EDITORS' CHOICE

edited by Gilbert Chin

GEOPHYSICS

Fault, Heal Thyself

Large earthquakes are known to recur on major faults, but before the next earthquake can happen, the previous rupture must first heal. Determining the amount of time for the new fractures (generated by shear faulting during the main shock) to disappear and for the tectonic stress cracks to reappear would facilitate hazard assessment along active faults.

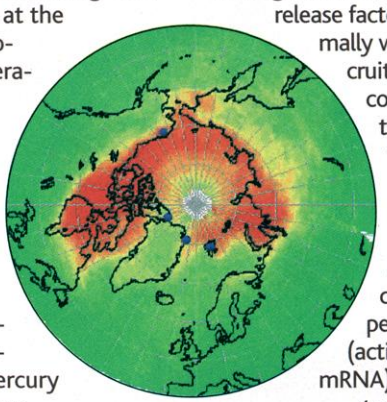
Tadokoro and Ando used shear-wave anisotropy analysis to show that the Nojima fault in Japan, site of the 1995 Hyogo-ken Nanbu earthquake (moment magnitude = 6.9), has healed in just 33 months. This rapid healing suggests that communities may need to remain on alert for further seismicity even soon after a recent event. — LR

Geophys. Res. Lett. **29**, 10.1029/2001GL013644 (2002).

CLIMATE SCIENCE

Mercury at Dawn

The toxic chemical mercury is extremely mobile in its gaseous elemental form and is transported globally due to the long atmospheric residence time of Hg^0. High concentrations of mercury have been found in the Arctic, but its accumulation at those latitudes cannot be explained by the same depositional processes used to account for the presence of organic toxins in the same areas, because Hg^0 does not condense at the ambient atmospheric temperatures. Therefore, some other mechanism must be responsible.



Elevated BrO concentrations (red) in April 2000.

Lindberg *et al.* measured concentrations of atmospheric mercury at Point Barrow, Alaska (71° N), from 1998 to 2001 and found that rapid photochemical oxidation of boundary-layer Hg^0 after polar sunrise causes deposition of oxidized gaseous mercury. Depletion of atmospheric Hg^0 began within a few days of polar sunrise and continued until snowmelt, and was correlated with variations in ozone concentration during these months. They attribute this behavior to rapid in-situ oxidation of gaseous Hg^0 by the same photochemically active halogen species involved in surface O_3 destruction: the halogen radicals Br and Cl and the halogen oxide radicals BrO and ClO. Studies of bioaccumulation of Hg in seabirds and marine mammals suggest that this depositional process has operated only for the past few decades and could be the result of changes in Arctic climate that have increased atmospheric transport of photooxidants and local production of reactive halogens. — HJS

Environ. Sci. Technol. **36**, 1245 (2002).

BIOCHEMISTRY

Pausing Signals

The curious story of tmRNA has taken an intriguing turn. When a translating ribosome reaches the end of an aberrantly truncated messenger RNA (mRNA), it stalls and becomes trapped, waiting in vain for the ribosome release factors that normally would be recruited by the stop codon. Enter tmRNA, which first binds to the ribosome (acting as a transfer RNA), and then encodes a short peptide segment (acting as a mRNA) that is attached to the end of the truncated protein and tags it for degradation by intracellular proteases. Hayes *et al.* have found that tmRNA also gets involved when the ribosome slows down as a consequence of encountering a rarely used arginine codon just in front of the stop codon. Apparently, this pause results in about 20% of correctly synthesized protein (in this instance, RbsK) being tagged and subsequently destroyed. How can this wastage be beneficial?

Nakatogawa and Ito, in a pair of papers examining the peculiar fate of the secretion monitor SecM, may have an answer. At first glance, it appears that SecM is made simply to be exported to the periplasm and degraded. A closer look has shown that a proline-containing segment near to the COOH-terminus of SecM interacts with the exit tunnel of the ribosome and serves to slow translation. This pause allows time for a secondary structural element encompassing the Shine-Dalgarno sequence in the *SecA* gene (which lies immedi-

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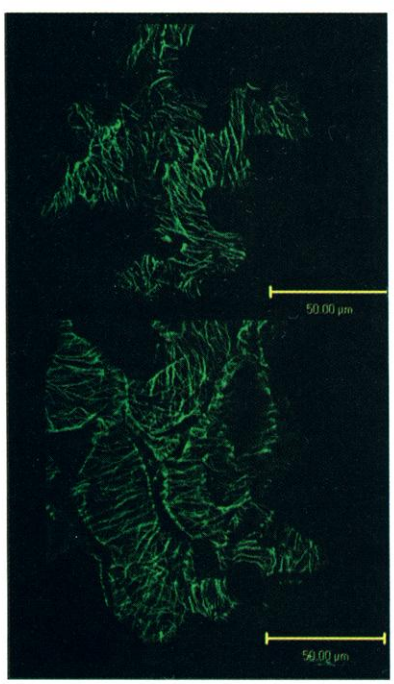
PLANT BIOLOGY

The Long and the Short of It

Making leaves is key to a plant's development, and the shape and size of leaves are carefully controlled by genetic pathways. Kim *et al.* and Folkers *et al.* have studied the role of the gene *ANGUSTIFOLIA* (*AN*) in leaf morphogenesis. Mutations in the *AN* gene yield leaves that are narrower and longer than normal. The AN protein is related to carboxyl-terminal binding protein (CtBP), which is a transcriptional regulator involved in differentiation pathways in mammals. In developing leaf cells in *an* plants, the orientation of cortical microtubules was disrupted: Microtubules were generally aligned parallel to the width of the leaf instead of being arranged more or less randomly. This restricted distribution would be expected to constrain leaf cell expansion. Folkers *et al.* also observed a genetic and physical interaction between AN and a kinesin-like, microtubule-based molecular motor known as ZWICHEL. The differentiation-specific regulation of microtubule distribution in this system may provide a paradigm for morphogenesis pathways in other systems. — SMH



Unlike the random pattern in wild-type leaves (upper), microtubules (green) in *an* cells (lower) run across the leaf.

