EDITORS' CHOICE

edited by Gilbert Chin

GEOCHEMISTRY

Silicon's Travels

Early in the evolution of Earth, the iron-rich core separated from the silicate-rich mantle. Exactly how this differentiation occurred is not understood, although the segregation of metal-rich parcels from a partially molten mantle (a magma ocean) is favored. The current composition of Earth's core also is uncertain because seismic evidence indicates that some lighter elements must be present.

Gessmann *et al.* measured the solubility of Si in liquid Fe metal and found that it increases with increasing pressure at upper-mantle conditions, and that it then decreases with increasing pressure at lower-mantle conditions (due to the increase in Si coordination from 4 to 6 in solid silicates). Thus, an 850 kilometer-thick magma ocean (providing approximately upper-mantle pressures with higher temperatures) would allow as much as 7% by weight of Si to be added to the core. These results are consistent with models of differentiation that start from a bulk chemistry like that of primitive meteorites (CI chondrites). After this initial differentiation, the liquid outer core could have begun to expel Si back into the lower mantle because of its lower solubility. This flux would help to explain the formation of the D″ layer at the core-mantle boundary, supporting the proposal that this layer is chemically distinctive. — LR

Earth Planet. Sci. Lett. **184**, 367 (2001).

MOLECULAR BIOLOGY

The Tail End of mRNA Decay

The amount of messenger RNA (mRNA) available for protein synthesis depends not only on how much mRNA is made but also on how rapidly it is degraded. In eukaryotes, mRNA degradation is initiated by deadenylation, a shortening of the poly(A) tail at the 3′ end of the message. Given the fundamental role of deadenylation in the regulation of mRNA stability, there is much interest in characterizing the factors that catalyze and regulate this process.

Through a series of genetic and biochemical studies, Tucker *et al.* have identified two protein components of the major cytoplasmic deadenylase in the yeast *Saccharomyces cerevisiae*. These proteins, Ccr4 and Caf1, are required for normal mRNA deadenylation in vivo, copurify with a poly(A)-specific exonuclease activity, interact with other proteins involved in mRNA degradation, and are conserved in other eukaryotes. In an intriguing twist, Ccr4 and Caf1 have been shown by Liu *et al.* and other researchers to interact physically with transcription factors, raising the possibility that there is a direct functional link between mRNA synthesis (transcription) and decay. — PAK

Cell **104**, 377 (2001); *J. Biol. Chem.*, in press.

ECOLOGY/EVOLUTION

Evolution of Testis Size

When female animals are inseminated by more than one male, competition amongst sperm ensues. Strength in numbers is key: males that produce more sperm tend to achieve more fertilizations in these contests. Theory predicts that larger testis size should evolve where the risk of sperm competition is greatest. Hosken and Ward test this prediction in the yellow dung fly *Scathophaga stercoraria*, a species which is to sperm competition what *Drosophila* is to genetics. Flies were bred for ten generations in either polygamous (polyandrous) or monogamous conditions. Under polyandrous conditions, where sperm competition was greater, there was, independent of body size, an increase in testis size. — AMS

Ecol. Lett. **4**, 10 (2001).

PSYCHOLOGY

The Fleeting Nature of Fame

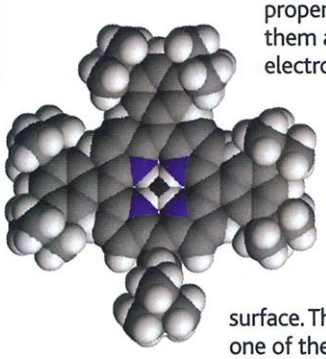
An experimental approach to probing the neural processes underlying consciousness has focused on identifying the differences in brain activity (via neurophysiology or brain imaging) when stimuli are presented and perceived versus when stimuli are presented yet masked or not perceived. Kanwisher uses these studies to hypothesize that awareness exists within the same circuits that process the stimuli and that this quantity must both be accessible to other cortical modules and linked to specific items in order to reach consciousness. Dennett weaves together this and other papers from this special issue into a "cerebral celebrity" theory, in which networks of evolving representations compete (invisible hand-like) for 15 minutes of fame. — GJC

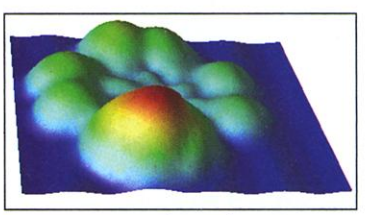
Cognition **79**, 89 (2001); *Cognition* **79**, 221 (2001).

