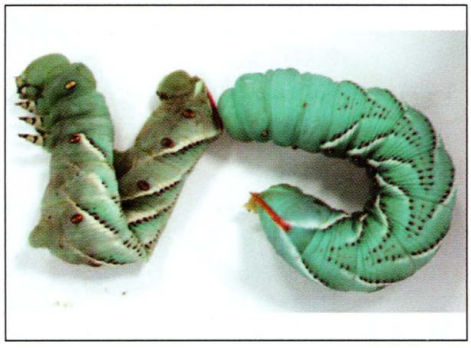
EDITORS' CHOICE

edited by Gilbert Chin

MICROBIOLOGY

Low Water Pressure

A particularly fearsome combination of an insect-predatory nematode and its enterobacterial partner (*Photorhabdus*) has been the subject of intense study. The partners' intertwined life cycles result in a molecular complexity (and a large bacterial genome of 5.5 Mb) of considerable commercial interest because of the range of toxins and antibiotics produced. *Photorhabdus* lives in the gut of the nematode, and when the nematode penetrates a caterpillar, the bacteria are regurgitated. The bacteria express several toxins that immobilize the caterpillars and destroy them from the inside out. The predatory partner replicates within the nutrient broth of the insect's carcass, with the offspring taking up a new generation of bacteria as they feed.



Floppy (left) and firm (right) *Manduca* larvae.

Daborn *et al.* have used a large toxin gene (*makes caterpillars floppy*) from *Photorhabdus* to endow *Escherichia coli* with the ability to evade a caterpillar's immune responses and to produce a loss of turgor. The toxin has little similarity to known proteins, except for a BH3 domain also found in proapoptotic proteins. This region of the genome is also associated with a shift in GC content, which suggests it may have been acquired laterally from another bacterium as a "pathogenicity island." — CA

Proc. Natl. Acad. Sci. U.S.A. **99**, 10742 (2002).

PLANT SCIENCE

Moving to Different Rhythms

Plants use light receptors, including the phytochrome family that detects red and far-red light, to monitor ambient conditions. The five phytochrome types in *Arabidopsis* cover a range of wavelengths and intensities and trigger diverse developmental responses, such as germination, adjustments to shade, and flowering time. As part of the signaling process, phytochromes translocate from the cytoplasm into the nucleus. Kircher *et al.* have analyzed the nuclear import of each of the five phytochromes and found differential translocation as a function of light condition and developmental stage. Mutated versions of phytochromes A and B known to be defective in signaling were competent for nuclear import but failed to form the characteristic nuclear speckles that wild-type phytochromes do. A tantalizing hint at the possible function of these nuclear bodies comes from the apparent diurnal regulation of phytochrome-containing speckle formation. — PJH

Plant Cell **14**, 1541 (2002).

GEOPHYSICS

Earthquake Patterns

Locating earthquakes is essential for identifying fault structures and seismic hazards, modeling Earth's deeper structure, and monitoring nuclear detonations. Most methods rely on a one-dimensional velocity model to calculate arrival times of the seismic waves at many stations and a least-squares method to pinpoint the hypocenter by reducing the difference between the observed and calculated arrival times.

Using over 8 million arrival times recorded over the past 35 years, Nicholson *et al.* have developed a pattern recognition algorithm to locate earthquakes. An event's location is determined by how well its arrival time pattern fits with previous arrival time patterns. They tested this algorithm by relocating 395 nuclear blasts from the Nevada Test Site with greater accuracy than the least-squares method, placing more than 70% of the blasts within 1 km of ground truth depths. The pattern recognition algorithm offers an efficient alternative to the least-squares method because a velocity model is not needed, although small-scale heterogeneities can still be a source of error. — LR

J. Geophys. Res. **107**, 10.1029/2000JB000035 (2002).

GEOLOGY

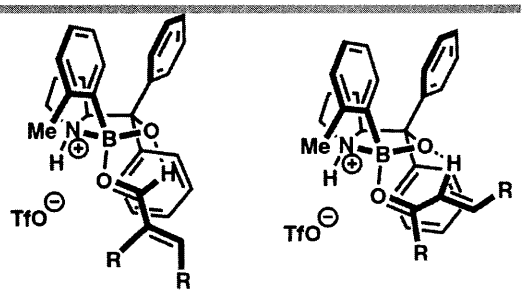
Maintaining the Spread

Seafloor is created at mid-ocean spreading ridges and is consumed (back into Earth's mantle) at subduction zones. The age of the ocean floor increases away from ridges, and crust from 180 million years ago (Ma) is still exposed in the western Pacific Ocean. The rate of creation reflects heat loss from the mantle, and some estimates have indicated that recent spreading rates have varied by as much as 50%. Using recent syntheses of past plate geometries and data

CHEMISTRY

A Change of Face

In the Diels-Alder reaction, an alkene reacts with a diene to form a six-membered ring. A variety of stereochemical outcomes are possible with substituted reactants, and substituent groups can deactivate the reaction. Thus, the search for general catalysts of this reaction continues. Recently, Corey *et al.* reported a route in which proline-derived oxazaborolidines, in the presence of trifluoromethanesulfonic acid (TfOH), produce a strong Lewis acid that enables even α,β-unsaturated aldehydes to react efficiently and with stereochemical control. Often, such routes are not general, but Ryu *et al.* show that these catalysts can direct the reaction of even weaker dieneophiles, such as acrylic acid and ethyl vinyl ketone, with cyclopentadiene both in high yield and with high enantiomeric excess. The pretransition-state complex in these latter reactions (**4**) differs in face selectivity from that for the α,β-unsaturated aldehydes (**3**) in terms of the hydrogen bonds formed. — PDS



3 **4**

Pretransition-state complexes 3 and 4, where Me is methyl and R is a substituent.

