EDITORS' CHOICE

edited by Gilbert Chin

MICROBIOLOGY

Surfacing to Sporulate

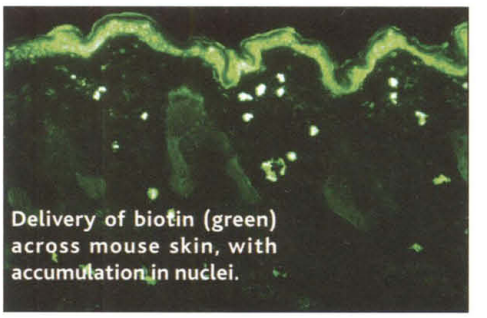
Most of us are familiar with the molds that decorate neglected foodstuffs with bluish-gray tufts. Before we can see these fruiting bodies, or conidia, the fungi grow microscopically within the food as hyphae. When the hyphae reach the surface, they change developmental programs and differentiate into conidia. High concentrations of calcium have been shown to trigger a sequence of synchronous morphogenetic changes leading to the appearance of conidia. Now, Roncal *et al.* have observed that *Penicillium cyclopium* secretes a diterpene molecule they call conidiogenone, which accumulates on the surface of the mold. When the terpenoid reaches a critical concentration, it initiates conidium formation, with calcium merely increasing the sensitivity to conidiogenone. — CA

Eukaryotic Cell **1**, 823 (2002).

CHEMISTRY

Drug Trafficking

In order to gain access to intracellular targets, drugs must be polar enough to dissolve in the bloodstream but nonpolar enough to travel across cellular boundaries. One way to overcome these limitations is to ship drugs on biological transporters, such as the viral transcription activator protein (Tat), whose critical permeability motif is a highly basic stretch of amino acids. Wender *et al.* investigated whether the peptide (amide) backbone could be modified to improve transporter activity in cells as well as to enhance protease resistance. They find that oligocarbamates (in which a -CH_2O- increases the spacing between the basic groups) are highly effective for cellular uptake. In a model study, they show that biotin, which does not normally cross the skin barrier, could be delivered into the skin of nude mice. — PDS



Delivery of biotin (green) across mouse skin, with accumulation in nuclei.

J. Am. Chem. Soc. 10.1021/ja0275109.

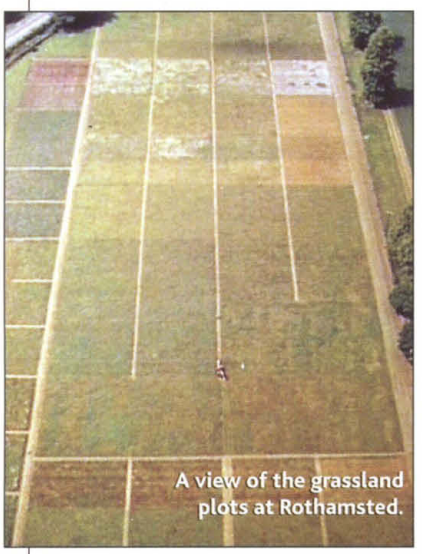
ECOLOGY/EVOLUTION

Long-Term Data, Part I

The time scale of many ecological processes spans decades and centuries—much longer than the lifetime of a researcher, let alone the duration of the average research grant. For instance, populations of organisms fluctuate over long periods of time, yet useful data generally are available in only a few instances.

In the mid-19th century, the Park Grass Experiment was initiated at the Rothamsted Experimental Station in the United Kingdom. Silvertown *et al.* have taken advantage of the documented history of fertilizer treatments in this set of grassland plots and the accompanying censuses of vegetation in order to examine the long-term population trends of plant species in relation to their genetic diversity. Species showing outbreak behavior—increases in abundance followed by decreases—had lower genetic diversity (due to inbreeding) and were thus unable to sustain their numerical expansion in comparison to persistent species that showed more stable population dynamics. The results suggest that limitation of local adaptability (to new habitats) by inbreeding may increase the extinction risk of species. — AMS

Am. Nat. **160**, 409 (2002).



A view of the grassland plots at Rothamsted.

GEOCHEMISTRY

Long-Term Data, Part II

Many atmospheric nuclear tests were conducted in the 1950s. These tests produced a wide spectrum of radiogenic pollutants, some of which, such as carbon-14, have had useful second lives as tracers for understanding atmospheric and ocean dynamics. However, isotopes of uranium and plutonium that were used to construct the bombs have enjoyed more limited application for environmental studies, primarily because mass spectrometric techniques were not sufficiently well developed at the time to establish a historical record. Isotopic ratios of uranium and plutonium have potential uses as fingerprints of specific nuclear tests; plutonium, in particular, has virtually no natural sources.

Warneke *et al.* present environmental records of isotopes of uranium and plutonium since the early 1950s from two sources: an annual archive of plants harvested at Rothamsted in the United Kingdom and an ice core from Mont Blanc. The qualitatively identical records show that plutonium fallout from tests in the Nevada desert in 1952 did in fact reach northwestern Europe, and they provide a baseline that can be used for tracer studies. — BH

Earth Planet. Sci. Lett. 10.1016/S0012-821X(02)00930-5 (2002).

