

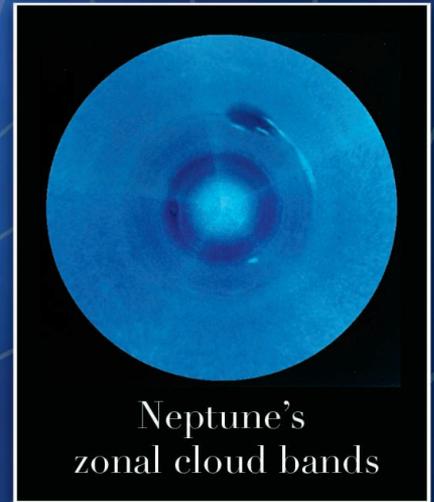
ASTRONOMY

Cloudy Down South

Neptune receives much less radiation from the Sun than either Jupiter or Saturn. Like these two large planets, though, it has a meteorologically active atmosphere, with clouds, storms and possibly a global circulation pattern. Most of Neptune's clouds evolve on a time scale of hours. One cloud, however, has appeared to persist since at least 1989, when it was first detected by the spacecraft Voyager 2. This cloud is located within a few degrees of the south pole, where the troposphere is known to be warmer and where, by analogy with Saturn's south polar environment, researchers suspect that a vortex may exist. Using the Keck Telescope in

Hawaii, Luszcz-Cook *et al.* observed Neptune's south pole in the near-infrared, thereby probing the upper and lower troposphere. Images taken over 3 days in July 2007 show the south polar cloud splitting in two and then coming together again. The altitude observed is consistent with cloud formation due to upwelling and condensation of methane gas. Thus, rather than representing a single stable cloud, the bright feature observed by Voyager marks a site of persistent cloud activity, which may be related to a Neptunian south polar vortex and an organized circulation pattern. — MJC

Icarus 10.1016/j.icarus.2010.03.007 (2010).



Neptune's
zonal cloud bands

CREDITS (TOP TO BOTTOM): ISTOCKPHOTO (INSET) VOYAGER PROJECT/NASA; VALLET ET AL., PNAS 107, 5124 (2010)

IMMUNOLOGY

Watching of the Sentinels

Natural killer T cells (NKTs) are a subset of unconventional T cells. They express a limited T cell receptor repertoire and recognize lipid (rather than protein) antigens presented by the nonclassical major histocompatibility complex CD1d. Although NKTs have been implicated in antimicrobial, inflammatory, and autoimmune responses, their dynamics during an immune response and the antigen-presenting cell (APC) populations that mediate their activation are not well defined.

Lee *et al.* have visualized the response of NKTs in the liver to infection with *Borrelia burgdorferi* (the causal agent of Lyme's disease), whereas Barral *et al.* followed NKTs in lymph nodes in response to particulate lipid antigens. In mice infected with *Borrelia*, they proliferated rapidly and produced cytokines; in response to antigen, NKTs slowed down and formed long-lasting contacts with their relevant APCs, which in both cases were macrophages. In the liver, sinusoid-localized Kupffer cells activated NKTs,

whereas lymph node NKTs were activated by a subset of macrophages located in the subcapsular sinus. — KLM

Nat. Immunol. 11, 295; 303 (2010).

CANCER

Runaway Remodeling

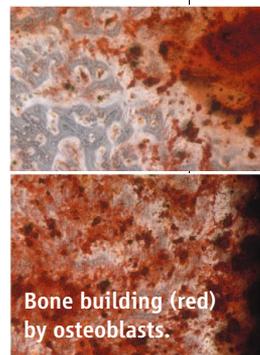
Bone metastases are a common feature of many advanced-stage cancers and are among the most painful and debilitating complications. Tumor cells alter bone tissue by unbalancing the bone remodeling process that occurs naturally throughout adult life. In the context of osteolytic (bone-destroying) metastases, this disruption occurs through an enhanced production of osteoclasts—the cells that resorb bone—or through a suppressed production of osteoblasts—the cells that build bone. The molecular

mechanism by which tumor cells alter the abundance of these cell types is the subject of two recent studies using mouse models of cancer.

Vallet *et al.* found that multiple myeloma cells cause bone marrow stromal cells to secrete activin A, which is a member of the transforming growth factor- β family of cytokines and which inhibits the differentiation of cells into osteoblasts. In independent work on breast cancer-associated bone disease, Min *et al.* found that Tie2, a receptor tyrosine kinase that is expressed at high levels in breast cancer, is also expressed in bone marrow cells that normally differentiate into osteoclasts and is in fact required for osteoclast production. Inhibition of either activin A or Tie2 signaling with soluble decoy receptors led to the amelioration of osteolytic bone disease, suggesting that these two molecules may be useful therapeutic targets. — PAK

Proc. Natl. Acad. Sci. U.S.A. 107, 5124 (2010); *Cancer Res.* 70, 2819 (2010).

