

edited by Gilbert Chin

GEOCHEMISTRY

Stores of Heating Gas

Methane hydrates, in which methane gas is bound within and stabilizes a water-ice cage structure, are thought to be abundant in continental shelves and on or near the ocean floor. The breakdown of these clathrates would release large amounts of methane, an important greenhouse gas, and is thought to have been responsible for some of Earth's abrupt climate changes in the past.

Clay minerals contain a silicate layer and an interlayer typically of water or hydrogen, and are abundant in ocean sediments and areas of permafrost. Guggenheim and van Groos show that methane hydrate can be formed and trapped as a layer within the lattice of clay minerals. This new clay-hydrate phase is stable at pressures greater than 4 MPa (40 bars), as is the free methane hydrate, and its density is roughly equal to that of clay-rich sediments. The authors speculate that the low temperature-triggered dis-

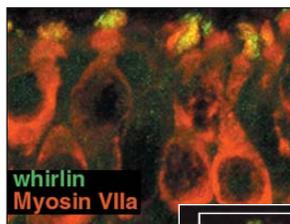
sociation of the clay-hydrate may serve as a buffering mechanism during periods of global cooling. — BH

Geology 31, 653 (2003).

CELL BIOLOGY

Building a Picket Fence

At the apical surfaces of hair cells in the mammalian ear, actin-containing stereocilia are arrayed like pickets in a fence, and deflection of them triggers auditory transduction; defects in stereocilia development have been linked to hearing impairment. Studying a mutant mouse called whirler, Mburu *et al.* find that the reason it is deaf and moves in circles is because of a mutation in a gene (*whrn*) that encodes an intracellular scaffolding protein containing three PDZ domains. These domains commonly mediate protein-protein interactions. The



whirlin protein is present in stereocilia of inner and outer hair cells in the developing mouse cochlea, and may play a pivotal role in coordinating stereocilia development by forming a bridge between the actin cytoskeleton and signal transduction proteins.

In humans, the chromosomal locus *DFNB31* has been linked to a rare form of deafness. These authors show that

this locus harbors the homolog of *whrn*, and a mutation that deletes one of the PDZ domains was



Whirlin localization to stereocilia.

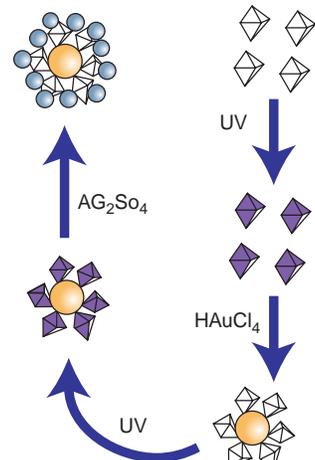
identified in individuals suffering from *DFNB31*-related deafness. — LDC

Nature Genet. 10.1038/ng1208 (2003).

CHEMISTRY

Lightly Reduced

Two component nanoparticles that consist of a core of one metal surrounded by a shell of a second metal have a number of potential applications in optics and catalysis. Unfortunately, the reduction step normally used to create the shell can introduce nucleation sites that allow nanoparticles of the second metal to form. Mandal *et al.* avoid this problem by exploiting the photoswitchable reducing behavior of Keggin ions, in this case phosphotungstic acid [PTA: $H_3(PW_{12}O_{40})$], for synthesizing both the core and the shell.



Synthesis of Au core-Ag shell particles.

Activation of PTA with ultraviolet (UV) light leads to a one-electron reduction. Adding $HAuCl_4$ initiates a reaction in which PTA is reoxidized while the gold is reduced to give a nanoparticle with surface-bound Keggin ions. A second round of UV activation and addition of Ag_2SO_4 produces the outer silver shell. — PDS

J. Am. Chem. Soc. 10.1021/ja034972t.

ECOLOGY/EVOLUTION

Sequence and Structure

Using molecular sequence data to determine the phylogenetic relationships of the major groups of organisms has yielded some spectacular successes but has also thrown up some conundrums. One such is the relationship of birds to the rest of the tetrapods. Morphological data and most molecular studies have placed the birds closer to the crocodiles than to any other tetrapod group, but analysis of sequence data from 18S ribosomal RNA (rRNA) has persistently allied the birds more closely to the mammals. There have been several attempts to account for this niggling doubt, and Xia *et al.* now

show that the discrepancy arose because of methodological flaws in the analysis of 18S rRNA data, which caused, among other things, misalignment of sequences from the different taxa. When structure-based alignment is carried out, the resulting phylogeny matches those obtained by other means, with the birds allied to the crocodiles via a common reptilian ancestor. — AMS

Syst. Biol. 52, 283 (2003).

