

APPLIED PHYSICS

Listening In by Nanoparticle

The degree of control with which particles can be trapped, rotated, pulled apart, and manipulated by focused light beams has made optical tweezers an extremely useful laboratory tool across many disciplines—from probing the mechanical properties of cells and DNA to building three-dimensional structures and cooling gases to their quantum ground state. It might be expected that external perturbation or excitement would produce a wobble of a light-trapped particle. Ohlinger *et al.* exploit this effect to show that a trapped gold nanoparticle can be used as an ultrasensitive detector of sound waves. A typical empty room has a sound level of 20 decibels. By comparison, the trapped gold nanoparticle can detect sounds down to -60 decibels—over six orders of magnitude more sensitive than the human ear. The authors suggest that such enhanced sensitivity could be used to probe live bacteria and cells that produce acoustic vibrations but are not easily seen with optical microscopes. — ISO

Phys. Rev. Lett. **108**, 18101 (2012).

STRUCTURAL BIOLOGY

A Fuzzy Fit

Careful tuning of gene regulation is crucial for proper cell function. Temporal or spatial changes in gene expression or changes in gene expression level can compromise cell activity or even viability. Transcriptional activators interact with coactivators, which in turn communicate with the general transcription machinery or chromatin remodeling factors to effect changes in gene expression. Using NMR, Brzovic *et al.* have examined the structural basis for the binding of the transcriptional activator Gcn4 to the coactivator Mediator subunit Gall11/Med15 (Gal11) in yeast. Activation domains, which are generally rich in acidic residues, often bind diverse coactivators through multiple low-affinity interactions. In this study, the activation domain shows a disordered structure that morphs to a more stable alpha-helical structure upon binding to Gal11. The protein-protein interface is rather simple and consists of only hydrophobic interactions, which allows the activator and coactivator to bind in multiple orientations, forming a so-called “fuzzy” complex. Gcn4 can also interact with other unrelated coactivators using the same residues through a similar mechanism, suggesting that this mechanism may enable transcriptional activators to interact with multiple targets. — BAP

Mol. Cell **44**, 942 (2011).

IMMUNOLOGY

Neutrophils Lend a Hand

Diverse antibody production by B cells, which is critical for protection against a variety of infections, often requires the help of T cells.

Marginal zone (MZ) B cells in the spleen, which are situated at the interface of the circulation and the immune system, are unusual in that they are able to provide a rapid, first line of antibody defense that is independent of T cells. Puga *et al.* now show that despite being independent of T cells, MZ B cells in humans do get help from another immune cell: neutrophils.

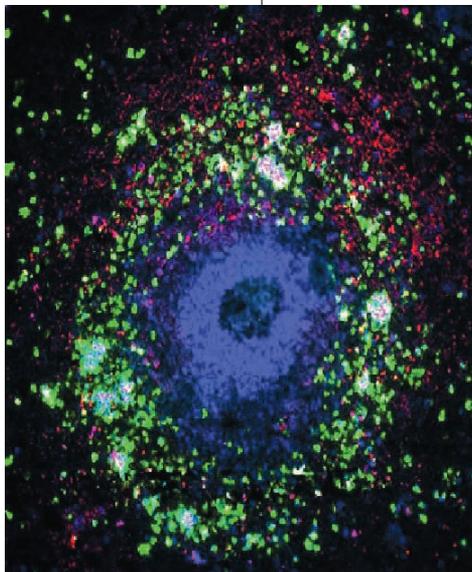
These so-called “B cell–helper neutrophils” were located in close proximity to MZ B cells in the spleens of humans, non-human primates, and mice. Their localization to the spleen coincided with postnatal colonization by microbes. Through the production of the cytokines APRIL, BAFF, and interleukin-21, B cell–helper neutrophils promoted the expression of activation-induced cytidine deaminase (AID), antibody isotype class switching, and somatic hypermutation by MZ B cells, events that help to diversify the antibody response but are typically associated with T cell help. Reduced MZ B cell numbers and altered MZ B cell antibody responses in patients deficient in neutrophils revealed the importance of B cell–helper neutrophils *in vivo*. — KLM

Nat. Immunol. 10.1038/ni.2194 (2011).

CLIMATE SCIENCE

Whence the Little Ice Age?

In the second half of the past millennium, glaciers advanced and temperatures fell in many regions around the world, although the timings and durations of the cold spells differed widely between regions. Numerous causes for this Little Ice Age have been proposed, including cyclical reductions in solar irradiance, changes in ocean circulation, and increases in volcanic activity, but the direct radiative effects of these processes are either weak or short-lived and require substantial feedbacks within the climate system. Miller *et al.* now exploit the fact that small ice caps in Arctic Canada are retreating, exposing vegetation that was entombed when the ice caps were advancing.



