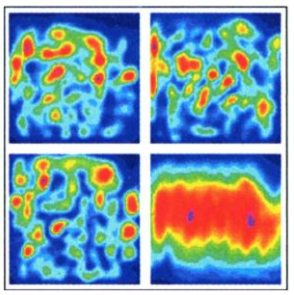
EDITORS' CHOICE

edited by Gilbert Chin

PHYSICS

Chaos Underlying Order

Chaotic systems, if examined over a sufficiently long time, can display regular patterns. Although such effects have been predicted for large-aperture lasers, the underlying dynamics evolve rapidly and are hard to observe with conventional detection. Encinas-Sanz *et al.* have used a recently developed system that allows intensity patterns transverse to the laser beam to be measured on the nanosecond time scale. The time-integrated pattern for a broad-area pulsed CO_2 infrared laser with an aperture of 2 centimeters exhibited a pattern with several well-defined "rolls." However, faster snapshots (taken in 6 nanoseconds) revealed irregular patterns. The time and length scales of the patterns observed can be reproduced faithfully in a numerical model based on the Maxwell-Bloch equations. — PDS



Laser Intensity Patterns

Phys. Rev. Lett. **84**, 883 (2000).

PHYSICS

Sending Spins Through Rough Terrain

Conventional electronics uses charges to switch currents on and off. In magnetoelectronics, or spintronics, the quantum-mechanical properties of the charge carriers (electron spin) are utilized as the pieces of information transferred around the system, but this has been restricted so far to studies of homogeneous systems. One of the major problems for an integrated magnetoelectronics technology is the transfer of the spin-states between different types of materials, that is, across heterojunctions. The different environments for the electrons in each of the layers can cause decoherence of the electron spin and prevent a coherent signal from crossing over.

Using a GaAs/ZnSe heterostructure, Malajovich *et al.* show that optically induced spins can be transferred from the GaAs layer across the interface and into the adjacent ZnSe layer without loss of coherence, despite an almost two-fold difference in band gap and different *g* factors describing the electron environment of the layers. Although the fraction of spins making it across the layers is relatively small (perhaps between 2.5 and 10% of those induced in the GaAs layer), the robustness of the spins described in this work provides encouragement for further development of spintronic devices. — ISO

Phys. Rev. Lett. **84**, 1015 (2000).

BIOCHEMISTRY

Mimicry Strikes Again

Protein biosynthesis terminates when release factors recognize the stop codons in the messenger RNA and promote hydrolysis of the bond between the nascent polypeptide chain and the ribosome-bound transfer RNA (tRNA). Song *et al.* have determined the crystal structure of human eukaryotic release factor (eRF1) at 2.8 angstroms and find that it looks very much like a molecule of tRNA. A conserved gly-gly-gln motif at one end is thought to help position the water molecule used for hydrolysis while the other end is proposed to recognize the stop codon, perhaps via a thr-ala-ser 'anticodon' along the lines of results described by Ito *et al.* Structural mimicry of tRNA recently was described by Selmer *et al.* (Reports, 17 Dec., p. 2349) for ribosome recycling factor (RRF), which promotes disassembly of the translation machinery after termination. In both cases the structural mimicry enables the proteins to bind to the same ribosomal sites as tRNA. — VV

Cell **100**, 311 (2000); *Nature* **403**, 680 (2000).

GEOLOGY

When Mountains Rose Up

Formation of mountains affects Earth's climate, ecosystems, and evolution. In many areas, the uncertainty in the age of formation of Earth's high topography is tens of millions of years. Because of this uncertainty, the relation between formation of topography and tectonic processes also is unclear, as is the role of weathering and denudation in limiting high topography.

A View of the Sierra Nevada

One way to measure relief is to use the known effect that the oxygen and hydrogen isotope ratios of precipitation decreases with elevation. Chamberlain and Poage thus looked at minerals formed from rain water worldwide to develop a relation between isotopic composition and relief. They then applied this approach to show that the topography of the Southern Alps in New Zealand formed about 5 million years ago whereas that of the Sierra Nevada in California formed about 16 million years ago. The age for the Southern Alps is consistent with another study by Batt *et al.*, who examined the cooling rates of rocks close to the Alpine Fault, the major fault through the Alps, thus connecting tectonic and topographic processes. — BH

Geology **28**, 115 (2000); *Geol. Soc. Am. Bull.* **112**, 250 (2000).

