EDITORS' CHOICE

edited by Gilbert Chin

GEOPHYSICS

Stress Accumulation

The magnitude 7.8 San Francisco earthquake occurred on the San Andreas fault in 1906. For about 70 years afterward, no earthquake greater than magnitude 6 occurred in the San Francisco Bay Area, except for the magnitude 6.5 Morgan Hill event in 1911. This quiescent period has been attributed to the 1906 earthquake having caused shear stress relaxation on other faults in the area, most of which run parallel or subparallel to the San Andreas. The regional perturbation to the stress field, which acts to extend the time until the next fault failure, is called the stress shadow, and almost all of the faults in the stress shadow showed delayed failure. The Morgan Hill earthquake was the exception because it ruptured the Calaveras fault, which lies inside the stress shadow of the San Francisco earthquake.

To explain this discrepant rupture, Hori and Kaneda modeled the Morgan Hill segment of the Calaveras fault as a mixture of creeping regions, especially at depth, with localized locked regions. The heterogeneous character of this fault segment allowed stress to accumulate at a much higher rate than normal, so that the fault failed only 5 years after the San Francisco earthquake. This high stress rate also may help to explain the relatively short recurrence rate on this segment of the Calaveras, which experienced another earthquake of magnitude greater than 6 in 1984. — LR

Geophys. Res. Lett. **28**, 2261 (2001).

MICROBIOLOGY

Iron and Virulence

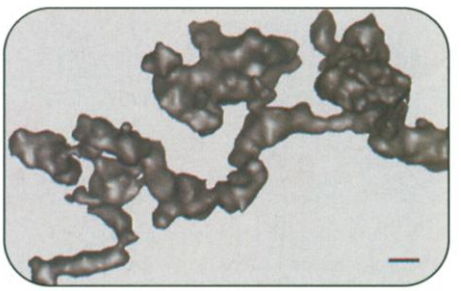
Little is known about how Gram-positive bacteria, such as the important human pathogen *Streptococcus pneumoniae*, acquire iron, a nutrient needed for the growth of pathogens within their hosts. Brown *et al.* have discovered two loci that encode high-affinity iron transporters in this organism. If both copies of the *pit* genes were disrupted, then the pathogen could not use hemoglobin as a source of iron, became insensitive to the iron-dependent antibiotic streptonigrin, and lost virulence in a mouse model of infection. The *pit2* locus lies within a region of the bacterium's chromosome that has several features of a pathogenicity island, possibly introduced into *S. pneumoniae* by horizontal transfer from another organism. Such pathogenicity islands have been seen frequently in Gram-negative bacteria but not as yet in Gram-positive *S. pneumoniae*. — CA

Mol. Microbiol. **40**, 572 (2001).

MOLECULAR BIOLOGY

Caught in the Act

The Balbiani ring 3 (BR3) gene of the dipteran *Chironomus tentans* contains 38 introns. These introns are roughly evenly spaced throughout the gene, and it is known that many are removed before synthesis of the RNA transcript is completed.



Nascent transcription and splicing (NTS) complexes; scale bar 10 nm

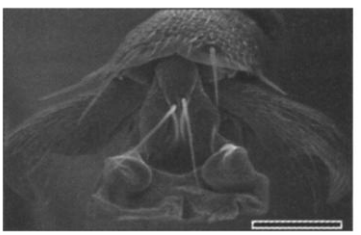
Taking advantage of the decondensed chromatin structure of active BR3 genes from the salivary gland, Wetterberg *et al.* have used electron tomographic reconstruction to visualize complexes of transcription and splicing factors at work. They found about 20 to 25 so-called NTS complexes on a BR3 gene, with immunolabeling evidence for the COOH-terminal domain of RNA polymerase II in the portion of the complex closer to the chromatin fiber and the U2 snRNP located within the distal regions of the complex. There were three main classes of NTS complex, with molecular mass ranging from 3.9 to 6.3 megadaltons. The approximate summed mass of the spliceosomal components and the lack of correlation between size and distance from one end of the gene together suggest that a transcribing polymerase recruits only one spliceosome and that splicing factors associate dynamically during the 15 to 25 seconds needed to excise an intron. — GJC

EMBO J. **20**, 2564 (2001).

BIOMECHANICS

Holding Tight, Letting Go

Ants appear to be oblivious to the orientation of surfaces; they run across the undersides of leaves and other smooth terrain. How do they adhere (supporting many times their own body weight), and how do they do so in a rapidly reversible manner?



Extended arolium; scale bar, 100 μm.

Federle *et al.* have performed anatomical and biomechanical observations of the Asian weaver ant, *Oecophylla smaragdina*. The arolium is a flexible adhesive pad located between the claws. With each step, the claws are retracted by the flexor tendon if they do not catch on surface irregularities; this movement extends the arolium and expands it hydraulically with fluid from the arolium gland reservoir. The applied pressure was determined to lie in the range of 10 to 15 kilopascals. Elastic recoil of the arolium cuticle then shunts the fluid back into the gland, allowing facile detachment. — GJC

Proc. Natl. Acad. Sci. U.S.A. **98**, 6215 (2001).

