

edited by Gilbert Chin

PHYSIOLOGY

Reduced-Fat Milk

Sometimes the most natural of events presents the most unnatural problems. Breast-feeding might be considered such an event, and about 5% of women experience lactation problems.

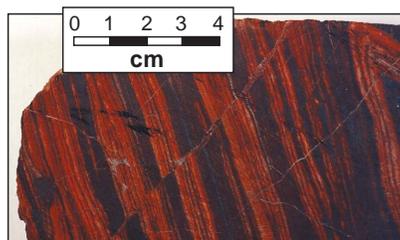
Vorbach *et al.* describe their work on mice that have only one copy of the gene for xanthine oxidoreductase (XOR). These mice appear normal and fertile but are incapable of nursing successfully, and hence their pups die of starvation within about 2 weeks of birth. Haplo-insufficiency of XOR in mice results in a defect in the enveloping of milk fat droplets, preventing their secretion into the lumen of the mammary alveoli. The involvement of XOR appears to be unrelated to its enzymatic function in purine catabolism; instead, it appears to contribute to the structural packaging of milk fat within the epithelial cells. — BAP

Genes Dev. 16, 3223 (2002).

CHEMISTRY

Synthesizing Siliceous Spiny Shells

Unicellular organisms such as diatoms and radiolaria make intricately patterned shells or tests, consisting mainly of amorphous silica. It has been suggested that these structures form through repeated phase separation events at decreasing length scales. To study this process,



Hematite (dark bands) in a BIF from Carajas, Brazil.

hydrothermal activity of the mid-ocean ridge or plume volcanism. The puzzling aspect is how ferrous iron from hydrothermal sources was oxidized into ferric iron in an oxygen-poor, early terrestrial setting. Konhauser *et al.* show quantitatively that iron-oxidizing bacteria, primarily chemolithoautotrophs, at cell densities much lower than what is found in modern environments could account for all of the ferric iron found in Precambrian BIFs. — LR

Geology 30, 1079 (2002).

Volkmer *et al.* have developed a simple biomimetic model system.

A surfactant-stabilized oil droplet is microinjected into an aqueous solution. Organic additives in the oil droplet induce spontaneous emulsification: the surface of the droplet develops protruding spines, which grow and then separate from the original droplet to form smaller droplets until the parent droplet disappears. When the oil droplet also contains a metal (silicon or titanium) oxide precursor that can hydrolyze at the oil-water interface, a mineralized shell results. The concentration of the metal oxide precursor can be varied so that the spines are preserved. The star-shaped morphology

bears some resemblance to that of the radiolaria, which have silica shells with fine radial spines. — JFU

Angew. Chem. Int. Ed. 42, 58 (2003).

CLIMATE SCIENCE

Freshwater Triggers

Climate records of the late Pleistocene from the North Atlantic region indicate a strong link between large-scale ocean circulation and iceberg discharges from ice sheets. Climate models and observational data point to the impact of meltwater on thermohaline forcing, but the mechanism responsible for the submillennial scale instability of marine ice margins remains unclear.

Knutz *et al.* present a paleoclimatic record of the last deglaciation, from the north-east Atlantic margin, which captures a detailed picture of the interaction between ocean circulation and ice sheets in northwest Europe. A moderate elevation of sea surface temperatures triggered a series of multi-decadal ice-rafting events, culminating in a major meltwater discharge 17,500 years ago. A similar sequence is also apparent during the Bølling-Allerød to Younger

Dryas transition 12,700 years ago. The authors suggest that the initial cooling observed in many North Atlantic records before the massive iceberg discharge event (Heinrich-1) that occurred near the beginning of the Younger Dryas is likely to be the effect of meltwater discharge from European ice sheets. These results provide important details in support of the idea that a sensitive and rapid response of ice sheets in northwest Europe occurred because of transient increases in thermohaline heat transport. — HJS

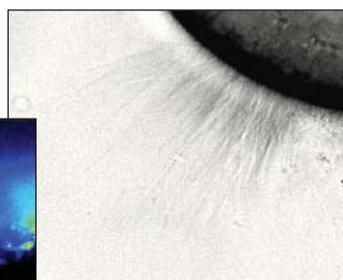
Geochem. Geophys. Geosys. 3, 10.1029/2002GC000351 (2002).