EMBO J. **21**, 1267; 1280 (2002).

CREDIT: (TOP) LINDBERG *ET AL., ENVIRON SCI. TECH.* **36**, 1245 (2002); (BOTTOM) KIM *ET AL., EMBO J* **21**, 1267 (2002)

ately downstream from the *SecM* gene) to unfold. Furthermore, this pause only transpires when there is not enough SecA protein to bind to the NH_2-terminal portion of SecM, which acts to overcome the frictional pull of the exit tunnel. Thus, SecM regulates the cellular levels of SecA (which mediates general protein export to the periplasm) by signaling to the ribosome: If more SecA is needed, slow down so that the way ahead can be cleared of obstacles; if there is enough SecA, finish making SecM and do something else. The close spacing of bacterial genes—the start site of *rbsR* is just three nucleotides away from the end of *rbsK*—prompts the proposal that rare arginine codons may offer another mechanism for coordinate gene expression. — GJC

Proc. Natl. Acad. Sci. U.S.A. **99**, 3440 (2002); *Cell* **108**, 629 (2002); *Mol. Cell* **7**, 185 (2001).

CHEMISTRY

Like an Enzyme

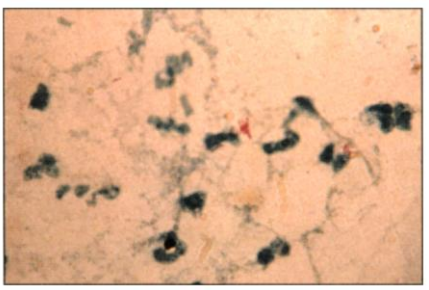
Ideally, chemical synthesis would be performed catalytically at low temperature and pressure, with few side products and without polluting solvents. But in reality, aerobic oxidations are particularly tricky because catalysts themselves often become oxidized, limiting their lifetime. Bench *et al.* have overcome this problem by synthesizing a homogeneous catalyst that contains a heme-like metal center protected within a Teflon-coated sterically restrictive cavity. This pseudoenzyme complex catalyzes the oxidative formation of carbon-phosphorus double bonds, as demonstrated by the coupling of phosphanes with acetone to produce synthetically utile ylides (Wittig reagents) at ambient conditions in air. No decomposition of the catalyst was observed after numerous catalytic cycles. With further modification, this new class of catalysts should be applicable to other substrates, replacing less efficient stoichiometric syntheses. — JU

Angew. Chem. Int. Ed. **41**, 750 (2002).

MICROBIOLOGY

No Coughing in the Cattle Shed

Tradition has it that *Mycobacterium tuberculosis,* the causative agent of tuberculosis, evolved from *M. bovis,* which displays a broad host spectrum and is thought to have colonized human beings as our ancestors domesticated cattle. Brosch *et al.* used deletion analysis to locate 20 variable regions found among the otherwise very similar (99.9%) genomes of the tubercle group bacilli. They discovered that the polymorphisms have not evolved independently but appear to have resulted from a few ancient events in ancestral strains. A corollary finding is that these regions can serve as diagnostic markers for different strains; one in particular, called TbD1, is specific to *M. tuberculosis* and discriminates between ancient and modern pandemic strains of the pathogen, suggesting that the ancestral strain was African or Asian. Progressive mapping of the deletions indicated that *M. bovis* evolved from *M. tuberculosis* and that its genome is smaller than that of *M. tuberculosis*. Previously, Cole *et al.* had shown that considerable gene decay has occurred in a related, specialist human pathogen, *M. leprae*, which since its divergence from their last common ancestor appears to have lost 2000 genes. — CA



Clumps of M. tuberculosis (red) surrounded by human cells (blue).

CREDIT: CARMEN BUCHRIESER

Proc. Natl. Acad. Sci. U.S.A. **99**, 3684 (2002); *Nature* **409**, 1007 (2001).

APPLIED PHYSICS

Seeing Beneath the Surface

The presence of defects in optical-electronic materials can detrimentally affect the output efficiency of light-emitting diodes. Pinpointing the locations of defects is therefore important for characterizing semiconductor crystals and is a first step toward countering their effects or improving the synthetic process. Illuminating defects with short-wavelength light and observing the subsequent photoluminescence is the routine analytical method; however, many of the defects are buried deep below the crystal surface and out of reach of short-wavelength photons, which are absorbed in the surface region. Kawata *et al.* use weakly absorbed long-wavelength, or sub-bandgap, light to illuminate their semiconductor sample, but focus the beam to a sharp spot within the sample so that the defects can be excited via two-photon absorption. The ability to control where the beam is focused provides the ability to create a three-dimensional image of the defects throughout the sample. — ISO

Opt. Lett. **27**, 297 (2002).