GEOLOGY

Weathering is Not Under the Weather

Chemical weathering of silicates is thought to help regulate Earth's atmospheric temperature, because weathering removes CO_2 from the air. Higher temperatures speed the rate of chemical weathering, and thus warmer climates should decrease positive radiative forcing by CO_2 and ultimately act to lower temperature. The rate of chemical weathering is difficult to determine, however, so it has been hard to test whether this temperature regulation hypothesis is correct.

Riebe *et al.* determined chemical weathering rates at the sites of 22 mountainous granitic catchments from measurements of the concentrations of insoluble elements in soils in eroding landscapes and from estimates of physical erosion rates derived from cosmogenic nuclides. They show that recent chemical weathering rates, over the relatively short time scales of soil formation at these locations (thousands of

CONTINUED ON PAGE 1613

SOURCE: (TOP) WETTERBERG *ET AL., EMBO J.* 20, 2564 (2001); (BOTTOM) FEDERLE *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* 98, 6215 (2001).

years), are related primarily to physical erosion rates and that the effect of climate is minor in comparison. This relation implies that tectonic uplift, which strongly influences the rate of erosion, is an important control of climate over long time scales. Chemical weathering in lowland areas and floodplains could be more dependent on climate, however, and thereby increase the strength of the weathering-temperature feedback loop. — HJS

Geology **29**, 511 (2001).

IMMUNOLOGY

Rising to the Vaccine Challenge

Strategies for vaccine development focus largely on the dendritic cell because of its capacity for initiating and guiding T cell–mediated immune responses. With the goal of activating dendritic cells in order to evoke immunity to tumors and pathogens, Stubbs *et al.* have turned to yeast as a vehicle. Inoculation of mice with recombinant *Saccharomyces cerevisiae* that expressed antigens derived from tumors elicited specific cytotoxic T cell responses that protected mice against subsequent tumor challenge. Exposure of dendritic cells to yeast in vitro resulted in efficient antigen presentation and the increased expression of costimulatory molecules and IL-12, a cytokine required for cell-mediated immunity. The natural adjuvant activity of yeast and the ease by which novel antigens can be expressed in this microorganism could offer a practical approach to vaccination in a wide range of immunological settings. — SJS

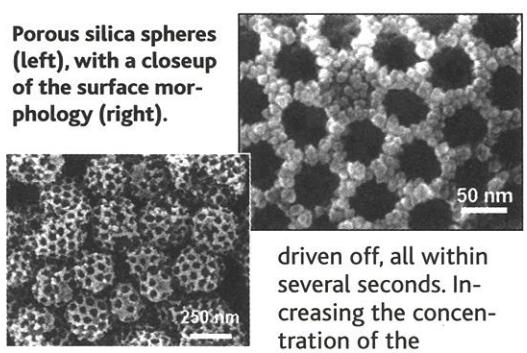
Nature Med. **7**, 625 (2001).

MATERIALS SCIENCE

Spraying Nanoporous Silica

The production of nanoporous templated materials often requires a multistage process: A template for a particular microstructure is made from a colloid or block copolymer, the desired material is solidified around this template, and then the template material is burned away.

Iskandar *et al.* describe a simpler process that produces nanoporous silica with hexagonally packed 50-nanometer pores. Colloidal silica particles were mixed with polystyrene latex and then dissolved in water. An ultrasonic nebulizer was used to break up the solution into small droplets that were then sprayed into a two-stage furnace. In the first stage, the water was evaporated, and in the second, hotter stage, the polystyrene was driven off, all within several seconds. Increasing the concentration of the polystyrene latex particles initially improves the porosity of the silica, but high concentrations lead to silica particles that are fractured and very brittle. With such a simple production method, it is envisioned that nanoporous silica will find use in areas ranging from catalysis to pigments to electronics. — MSL



Porous silica spheres (left), with a closeup of the surface morphology (right).

Nano Lett. **1**, 231 (2001).

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Multiple Zippers

Ryanodine receptors (RyRs) are calcium channels essential for proper excitation-contraction coupling in muscle. Phosphorylation modulates the channel properties of these receptors, and elevated phosphorylation of RyR2 (the cardiac form of RyR) is associated with heart failure.

Marks *et al.* show that RyR2 has three leucine/isoleucine zipper (LZ) motifs, each of which interacts with a distinct cellular regulator. LZ1 mediates binding of protein phosphatase 1 (PP1) through the PP1-targeting protein spinophilin; LZ2 mediates binding of PP2A through the PP2A-targeting protein PR130; and LZ3 mediates binding of the cyclic AMP–dependent protein kinase through the A-kinase anchoring protein (AKAP). Disruption of the LZ-mediated interactions resulted in changes in RyR channel activity and altered regulation by phosphorylation. These results enabled Marks *et al.* to predict kinase and phosphatase interactions with RyR1 (the skeletal form of RyR) and may facilitate identification of regulatory components in other channel complexes. — NG

J. Cell Biol. **153**, 699 (2001).

CREDITS: ISKANDAR *ET AL., NANO LETT.* **1**, 231 (2001).

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