GEOLOGY

Snowball or Slushball?

The provocative snowball Earth hypothesis states that, during the Neoproterozoic Era, ice covered Earth's entire surface, including its oceans, for several periods lasting from 5 to 10 million years. In this scenario, global glaciation, recorded in worldwide stratigraphic sections from the era, would have continued until sufficient atmospheric CO_2 had accumulated to initiate melting of the glaciers, an event marked by the sudden appearance of a characteristic suite of carbonates in the rock record. Occurring at an early stage in metazoan evolution, the global deep-freeze would have exerted a devastating impact on organisms of the time and perhaps have helped to shape the subsequent metazoan radiations of the late Neoproterozoic and early Cambrian.

One prediction of the snowball Earth hypothesis is the virtual shutdown of Earth's hydrologic cycle. Leather *et al.* ex-

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amined a 1.5-km-thick succession of Neoproterozoic glacial and nonglacial rocks in Oman, overlain by the characteristic cap carbonate. They found evidence for pulsed glacial advances and retreats, with a highly active hydrological cycle, that appear more reminiscent of the high-frequency glaciations of the Pleistocene than of the long stasis envisioned in snowball Earth. This geologic evidence may necessitate a reconsideration of some of the key assumptions underlying the hypothesis. — SW

Geology **30**, 891 (2002).

CHEMISTRY

Weaker in Tighter Groups

The surfaces of liquids such as water and methanol are the place where key processes such as dissolution, evaporation, and condensation occur. The surface tension of liquid water is much greater than that of methanol, and one might therefore expect intermolecular distances (for example, those between oxygen atoms) to be shorter at the water surface. Wilson *et al.* show that the opposite is the case. In an extended x-ray absorption fine structure study of both surfaces, they find that the O-O distance expands by 5.9% at the water surface and contracts by 4.6% at the methanol surface.

This counterintuitive result may be explained by the different hydrogen-bonding networks in the two liquids. Water molecules can form a large number of interfacial bonds in a variety of configurations, not only parallel but also perpendicular to the surface; the water molecules are highly mobile but still relatively tightly bound, increasing the surface tension. In contrast, methanol molecules form highly ordered surfaces, but lateral interactions between molecules at the interface are weak, which decreases the surface tension. — JFU

J. Chem. Phys. **117**, 7738 (2002).

GENETICS

Crossing to the Other Side

The beetle *Callosobruchus chinensis* lives on adzuki beans. It has the misfortune to harbor intracellular endosymbionts of the genus *Wolbachia*, which are rickettsia-like bacteria that infest a variety of insects. The *Callosobruchus*-resident bacteria are transmitted in the maternal lineage and can be expunged by administration of the antibiotic tetracycline. Kondo *et al.* find that one such *Wolbachia* strain has succeeded in transferring a sizeable portion of its genome (more than 1%) to the X chromosome of its host. This fragment contains several genes that do not appear to be expressed, but it is no longer removable by antibiotic treatment and shows an X-linked pattern of inheritance. Might this be an attempt at horizontal gene transfer? — GJC

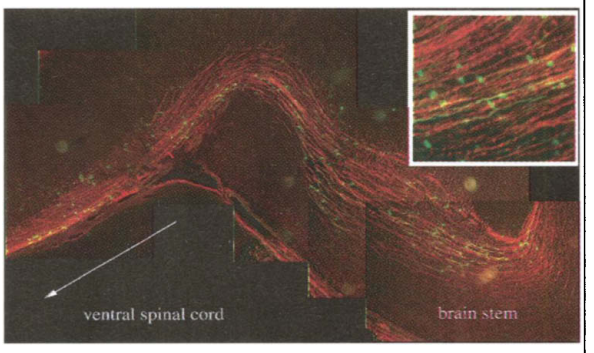
Proc. Natl. Acad. Sci. U.S.A. **99**, 14280 (2002).

CELL BIOLOGY

Switch to Survival

Growth factors usually promote cellular proliferation, but, depending on the developmental state of the cells concerned, they also can be responsible for promoting cell survival and differentiation. Colognato *et al.* examined target-dependent survival of myelin-producing oligodendrocyte cells within the central nervous system. Using mice lacking the integrin receptor subunit α_6, which acts as a receptor for the extracellular matrix component laminin, they demonstrated the existence of an integrin-regulated switch activated by contact of oligodendrocytes with laminin-bearing axons. Oligodendrocytes from the α_6-deficient mice were more likely to undergo apoptotic cell death in the developing axon tracts than were those from wild-type animals. In the absence of integrin-laminin interaction, the growth factor neuregulin acts through a phosphatidylinositol kinase to promote cell proliferation; after the switch is made, the same growth factor works via the mitogen-activated kinase pathway to promote survival and differentiation. Thus, neuregulin can promote different effects depending on the developmental stages of individual cells. — SMH

Nature Cell Biol. 10.1038/ncb865 (2002).



Myelinating axons revealed by neurofilaments (red) in the axons and myelin basic protein (green) in the associated oligodendrocytes.

CREDIT: COLOGNATO ET AL., NATURE CELL BIOL. 10.1038/NCB865 (2002)