J. Am. Chem. Soc. **124**, 3808 (2002); *J. Am. Chem. Soc.* 10.1021/ja027468h.

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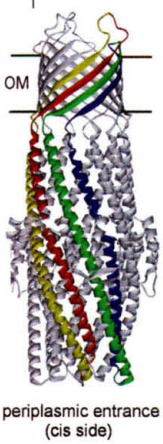
on the area of ocean crust as a function of age, Rowley shows that the rate of production of new seafloor has remained relatively constant (3.4 km^2/year) during the past 180 million years. This period includes times when the geometry of ocean spreading ridges changed greatly (about 40 Ma) and when large oceanic volcanic provinces were formed (about 100 Ma). A constant mid-ocean ridge production rate also implies that the mean depth of the oceans has been constant during this period. — BH

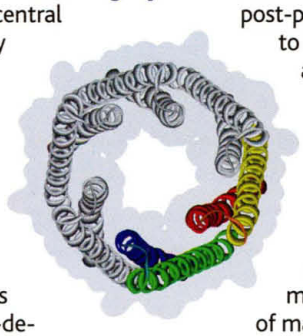
Geol. Soc. Am. Bull. **114**, 927 (2002).

BIOCHEMISTRY

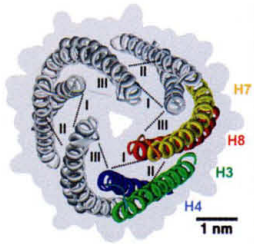
Twist to Open

A recurring structural motif in membrane proteins is a bundle of α helices whose axis is oriented perpendicularly to the plane of the membrane. For TolC, this bundle spans the 10-nm periplasmic gap between the inner and outer membranes of Gram-negative bacteria. Andersen *et al.* have used the crystal structure of TolC in the closed state to design mutations in interhelical contacts that serve to reduce the overall twist of the individual helices, thus unwinding the bundle slightly and creating a central passageway about 1.5 nm in diameter.





They propose that reversible disruption of these contacts provides a mechanism for regulated export of proteins and antibiotics (in self-defense as well as in combat against other bacteria). Detailed studies of the transmembrane helical bundle of the mechanosensitive channel MscL by Perozo *et al.* and Betanzos *et al.* lend support to the generality of helical twisting as a means of controlling permeability. — GJC



Side and end-on views of TolC in open (bottom) and closed (top) states.

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.162039399 (2002); *Nature Struct. Biol.* 10.1038/nsb827; 10.1038/nsb828 (2002).

APPLIED PHYSICS

Irradiation for Magnetic Order

The distinction between the binary states zero and one in a magnetic memory device is determined by the orientation of the magnetization in the bit. Information storage density benefits from making the memory elements smaller, but as the memory elements decrease in size, the distinction between the one and zero states can become blurred because the energy barrier, or anisotropy, also tends to be reduced. Woods *et al.* present a post-growth and post-patterning technique that can be used to redirect and imprint the magnetic anistropy in thin-film structures. Irradiation of magnetic films with 200-kiloelectron-volt argon ions while a saturating magnetic field was applied fixed the orientation and extent of separation of the easy and hard axes. The technique should provide a route to satisfy the demand for further reduction in the size of magnetic storage devices. — ISO

Appl. Phys. Lett. **81**, 1267 (2002).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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Sustained Signaling

How can activation of the extracellular signal–regulated kinase (ERK) pathway result in opposite cellular responses such as proliferation or differentiation? Murphy *et al.* suggest that the duration of activation of immediate early gene products (for example, c-Fos) may be a critical factor in interpreting the signal. Phosphorylation of c-Fos at positions Ser^{374} and Ser^{362} stimulated the phosphorylation of other residues (Thr^{325} and Thr^{331}) by ERK via a docking motif called DEF (amino acids F^{343}TYP in c-Fos). The initial phosphorylation events also prolong the lifetime of c-Fos, thus allowing cells to distinguish between transient and sustained ERK activation. Phosphorylation of Thr^{325} correlated with the stimulation of cell proliferation in response to sustained ERK signaling, whereas mutation of Thr^{325} and Thr^{331} or the DEF domain blocked c-Fos signaling. — NG

Nature Cell Biol. **4**, 556 (2002).

CREDITS: ANDERSEN *ET AL.*, *PROC. NATL. ACAD. SCI. U.S.A.* 10.1073/PNAS.162039399 (2002)