CHEMISTRY

Made to Resist

Polyethylene glycol is frequently used in biomedical applications. Proteins do not stick to it, but it is not biodegradable and can only be functionalized at the ends of the linear polymer chains. Previous studies have identified hydrophilicity, the ability to accept but not donate hydrogen bonds, and overall charge neutrality as key performance characteristics; surfaces covered with carbohydrates have been shown to resist protein adsorption.

Metzke *et al.* describe the properties of a carbohydrate-derived side chain polyether. Surface plasmon resonance spectroscopy of polymer films was used to measure retention of fibrinogen and lysozyme, representing sticky serum proteins and electrostatically adsorbed proteins, respectively. In both cases, the polymer film behaved comparably to tri(ethylene glycol) monolayers, and the ester linkage in the polymer backbone may also render it biodegradable. — MSL

J. Am. Chem. Soc. 125, 7761 (2003).

ASTRONOMY

Going Deep for a Catch

In astronomy, going deep means gathering observations of very faint objects, which are

CONTINUED ON PAGE 281

billions of light years away and hence represent structures formed early in the universe; these observations provide important clues to the origins of stars, galaxies, and even minor bodies, like Earth. Since the original Hubble Deep Field imaging of the early universe, surveys have been conducted on powerful space-based observatories with follow-up spectroscopy on the most sensitive ground-based telescopes. In fact, the Great Observatories Origins Deep Survey (GOODS) combines the best space-based observatories with the largest ground-based telescopes.

Bunker *et al.* used a recently developed method to select high red-shift galaxies from GOODS data. A high-resolution spectrum of one candidate galaxy at $z = 5.78$ from the Chandra Deep Field South, collected with the new Deep Imaging Multi-Object Spectrograph on the Keck telescope, showed atomic hydrogen emission typical of a starburst galaxy. This is one of the earliest starbursts observed, and the star formation rate is consistent with cosmological data suggesting that the first stars formed at a redshift of about 10, which the next generation of deep observations may be able to catch. — LR

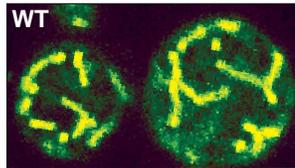
Mon. Not. R. Astron. Soc. **342**, L47 (2003).

CELL BIOLOGY

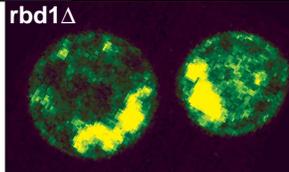
Made to Break

Recent determinations of protein structures have shown that transmembrane helices, previously thought to extend straight across the bilayer, can instead be bent, twisted, or even broken. These results come from proteins with multiple helices and

thus may not apply to those spanning the membrane only once. Urban and Freeman highlight the dangers of intramembrane helix-breaking residues by mapping the specificity of the *Drosophila* rhomboid protease, one of a class of enzymes that releases membrane-bound ligands by cutting once within their single-span membrane



Mitochondria (green) in wild-type (left) and rhomboid mutant yeast (right).



tethers.

Amino acids with small side chains (glycine and alanine) are known to destabilize helices and, when coupled to nearby nonhydrophobic residues at the extracellular surface, promote susceptibility to rhomboid. The authors also find that similar sequence motifs serve as the signals for cleavage of adhesion proteins that the intracellular parasite *Toxoplasma* uses to invade host cells. These findings add to the range of processes involving intramembrane proteolysis, in particular, the earlier observations by Herlan *et al.* and McQuibban *et al.* that a yeast rhomboid protease cuts a dynamin-like protein involved in regulating mitochondrial morphology. — GJC

Mol. Cell **11**, 1425 (2003);

J. Biol. Chem. **10.1074/jbc.M211311200** (2003);

Nature **423**, 537 (2003).

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Painful Inflammatory Responses

Chronic neuropathic pain (due to nerve damage) is a condition that can interfere with the simple activities of daily life and remains poorly understood. Abbadie *et al.* compared the responses of wild-type mice and mutant mice lacking chemotactic cytokine receptor 2 (CCR2), which mediates the inflammatory response of monocytes, in several models for pain. After injury to the sciatic nerve, the mutant mice lacked the typical behavioral response associated with chronic neuropathic pain, whereas in wild-type mice, injury led to higher levels of CCR2 in the sciatic nerve and dorsal root ganglia. In addition, CCR2-immunoreactive macrophages were identified in the sciatic nerve, and CCR2-immunoreactive microglia were observed in the spinal cord. On the other hand, the CCR2-deficient mice had fewer astrocytes in the dorsal horn of the spinal cord after nerve injury than did wild-type mice and showed lower levels of glial activation, consistent with common pathways being recruited in inflammatory and neuropathic pain. — EA

Proc. Natl. Acad. Sci. U.S.A. **100**, 7947 (2003).