GENETICS

Heterochromatin Knobs Revisited

Genomic sequencing projects generate vast amounts of data about transcribed genes and euchromatic regions, but this leaves unanswered the mystery of what's going on in heterochromatic regions of chromosomes.

Fransz *et al.* and McCombie *et al.* present detailed analyses of a portion of chromosome 4 from the small mustard plant, *Arabidopsis thaliana*, linking physical and cytological markers and delving into the sequence of a large heterochromatic region. Careful mapping studies show how the distribution of transcribed genes and transposons relates to the structure of euchromatic and heterochromatic regions. Analysis through the cell cycle revealed which portions of the chromosome condensed and decondensed during meiosis.

Mapping studies indicated that the heterochromatic 'knob,' a lump observable by classical cytogenetics, may have evolved from an inversion event that brought heterochromatic sequences normally near the centromere out into the arm of the chromosome. The knob contains largely tandem repeats and retrotransposons with very few

CONTINUED ON PAGE 1171

CREDITS: (TOP TO BOTTOM) F. ENCINAS-SANZ *ET AL.*, *PHYS. REV. LETT.* **84**, 883 (2000); B. HANSON

transcribed genes, and is susceptible to methylation in the same pattern as are other heterochromatic sequences. With these observations comes greater understanding of the interplay between heterochromatin and the function of chromosomes. — PJH

Cell **100**, 367 (2000); *Cell* **100**, 377 (2000).

ASTRONOMY

Chlorine Cycles on Io

Of the four Galilean satellites Io is the closest to Jupiter. It is also the most volcanically active object in the solar system with an atmosphere rich in SO_2. Along the orbit of Io lies a torus of plasma comprised of ionized material that escapes from Io's atmosphere and becomes trapped in the jovian magnetosphere. Küppers and Schneider used the Kitt Peak telescope to obtain spectra of the torus in the near infrared and detected a 2% abundance of Cl^+ in the torus. Chlorine on Io may be derived from HCl or Cl_2 gas or from molten SCl_2 released during volcanic eruptions. Another possible source of chlorine may be NaCl, either in solid deposits brought to the surface via SO_2 aquifers or in gaseous form produced by atmospheric reactions between Na- and Cl-containing compounds. New models that combine these measurements of Cl with previous studies of Io's chemistry may allow ground-based volcanologists to explain the dynamic processes as its interior is heated and extruded by its interactions with Jupiter. — LR

The medium ground finch

CREDIT: G. FELDMAN

Geophys. Res. Lett. **27**, 513 (2000).

EVOLUTION

What Begets Fitness?

A measure of the fitness of an individual organism, in the terminology of evolutionary biology, is the number of recruits it contributes to the next generation. In wild populations fitness can vary greatly between individuals, and the causes of the variation have proved hard to tease apart.

Since 1976, Rosemary and Peter Grant have been tracking populations of two species of Darwin's finch, *Geospiza fortis* and *G. scandens*, on the Galapagos island of Daphne major. They found that fitness, despite great variation from year to year, was closely correlated with longevity (these finches can live as long as 16 years) and reproductive output. Long life was associated with a number of more contingent factors, such as hatching early in the season (when food supply is most abundant), or large body size, or beak shape suited to the changing composition of the food supply. Piecing together their observations of different cohorts of the two finch species over several generations, they conclude that the heritable components of fitness can be selected in different directions and in different combinations according to the fluctuating environmental conditions, explaining why fitness variation was not heritable or random. The large variation in fitness in these finches also implies that the effective population size, in genetic terms, is a lot smaller than the actual population size. — AMS

Proc. R. Soc. London **267**, 131 (2000).

Science's stke

New Docking Motifs in MAPKs

Binding domains are essential for the proper docking and alignment of protein partners and the subsequent transmittal of intracellular signals. Tanoue *et al.* have uncovered new docking motifs in the family of mitogen-activated protein kinases (MAPKs) and their upstream and downstream regulators. A small cluster of negatively charged residues, referred to as the common docking (CD) motif, interacts electrostatically with a cluster of positively charged residues found on MAPK activators, inactivators, and substrates. Coexpression studies revealed that mutation of either charged cluster abrogated protein-protein interaction, whereas in vitro experiments demonstrated that association increased kinase activity. They suggest that phosphorylation or dephosphorylation of MAPKs and the proteins that associate with them may induce conformation changes that allow one protein to dissociate as another binds to the CD motif. Such a mechanism might contribute specificity to signal transduction in MAPK pathways. — JN

Nat. Cell Biol. **2**, 110 (2000).