EDITORS' CHOICE

edited by Gilbert Chin

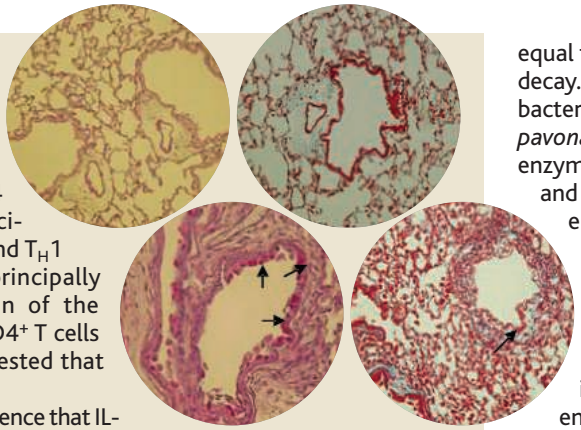
IMMUNOLOGY

An Inflammatory Lineage

Helper CD4+ T (T_H) cells are traditionally divided into two principal lineages: interleukin-4 (IL-4)/IL-5–producing T_H2 cells, which are associated with allergic and antiparasitic responses, and T_H1 cells that produce inflammatory cytokines, principally interferon-γ (INF-γ). However, the expression of the cytokine IL-17 by a relatively small subset of CD4+ T cells and its association with inflammation has suggested that this may define a T_H1 sublineage.

Now, Harrington *et al.* and Park *et al.* provide evidence that IL-17–producing CD4+ T cells may represent a distinct T-helper population altogether, the development of which is coordinately regulated with those of T_H1 and T_H2 cells. Both studies confirmed the dependence of IL-17 expression on signaling through the receptor for the cytokine IL-23 and demonstrated that this was independent of the signals and transcriptional pathways responsible for IFN-γ and IL-4 production. Furthermore, both of these T-helper cytokines were found to inhibit IL-17 expression in naïve T cells—as opposed to differentiated IL-17+ T cells—suggesting a dominant role in cross-regulation during early T cell priming. Given the clear association of IL-17 with tissue inflammatory responses, the strict management of T_H17 cell differentiation may represent a central checkpoint in preventing immune pathologies such as those seen in autoimmune diseases. — SJS

Nat. Immunol. **6**, 1123; 1133 (2005).



Lung inflammation induced by overexpression of IL-17 (lower row), with increases in mucus production (arrows, left) and collagen deposition (arrow, right) in bronchioles.

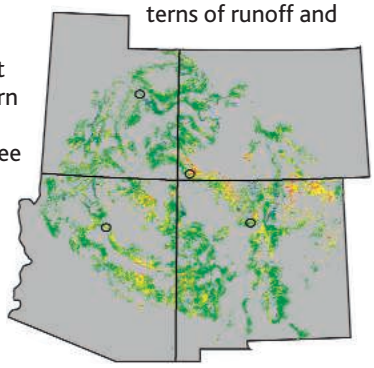
CREDITS: (TOP) PARK *ET AL.*, *NAT. IMMUNOL.* **6**, 1133 (2005); (BOTTOM) BRESHEARS *ET AL.*, *PROC. NATL. ACAD. SCI. U.S.A.* **102**, 15144 (2005)

CLIMATE SCIENCE

Warmer and Drier

One effect that is expected to accompany global warming is the occurrence of more intense and more frequent droughts. Although it is known that protracted drought increases tree mortality, the response of forests on regional or continental scales to the kind of warmer drought that may occur in the future is poorly understood.

Breshears *et al.* examined the impact of recent drought on piñon pine trees in western North America, focusing on the relationships between tree die-off, temperature, and rainfall. They found that the 2000–2003 drought was not as dry as the previous one of 1953–1956, but that it occurred during a warmer period and hence might illustrate drought effects in the future. Their analysis shows that the recent drought caused a rapid regional-scale loss of overstory trees mainly due to infestation by bark beetles, outbreaks of which are commonly caused by water stress; whereas the 1950s drought affected mainly older trees, the 2000s drought killed trees of all ages. Similar widespread drought in this century could cause large changes in carbon storage and dynamics, in fluxes of near-ground solar radiation, and in patterns of runoff and erosion, as well as alter microclimate feedbacks between the land and atmosphere and reduce the production of piñon nuts, an important food source for a number of species of birds, small mammals, and local people. — HJS



Changes in the normalized difference vegetation index (green, no change; red, largest decrease) in the southwestern US.

Proc. Natl. Acad. Sci. U.S.A. **102**, 15144 (2005).

