EDITORS' CHOICE

edited by Phil Szuromi

GEOLOGY

Tracking Canadian Hotspots

Hotspots are areas of stable active volcanism in the mantle. The movement of tectonic plates across these mantle hotspots leads to the formation of a volcanic chain, most notably seen in the Hawaiian Islands and Emperor Seamounts. Heaman *et al.* may now have helped delineate a long-lived hotspot track across North America. Recently, a large number of kimberlites—volcanic rocks derived from deep in the mantle and the source of most diamonds—have been discovered or studied in central and eastern Canada. Heamon *et al.* provide accurate uranium-lead dates on many of these samples and show that the ages of the fields generally increase from southeast to the northwest over about 1000 km. The oldest fields seem to be located in central Canada, on the western shore of Hudson Bay, and date to the Triassic, which is the period when the Atlantic Ocean began to open up. This magmatism and hot spot may help delineate a previously proposed hotspot track, based in part on Atlantic Ocean seamounts, known as the Great Meteor hotspot. — BH

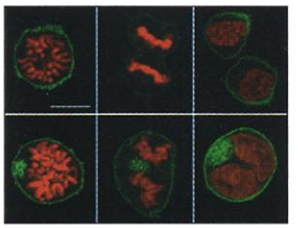
Earth Planet. Sci. Lett. **178**, 253 (2000).

ECOLOGY

Wildlife in a Charcoal Medium

Wildfires are a common feature of many of the world's vegetation types, and deliberate setting of fires by humans frequently causes huge losses of biomass and local diversity. The above-ground effects of fire on macroscopic organisms are well known. In vegetation with a natural fire cycle, for example in many parts of Australia, plants show a range of adaptations to fire, and some actually require fire for germination.

The effects of fire on the below-ground community of organisms are less well understood. Pietikäinen *et al.* have studied the effects of charcoal layers on the soil microbial community. They reasoned that the absorptive capacity of charcoal should allow the retention of organic compounds and the subsequent hosting of microorganisms. In experimental microcosms, they examined the capacity of the charcoal layer to adsorb nutrients from leaf litter extract deposited on it and used nonadsorptive pumice and activated carbon as reference materials. They also compared the microbial communities that formed in the charcoal layer with those in a humus layer below.



Effect of psychosine on cell division; scale bar is 10 μm.

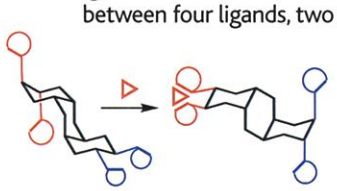
The charcoal layers adsorbed substantial amounts of organic carbon from the litter extract (more than pumice and less than activated carbon). The microbial communities that formed in the charcoal layers that had higher growth rates and distinct densities and metabolisms compared to those in the underlying humus. These charcoal communities might be an important component in the ability of ecosystems to recover from fire. — AMS

Oikos **18**, 231 (2000).

CHEMISTRY

Modeling Signal Transduction

Signal transduction is an integral part of biological systems. When a receptor is stimulated, small "messenger" molecules often act as transducers to carry the signal to the next site (the "effector") in the signaling cascade. Krauss *et al.* now report the synthesis of a molecule that contains both a receptor and an effector. The molecule transduces the signal through a conformational switch; a central three-ring unit that can switch between two conformers is located between four ligands, two at either end. Upon binding zinc (Zn^{2+}), the ligands at one end come closer together, which triggers a conformational change in the central unit that in turn increases the separation of the ligands at the far end from the Zn^{2+} binding site. This change can be monitored through a change in the fluorescence signal of the molecule. The process is reversible. Modifications of the present molecule may allow different stimuli, such as photoisomerization, to be exploited at the receptor, and could trigger the release of an ion or ligand at the effector. — JU



Signaling with a twist.

Angew. Chem. Int. Ed. **39**, 1835 (2000).

CELL BIOLOGY

Making the Final Cut

Mitosis produces two daughter nuclei, but cell division is not complete until the cytoplasm is successfully divided into two distinct daughter cells during a process known as cytokinesis. Compared with mitosis, relatively little is known about the molecular processes involved in cytokinesis. Kanazawa *et al.* found that a lipid metabolite, psychosine, can inhibit cytokinesis and lead to the production of multinucleate cells. In cells treated with psychosine (bottom panels), cellular actin (stained green) "clots" rather than forming a contractile ring around the plane of division, as do untreated cells (top panels). After mitosis, both nuclei (the red-stained DNA) remain in the same psychosine-treated cell. These observations correlate with the production of multinuclear cells in the brains of patients who have the neurological disorder globoid cell leukodystrophy and who also accumulate psychosine through defects in lipid metabolism. — SMH

J. Cell Biol. **149**, 943 (2000).

IMMUNOLOGY

Designer Dendritic-Cell Therapy

Vaccination with dendritic cells (DCs) and genetically modified tumor cells remain important potential avenues in treating cancer. Although both methods may share related mechanisms of action, few data are available that directly compare each approach. Of the many candidate genes under investigation for expression in tumors, granulocyte-macrophage colony-stimulating factor (GM-CSF) perhaps offers most promise because of its strong influence on the development and function of DCs.