By radiocarbon-dating these plants, the authors can accurately determine the time of glacial advance. They identify abrupt summer temperature decreases in the late 13th century and between 1430 and 1455 CE; subsequently, most ice caps remained in an expanded state until the 20th century. Comparison with varved sediments recording ice-cap growth from

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EDITORS' CHOICE

Iceland provides support for these dates, which coincide with periods of enhanced volcanic activity. Climate model results suggest that short-lived volcanic eruptions, reinforced by weak solar irradiance changes, can cause a sea-ice/ocean feedback that yields a centuries-long reduction in summer air temperature across the Arctic. — JFU

Geophys. Res. Lett. 10.1029/
2011GL050168 (2012).

PSYCHOLOGY

Us vs. Them in Context

Us versus Them is both an enduring view of the world and a malleable one. It is enduring in the sense that groups form naturally even where there are no preexisting differences and malleable in the sense that the group that one identifies with can change over time or between situations. Theoretical and empirical evidence justifies the generalization that members of a majority group tend to favor the assimilation of immigrants into the native culture, whereas immigrants are more likely to vote for pluralistic policies that acknowledge the distinctiveness of minority cultures. *Hehman et al.* have examined students' cultural assimilation and pluralism preferences at both a national and university campus level. As one would predict on the basis of their histories in the United States, white American undergraduates were more likely than their black classmates to vote for the establishment of English as the sole official language of the country. Similarly, when surveyed about funds to support multicultural activities on campus, white students were much less keen than their black classmates—when the context was a majority-white university. This preference disappeared, however, when white students at a majority-black institution were quizzed, revealing an association between minority status and pluralistic attitudes, regardless of individual identity. — GJC

Psychol. Sci. 23, 46 (2012).

MICROBIOLOGY

Full Sequence Ahead

Some of the most abundant microorganisms in surface ocean communities are resistant to cultivation in the laboratory. Metagenome sequencing can reveal insights into the metabolism and physiology of such microbes, but the other ~200 fully sequenced marine microbial genomes to date remain poor references for

useful comparisons. To provide a better genomic context for uncultivated microbes, *Dupont et al.* used metagenomic reconstructions of Global Ocean Survey samples to generate two nearly complete genomes of SAR86 bacteria, a clade of ubiquitous nonphotosynthetic γ -proteobacteria. The authors also sequenced two partial genomes of single cells within the SAR86 lineage collected off the coast of San Diego, USA. The reconstructed genomes and single-cell genomes all suggest that SAR86 bacteria have streamlined metabolisms: They cannot synthesize all of their required vitamins or amino acids and rely on specialized carbon sources. All four genomes also contain at least one gene encoding green light-tuned proteorhodopsin, which suggests that the organisms generate ATP via light-sensitive enzymes. The genomes vary significantly according to biogeography (i.e., sample locations and water temperatures), implying physiological differences. This broader genomic context may aid in future cultivation efforts. — NW

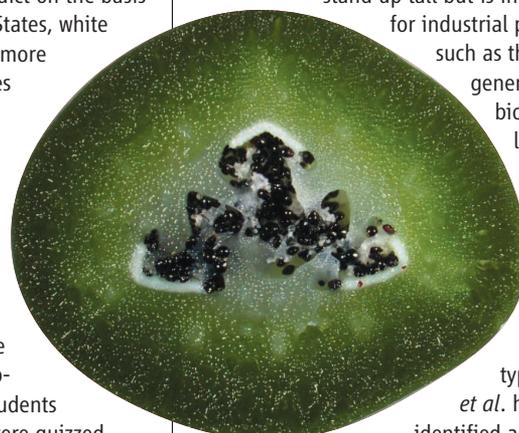
ISME J. 10.1038/ismej.2011.189 (2011).

PLANT SCIENCES

A Cactus by Any Other Name

Lignin polymers toughen up plant cell walls, which may be good for the plant that needs to stand up tall but is inconvenient for industrial processes such as those that generate pulp or biofuels. Most lignins are assembled from a small handful of common monomer types. *Chen et al.* have now identified a lignin that is constructed from an unusual subunit, the catechyl (C) monolignol caffeoyl alcohol. The lignins in the black coats of seeds within the vanilla bean are entirely composed of these catechyl subunits. Other portions of the vanilla plant—the seed pod, stem, and leaves—instead contain the more standard sort of lignin, without the C subunit. A similarly high content of C-lignin was also found in seed coats of several cactus species, seeds that, like the vanilla seeds, carried black coats. Thus, there is greater natural diversity in these sturdy polymers than previously appreciated. — PJH

Proc. Natl. Acad. Sci. U.S.A. 109, 10.1073/
pnas.1120992109 (2012).



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Science

Whence the Little Ice Age?

Julia Fahrenkamp-Uppenbrink

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