CHEMISTRY

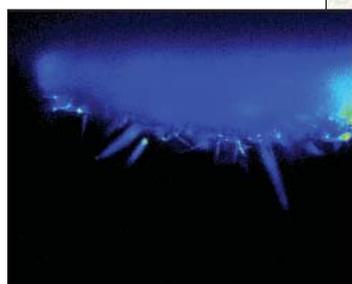
Bridging the Gap

In molecular electronic devices, a critical step is making the connection between the active molecules and a pair of electrical terminals. For vertical devices, a connection can be made by depositing a layer of metal on top of the molecular layer, but the quality of the interface is unpredictable, and short circuits often occur. An alternative is to build a lateral device, but

CONTINUED ON PAGE 169



Titanium spines, visualized by fluorescence (left, coumarin dye) and bright-field (above) microscopy.



here the problem is that the smallest achievable electrode separation is about 6 nm, which is much larger than the length of the typical molecules of interest.

Lin and Kagan solve the lateral problem by using a layer-by-layer deposition process to grow a metal-metal paddlewheel complex based on ruthenium. This sort of complex has been shown to undergo multiple redox processes, with extensive coupling between the metal centers, and can be tuned by changing the ligand chemistry. The authors demonstrate that the complexes can be layered onto two gold electrodes until the intervening gap of 60 to 80 nm closes. Measurement of the current-voltage characteristics showed a voltage-controlled negative differential resistance (a rise and then a fall of current as voltage was increased). However, this was observed only during the first cycling of the device, possibly due to irreversible oxidation of the ruthenium units in the solid state or to the use of symmetric electrodes. — MSL

J. Am. Chem. Soc. 10.1021/ja028653y (2002).

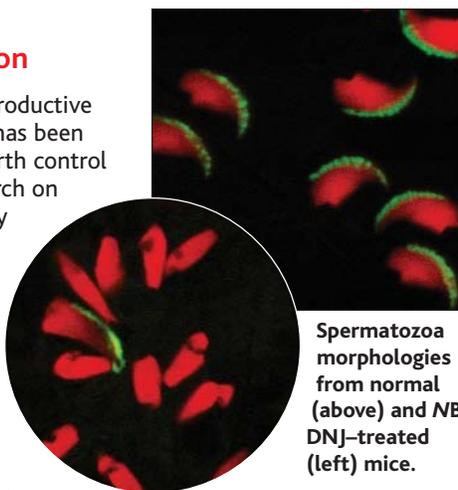
REPRODUCTIVE SCIENCE

Sugarcoating Male Contraception

Over a billion people will be entering reproductive age by the year 2020, yet little progress has been made toward the development of new birth control methods (News, 21 June, p. 2172). Research on male contraceptives has focused primarily on hormonal manipulations that disrupt spermatogenesis, but these strategies can have undesired side effects.

van der Spoel *et al.* report that oral delivery of a sugar molecule called NB-DNJ (for *N*-butyldeoxynojirimycin) causes sterility in male mice that is fully reversible after withdrawal of the drug. Although NB-DNJ did not affect sperm counts, the epididymal spermatozoa in the treated mice showed morphological abnormalities and severely impaired motility. These effects may relate to the drug's ability to inhibit synthesis of certain glucosphingolipids that are required for spermatogenesis. NB-DNJ is a particularly promising lead in the search for a male pill, because it already has been evaluated in clinical trials for other indications and is known to be well tolerated by humans. — PAK

Proc. Natl. Acad. Sci. U.S.A. 99, 17173 (2002).



Spermatozoa morphologies from normal (above) and NB-DNJ-treated (left) mice.

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Keeping Cells in Their Places

Vascular proliferative diseases, such as atherosclerosis and coronary restenosis, are characterized by dedifferentiation, abnormal proliferation, and migration of vascular smooth muscle cells, a pathophysiological reaction to injury that has been interpreted as a response to cytokines released by inflammatory cells. By comparing vascular smooth muscle cells from mice lacking elastin to cells from wild-type mice, Karnik *et al.* show that the extracellular matrix protein elastin, which is secreted by vascular smooth cells, inhibited cell proliferation and promoted the development of actin stress fibers, a marker for a mature contractile phenotype. Vascular smooth muscle cells migrated through a filter in response to an elastin concentration gradient, but elastin inhibited cellular migration in response to a platelet-derived growth factor gradient. In an *in vivo* porcine model of coronary artery stenosis, insertion of an elastin sheath into arteries after vascular injury reduced the pathophysiological response, suggesting the possibility that elastin's effects on vascular smooth muscle could be exploited in therapy to treat vascular proliferative diseases. — EA

Development 130, 411 (2002).

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Science

Reduced-Fat Milk

Beverly A. Purnell

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