Continued on page 141



Bone building (red)
by osteoblasts.

Continued from page 139

BIOMEDICINE

Liquid Biopsy

Certain cancers spread through the migration of circulating tumor cells (CTCs). Once shed from either primary or metastatic sources into the bloodstream, these cells can become lodged in bone, lungs, brain, or liver. The rarity of the cells, at concentrations of one per billion blood cells, has hindered their use in quantitative evaluations. Stott *et al.* have now developed an automated imaging system for prostate cancer CTCs. The cells are isolated with a microfluidic chip that extracts them from the leukocytes and red blood cells. They are then stained to highlight the nuclei and prostate-specific antigens (PSAs), as the distance between the two markers can be used to identify and verify each whole cell.

Significant PSA heterogeneity was detected across the CTCs taken from a range of patients, and there was also considerable variability in the rate of decline of CTCs after surgery. However, the authors were able to track significant decreases in CTCs in patients with metastatic cancer after hormone therapy, with only modest decreases in CTCs after chemotherapy. The authors envision scaling up this automated method for tracking the migration of CTCs. — MSL

Sci. Transl. Med. **2**, 25ra23 (2010).

ECOLOGY

No Plant Is an Island

Most land plants form mutualistic associations with fungi, in which the partners rely on each other for mineral and nutrient exchange, as well

as for the endowment of beneficial properties such as heat tolerance and protection from pests. These arbuscular mycorrhizal fungi (AMFs) in turn host at least two types of endosymbiotic prokaryotes: a β -proteobacterium and a distinctive coccoid

Gram-positive entity. Naumann *et al.* have found the latter in the cytoplasm of many AMF lineages, and sequence analysis shows that despite possessing a cell wall, these bacterium-like organisms cluster with the *Mollicutes*. These bacteria appear to have been associated with AMFs since the Devonian, 400 million years ago; for this partnership to have persisted so long, there must be significant fitness benefits. Furthermore, this association is an intimate one as the bacteria live in the fungal cytoplasm with no discernable membrane enclosing them. This discovery raises several questions about the evolution of key bacterial and fungal lineages,

as well as the evolution of plants and the functional nature of this ecologically key suite of symbioses. — CA

ISME J. **10**.1038/ismej.2010.21 (2010).

PHYSIOLOGY

Old and Fat

Adipose tissue secretes the hormone leptin, which regulates food intake and energy use. The loss of leptin signaling through its receptor can cause obesity and diabetes in mice and is associated with obesity in humans, too. The leptin receptor signals in part via three tyrosine residues that become phosphorylated after leptin binds. The effects are complex because other signaling components bind to the phosphorylated residues: One attracts the JAK2 protein kinase and STAT transcription factors, and a second (Tyr⁹⁸⁵) appears to transduce both positive and negative signals, and also inhibits the receptor itself. Tyr⁹⁸⁵ is bound by the SOCS3 protein, which inhibits the activation of STAT3, and by the protein tyrosine phosphatase SHP2, which antagonizes JAK-STAT signaling.

You *et al.* engineered mice to block phosphorylation of Tyr⁹⁸⁵. When young, these animals were leaner than controls and showed increased responses to leptin; however, as the animals aged, the opposite was true. They ate more than controls and expended less energy. Obesity induced by a high-fat diet was also more severe in the older mutant mice than in controls. Hence, Tyr⁹⁸⁵ may be important for the normal adjustment of metabolic control as mice age. — LBR

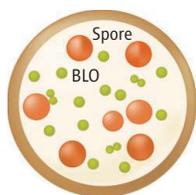
Mol. Cell. Biol. **30**, 1650 (2010).

GEOLOGY

Alpine Growth Spurts

Traditionally, the formation of metamorphic rock was thought to occur slowly and steadily, driven by the gradual rates of tectonics or conductive heat flow. However, recent research has shown that more rapid transformation is possible when fluid movement through the crust is involved. Pollington and Baxter show that this probably occurred in the Austrian Alps, where metamorphism broadly reflects gradual continental collision and tectonic exhumation of deep seated rocks. The authors used the Sm-Nd isotopic system to date garnets from old cores to young rims, with improved accuracy. The garnets overall grew during about 8 million years, but the individual dates show that most of the growth actually occurred during two short pulses. The first, which may have lasted less than a few hundred thousand years, seems to reflect the infiltration of fluids during the beginning of exhumation. — BH

Earth Planet. Sci. Lett. **293**, 63 (2010).



CREDIT: NAUMANN ET AL., ISME J. 10.1038/ismej.2010.21 (2010)