The Sverdrup Basin, Arctic Canada, which is now known to contain thick sections of Permian and Triassic rocks. Sections at the margin of the basin, where some erosion is documented to have occurred, show an abrupt carbon isotope drop at the boundary. Sections in the center, which seem to record continuous deposition and a thicker boundary layer than most other sections globally, show a more gradual decline over about 3 m, after a period of relative stability that is not well resolved elsewhere. Although the sections thus provide important detail on the extinction record and perhaps a period just before it, detailed dates are not yet available to calibrate absolute rates of change. — BH


DEVELOPMENT

The Roots of Hair Growth

Adult hair follicles sustain repeated cycles of hair loss and regrowth. Stem cells reside within a small niche, called the bulge, located in the upper part of the hair follicle. These stem cells are responsible for driving this cycle of growth and can repopulate follicles and surrounding epidermis damaged by wounding. However, the first hair follicles in mice arise from the developing epidermis, not from preexisting bulge stem cells, and these first-time hair follicles do not exhibit the conspicuous bulge that only becomes apparent some weeks after birth.

Nowak et al. have analyzed the origins of the hair follicle stem cell niche in developing mice. The stem cells of the bulge are in fact established much earlier than previously suspected and begin to form in the embryo. These cells, which are characterized by expression of the transcription factor Sox9, not only contribute to the formation of the initial hair follicle, but also give rise to the adult bulge stem cells that are responsible for the maintenance of the hair follicle itself. Ablation of Sox9 left the embryos without bulge cells, and the mice never grew any hair and did not have any sebaceous glands. Moreover, the skin did not repair epidermal wounds well when Sox9 was missing. These results implicate Sox9 in establishment of the hair follicle stem cell population and show that early stem cells can contribute to skin morphogenesis before assuming their role as adult stem cells. — PJH


PHYSICS

Every Little Second Counts

Part of the appeal of nuclear magnetic resonance phenomena is that the two-level system being manipulated (nuclear spin up, or nuclear spin...
down) is comparatively easy to model in a quantum mechanical framework. In this context, application of a very short and strong (“hard”) electromagnetic pulse to a spin ensemble can be approximated as having an instantaneous effect—a hard pi pulse, for instance, immediately rotating the aggregate spin vector 180°. Of course, such pulses are not precisely instantaneous, and Dong et al. show that it is possible to exploit their small but still finite durations to manipulate coherence in experiments that apply many of them, one after the other, in a train. The technique substantially reduces linewidth in inhomogeneously broadened samples, most strikingly by nearly five orders of magnitude for 29Si resonances in antimony-doped silicon powder. The authors also apply the technique to 13C probing in C2H2 samples. — JSY


Resistance to Infection

In 1987, W. D. Hamilton wrote that the pressure of parasites is one of the factors favoring genetic diversity. The ant Formica selysi is found in colonies with single or multiple queens. Colonies with one queen have low genetic diversity, but workers tend to live longer than in polygynous colonies with high genetic diversity. In the wild, the multiqueen colonies are large, and individual workers are small and have short lives, mainly because they do not provision so efficiently. So why does polygyny persist? The advantages of diversity became apparent when Reber et al. brought ants into experimentally controlled conditions to reduce the impact of compensating factors such as environmental variables. Artificial ant colonies revealed a strong advantage conferred by diversity when challenged by a fungal parasite; colonies of lower genetic diversity were decimated by infection. — CA


Radical Stabilization

The properties and reactions of single hydrogen atoms are of interest because of their inherent quantum mechanical behavior; experimentally, they can be generated and stabilized at very low temperatures (4 K) by high-energy irradiation of solid molecular hydrogen. Yeon et al. show that icy organic hydrates, which contain small cages that can trap guest molecules, can be used to create and trap H atoms at higher temperatures. They trapped H in deuterated tetrahydrofuran hydrates (D2O and THF-d8) at 123 K, using γ-ray irradiation to form stabilized H atoms that were detected by electron spin resonance (ESR) and magic-angle spinning proton nuclear magnetic resonance (MAS NMR) spectroscopy. Irradiating THF afforded ESR assignments for free D atoms and THF radicals that were also created. The temperature evolution of the MAS NMR signals from 173 to 183 K indicated that the formation of radical products H+ and H likely occurred directly as opposed to being mediated by reaction with the ice framework. — PDS


<< A Ligand, Not a Carrier

Volatile odorants are generally thought to bind to G protein–coupled receptors, and this event then activates downstream signaling pathways. In Drosophila, various odorant-binding proteins are secreted into the lymph around subsets of olfactory neurons; the function of these pheromone- and odorant-binding proteins, however, has been unclear. Building on earlier work that showed that the odorant-binding protein LUSH is required for sensitivity to the pheromone 11-cis vaccenyl acetate (cVA), Laughlin et al. have compared the x-ray crystal structure of LUSH bound to cVA with the previously determined structure of uncomplexed LUSH and found that binding of cVA (which was almost completely enclosed by LUSH) induced a conformational change in LUSH. A LUSH mutant bearing an amino acid substitution predicted to minimize this conformational change was less effective than the wild-type protein at conferring cVA sensitivity to T1 neurons, which mediate the response to this pheromone; in contrast, a mutation predicted to enhance the conformational change produced a more potent ligand. Moreover, a mutation yielding an uncomplexed LUSH conformation that resembled that of the cVA-bound form stimulated T1 neurons even in the absence of cVA. Thus, the authors conclude that LUSH is an inactive ligand that is converted into an active form through cVA binding. — EMA


Resistance to Infection
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