In an animal-tumor model study, Klein *et al.* reveal profound differences in the ability of tumor cells and DCs to elicit antitumor immune responses after retroviral gene expression of GM-CSF. There was a significantly increased antitumor effect of DCs coexpressing the tumor antigen and GM-CSF, but similar expression in the tumor cell line had a poor or reduced therapeutic influence

CONTINUED ON PAGE 1707

SOURCE: (LEFT TO RIGHT) KRAUSS *ET AL., ANGEW. CHEM. INT. ED.* **39**, 1835 (2000); KANAZAWA *ET AL., J. CELL BIOL.* **149**, 943 (2000).

on the efficacy of the tumor-cell vaccine. This work builds on that of Timmerman and Levy, who also provide evidence for a beneficial antitumor effect of GM-CSF expression by antigen-pulsed DCs. Both studies reinforce the notion that modification of DCs to express GM-CSF could provide a boost to immunization regimes against tumors. — SJS

J. Exp. Med. **191**, 1699 (2000); *J. Immunol.* **164**, 4797 (2000).

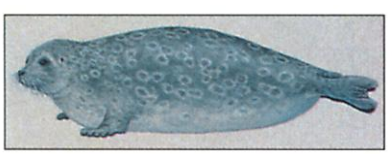
CHEMISTRY

Finding the Missing Zinc

Divalent cations such as calcium and magnesium play critical biochemical roles as cofactors and in cell signaling, and specialized dyes and probes have been developed to determine their free intracellular concentrations. Although zinc (Zn^{2+}) also plays important roles as a cofactor as well as in programmed cell death and neurotransmission, readily determining cellular concentrations of unchelated Zn^{2+} has proven more difficult, in part because Zn^{2+}, even when bound to a molecule, can still bind to some of its fluorescent dyes. Dyes currently in use or that have been considered have drawbacks that include low affinity, poor optical properties, or the need for microinjection into cells or ultraviolet excitation. Walkup *et al.* now report on a high-affinity, membrane-permeable fluorescent dye, Zinpyr-1, whose emission at 507 nm, which can be excited at visible wavelengths, increases by more than a factor of 3 when free Zn^{2+} is present. Preliminary studies in Cos-7 cells show targeting (Golgi and acidic compartments) similar to that of dyes currently in use. — PDS

J. Am. Chem. Soc., in press.

Short-changed sea otters...



...and burdened ringed seals.

PHYSICS

Giving Conductivity the Push

The interrelation of the electronic and mechanical properties of carbon single-wall nanotubes could potentially be exploited in what could be the nanoscale equivalent of a mechanical switch. Previous experimental work has shown that bending a suspended nanotube by as little as 13° with the tip of an atomic force microscope (AFM) can result in an almost two orders of magnitude decrease in the conductivity of the nanotube. As discussed by Liu *et al.*, such changes in conductivity at such small deformations is not readily explained with existing models in which the bend in the tube is defined at the ends that hold it in position. They now introduce a molecular dynamics model in which the pressure applied by the AFM induces local strain in the tube. Their calculations suggest that such a large decrease in the conductivity is caused by a transition in the local bonding configuration from a conducting sp2 environment to a less conducting sp3 configuration caused by the deformation made with the tip. — ISO

Phys. Rev. Lett. **84**, 4950 (2000).

ENVIROMENTAL SCIENCE

Arctic After-Effects

Toxic chemicals can persist for long periods of time in high-latitude oceans. Two recent papers highlight the long-term effects of water pollution, whether from acute episodes such as oil spills or the chronic introduction of chemicals such as polychlorinated biphenyls (PCBs), in marine mammals. Monson *et al.* examined how the Alaskan sea otters have fared since the 1989 Exxon Valdez oil spill by examining mortality data to determine the age distribution at death of sea otters in Prince William Sound from 1976 to 1998. Although sea otters born after the spill were less affected, decreased survival rates persist for sea otters of all ages. One method for monitoring the persistence of PCBs and other chlorinated organic species, such as those used in many pesticides, is to examine their levels in predatory marine mammals.

Muir *et al.* have estimated part of the geographical distribution of PCBs and organochlorine pesticides across the Arctic from northern Canada across Greenland and into northern Russia by examining the blubber of ringed seals taken in local subsistence hunting. They find higher levels of PCBs, especially the less readily degraded penta- and hexachlorinated species, in the European and Russian Arctic, which they attribute to the continued use of PCBs in Russian electrical equipment. — PDS

Proc. Natl. Acad. Sci. U.S.A., in press; *Environ. Sci. Technol.*, in press.

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