BIOCHEMISTRY

New Activity, Old Enzyme

Ever since we realized that chemicals introduced into the environment for the control of agricultural pests can persist for uncomfortably long periods, there has been an interest in microbes that are able to adapt to living off of (metabolizing) these synthetic carbon sources. In the case of the nematocide 1,3-dichloropropene, its degradation product, *trans*-3-chloroacrylic acid, undergoes hydrolytic decomposition with a half-life of 24,000 years at 19°C, roughly equal to the half-life for ^{239}Pu decay. Fortunately, the soil bacterium *Pseudomonas pavonaceae* expresses the enzyme CaaD, which Horvat and Wolfenden show accelerates hydrolysis, yielding malonate semialdehyde through addition of water and loss of HCl, by a factor of 10^{12}. They argue that this impressive rate enhancement is due largely to chemical transformations taking place in the active site (as opposed to substrate binding or product release) and that CaaD appears to be a considerably more proficient enzyme than its structural cousin 4-oxalocrotonate tautomerase, all of which provides support for the proposal that the degradation of 3-chloro-acrylate may be a recently acquired activity of a relatively ancient and catalytically sophisticated enzyme. — GJC

Proc. Natl. Acad. Sci. U.S.A. **102**, 16199 (2005).

GEOCHEMISTRY

Reversing Crystal Growth

Much of the chemistry and dynamics of Earth's surface depends on the dissolution of minerals: It determines the composition of soils, rivers, and oceans and affects the amounts of major gases, such as CO_2, in the atmosphere. Rapid dissolution weakens rocks, facilitating erosion, and dissolution and corrosion are critical in evaluating the performance of engineered structures. Various data have implied that the dissolution rates of many minerals are complex functions, depending subtly on interacting waters, for example.

Dove *et al.* show, both theoretically and through experi-

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ments, that for quartz, and likely for other silicate minerals, well-developed theories of crystal nucleation and growth can be used to understand dissolution. Nucleation theory involves four parameters: temperature, oversaturation, and two parameters that describe the energy and kinetics associated with a step on a growing crystal. The authors derive the analogous equations for dissolution at dislocations and vacancies, and show that the theory fits well with experimental data for quartz, feldspar, and a common clay mineral, dissolving in waters under a range of pH and salt conditions. If the result holds across a full range of minerals, it would allow the prediction of dissolution and corrosion under a variety of conditions and temperatures. — BH

Proc. Natl. Acad. Sci. U.S.A. **102**, 15357 (2005).

APPLIED PHYSICS

Patterns of Light

Polymers have found use in the fabrication of optoelectronic and magnetic devices and as inexpensive, flexible, and lightweight templating materials. Patterns are created through the solvent or by thermally driven phase separation of a blend of homopolymers or block copolymers. One problem with using homopolymers is that it is difficult to create large areas that are defect-free yet retain precise patterning on a much smaller scale. Block copolymers are better for achieving this, but changes in the pattern can require the synthesis of a new copolymer.

Travasso *et al.* describe an alternative method for creating materials that are spatially patterned on the submicrometer scale and are defect-free on the millimeter to centimeter scale. They consider a ternary A/B/C blend of immiscible polymers. Polymers A and B are chosen so that the extent to which they interact or separate can be tuned by exposure to light. Initially, a uniform light source is used to create a homogenous mixture of A and B. By rastering over the sample with a higher-intensity secondary beam, defects in the local pattern can be annealed out. Polymer C is chosen to migrate to areas illuminated by the higher-intensity light. Thus, it is possible to write regions of polymer C onto a spatially patterned AB film. — MSL

Ternary A/B/C blends (blue/red/green)

CREDITS: TRAVASSO *ET AL.*, *LANGMUIR* 10.1021/LA052511A (2005)

Langmuir 10.1021/la052511a (2005).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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Bacterial Pheromone for Sex and Abstinence

Bacteria can transfer DNA through conjugation, and the transfer of these extrachromosomal elements contributes to virulence and antibiotic resistance. Chandler *et al.* report that in *Enterococcus faecalis*, a mammalian pathogen, the same pheromone that stimulates a donor bacterium to initiate conjugation with a plasmid-free recipient is also produced by the donor itself and regulates its sensitivity to the recipient-produced pheromone. The bacterial chromosome encodes the pheromone (cCF10), so both donor and recipient can produce this molecule; to prevent conjugation with other donors, donor cells have two mechanisms for suppressing the response to the endogenously produced pheromone. One of the conjugation inhibitors is a secreted inhibitor protein, iCF10, which binds and sequesters secreted cCF10, and another is the membrane protein PrgY, which degrades or binds cCF10 as it is released. Using mutant bacterial strains that lacked functional cCF10, Chandler *et al.* show that cCF10 produced by the donor cells stimulates the production of iCF10. Donor cells grown in human plasma or in vivo also produce the plasmid-encoded aggregation factor Asc10, which contributes to cellular invasion and virulence of the bacteria. Albumin was identified as the plasma protein that bound iCF10, thereby shifting the balance between iCF10 and cCF10, allowing self-induction of the conjugation genes, including the one encoding Asc10. — NRG

Proc. Natl. Acad. Sci. U.S.A. **102**, 15617 (2005).