SJS

Nature Med. 8, 1024; 625 (2002).

ECOLOGY/EVOLUTION

Intricate Webs in the Rain Forest

The processes maintaining the high diversity of tropical rainforest organisms remain a central focus of ecological research.

Quantifying the trophic interactions between species via the construction of food webs is a key to understanding the structuring of these communities and the relative abundances of their components. Lewis *et al.* constructed quantitative food webs for leaf-mining insects, their food plants, and their parasitoids for a rain forest in Belize. This analysis, involving 93 leaf miner species, 84 parasitoid species, and 71 species of host plants at three different seasons, is the most comprehensive one to date. The leaf miners were fastidious in their choice of plant, whereas the parasitoids tended to be catholic, attacking

a range of insects. The analysis suggests that herbivorous insect species might indirectly influence each other's abundance and population dynamics, with the more abundant species having greater effects on the less abundant ones. — AMS

J. Anim. Ecol. 71, 855 (2002).

PHYSICS

Improved Quantum Communication

At a cocktail party, two people speaking softly, to avoid being overheard, often have to listen attentively in order to follow the conversational thread. A similar, but more complex, prin-

CONTINUED ON PAGE 2173

GEOPHYSICS

Three Strikes and You're Out

A large bolide hit the Yucatan Peninsula of Mexico about 65 million years ago, as revealed by the Chicxulub impact crater and the layers of debris at the Cretaceous-Tertiary (K-T) stratigraphic boundary in North America, Europe, Africa, New Zealand, and the Pacific and Atlantic Oceans. The K-T

impact event was a global catastrophe that probably led to the demise of the dinosaurs and other organisms whose lifestyles were disrupted by the

impact and by post-impact effects such as wildfires and nuclear winter-like conditions.

Kring and Durda have modeled the energetics and trajectories of heterogeneous particles, including gravity and shape explicitly, from their launch in the vapor plume or ejecta curtain to their return to a rotating Earth. They find that some (12%) of the vapor plume ejecta escapes from Earth, while most of the remaining material falls to the surface in daily pulses over 3 days. Although debris is distributed globally, the highest concentrations occur near Chicxulub and its antipode, roughly where India was situated at the end of the Cretaceous. The repeated intense heating of the atmosphere in these regions would likely have ignited multiple wildfires, ensuring the destruction of fauna and flora. — LR

J. Geophys. Res. 107, 10.1029/2001je001532 (2002).



Global ignition of vegetation.

ciple is involved in optical coherent communication: Weak pulses of light encode information in the phases of coherent pulses, but the small number of photons per pulse makes it hard to measure the phases. Quantum mechanics places a fundamental limitation on how precisely observable quantities such as position, momentum, and phase can be determined, and so introduces intrinsic errors in the ability to decode information accurately. Armen *et al.* describe an adaptive feedback technique in which the leading one or two photons in a single 50-microsecond pulse (with unknown phase and containing merely 10 to 300 photons in toto) are used to adjust the phase of a local oscillator. This procedure allows the determination of the entire phase of the packet of coherent photons and may prove useful for secure communication in which only several quanta are used as the information carriers. — ISO

Phys. Rev. Lett. **89**, 133602 (2002).

MICROBIOLOGY/DEVELOPMENT

Cutting Both Ways

Cells need to be able to communicate with other cells, either within a multicellular organism (during development) or in a population of bacteria (during quorum sensing), and this need is manifest in the enormous variety of mechanisms for generating and receiving signals. One recently discovered pathway for producing signaling molecules (peptides) from inactive membrane-embedded precursors involves, in *Drosophila*, the cleavage of the ligand precursor Spitz by the serine protease Rhomboid. Two noteworthy aspects of this reaction are that the protease cuts the precursor at an intramembrane site and that it takes place in an internal compartment, after which the now-soluble ligand is secreted.

The human pathogen *Providencia stuartii* contains a Rhomboid-like protein, AarA, that is known to be involved in sensing its population density. Gallio *et al.* show that AarA can substitute for Rhomboid in two mutant flies with abnormalities in eye de-

velopment and wing venation; conversely, Rhomboid can rescue *aarA* mutant bacteria and activate the expression of density-dependent genes. Using a transfected cell assay system, Urban *et al.* document the biochemical activities of a group of Rhomboid-like bacterial intramembrane serine proteases against the three transmembrane precursor ligands Spitz, Keren, and Gurken. — GJC

Proc. Natl. Acad. Sci. U.S.A. **99**, 12208 (2002);
Curr. Biol. **12**, 1507 (2002).

GEOPHYSICS

Rising Rapidly Recently

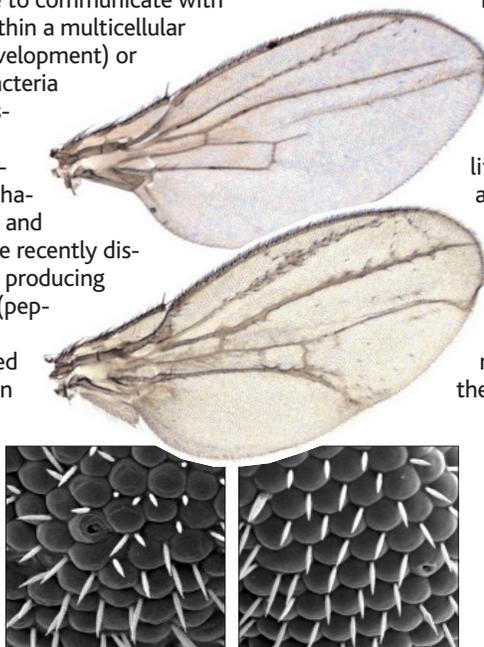
The Grand Canyon formed as the Colorado River cut through rocks of the Colorado Plateau and as the average elevation of the region increased by about 2 kilometers. The timing of the uplift has been debated: One estimate is that most of it took place during the past 5 million years; a second is that it began as early as 40 million years ago (Ma). This question not only bears on the age of the Grand Canyon but relates to the development of topography and climate throughout

western North America, as well as the understanding of the mechanisms of uplift of this plateau and, through comparison, other plateaus worldwide.

Sahagian *et al.* provide a new estimate by looking at the size of air bubbles in basalt flows that erupted on the Colorado Plateau since 23 Ma. Simply put, the size of bubbles in a basalt flow depends primarily on the atmospheric pressure at the top of a flow and its thickness. Thus, the distribution of bubble sizes in flows of

known thickness can be used to infer pressure and elevation. Analysis of many flows across the Colorado Plateau dating from 23 Ma indicates that the region experienced slow uplift (40 meters per million years) until about 5 Ma, and has risen five times as rapidly since then. — BH

Geology **30**, 807 (2002).



AarA rescues the wing vein deficiency of the *veinlet* allele (above) and the malformed eyes of *roughoid* (below).

Science

Cutting Both Ways

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