APPLIED PHYSICS

Twisting an Arm Gently

The ability to manipulate single molecules and their electronic properties offers the opportunity to use them as active elements in nanoscale electronics. Moresco *et al.* demonstrate that a scanning tunneling microscope can be used to induce a conformational change in a single molecule; this alters the electronic properties of the tunnel junction. A derivatized porphyrin molecule is deposited onto a copper surface with its four arms (di-*tert*-butylphenyl groups) perpendicular to the plane of the porphyrin and the surface. The tip of a scanning tunneling microscope (STM) is brought close to just one of the arms, and a gentle nudge serves to twist the arm into an orientation parallel to the surface. The tunneling current through the arm depends on the extent of the rotation. A 90° rotation induces the maximum change (of over six orders of magnitude) in resistance, which can be reversed by nudging the arm back up to its original position. — ISO





An STM image (above) and space-filling model (blue, nitrogen; red, copper) showing the porphyrin core with one perpendicularly-oriented arm.

SOURCE: MORESCO *ET AL.*, *PHYS. REV. LETT.* **86**, 672 (2001).

Phys. Rev. Lett. **86**, 672 (2001).

CLIMATOLOGY

The Rainy Season

Asian monsoons are powered by the difference in heating of the Tibetan Plateau and Indian Ocean during the year. Mon-

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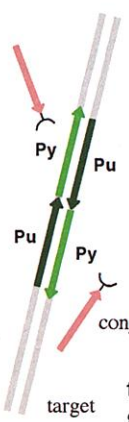
soons likely have occurred ever since the uplift of the Tibetan Plateau, but the precise age of that event has been controversial. Dettman *et al.* used stable isotope analyses from freshwater bivalve shells and mammal teeth in deposits from the paleo-Indus and paleo-Ganges rivers to examine the history of seasonal variations in rainfall. They find a pattern of pronounced wet and dry seasons, characteristic of a strong monsoon, throughout at least the past 10.7 million years, although the climate 7.5 million years ago was particularly dry. Nevertheless, the monsoon has persisted during periods of major changes in Earth's climate and in ocean circulation. Monsoon intensity does vary and has been linked to the longer El Niño cycles; Kudrass *et al.* describe how these events affect weather globally. — BH

Geology **29**, 31 (2001); *Geology* **29**, 63 (2001).

CHEMISTRY

Tying Up Triplexes

The nucleotide bases of single stranded DNA can form hydrogen bonds with exposed portions of the paired bases of duplex DNA; the binding of this single strand in the major groove then creates a triple-stranded DNA. Triplex formation depends in a complex way on sequence, although repeated purine (Pu) and pyrimidine (Py) tracts tend to favor formation. Ihara *et al.* report that Cu^{2+} ions can be used to join purine tracts by means of a conjugated glutamic acid. This hybrid single strand, containing an inverted repeat, can then form a triple-stranded adduct with palindromic duplex sequences. The Cu^{2+} ion appears to act as an allosteric effector that helps stabilize the triplex cooperatively. Such approaches could prove useful in synthesizing sensors for target repetitive DNA sequences that occur in some genetic diseases and at telomeres. — PDS

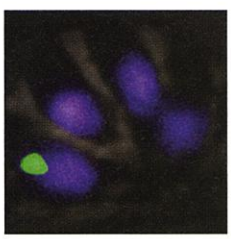


J. Am. Chem. Soc., in press.

MICROBIOLOGY

Not So Silent Passenger

The intracellular parasites responsible for diseases such as malaria and toxoplasmosis contain a secondary endosymbiotic plastid, known as the apicoplast, thought to have been derived from eukaryotic algae. The role of the apicoplast in virulence has been unclear. Whilst making transfected *Toxoplasma gondii* that expressed a fluorescently-tagged apicoplast protein, He *et al.* noticed the appearance of apicoplasts with significant morphological abnormalities; these apicoplasts were not replicated during growth of the parasites in the first cycle of infection. The apicoplast-deficient progeny parasites could infect a second host cell successfully but subsequently failed to grow and propagate. These findings confirm the contribution of the apicoplast to *Toxoplasma* pathogenicity and call attention to it as a potential target for therapeutic intervention. — SMH



A vacuole in a host cell contains four parasites (purple, nucleus), but only one of them contains an apicoblast (green).

EMBO J. **20**, 330 (2001).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

Science's stke www.stke.org

Taking up Residence

How do viruses evade detection and clearance? Strategies used range from inhibiting antigen processing and presentation to establishing latent or dormant nonreplicative infection. The herpes virus family is particularly adept at both. Latent infection established by Epstein-Barr virus (EBV) in B cells is marked by the constitutive expression of the latent membrane protein 2A (LMP2A). Cells expressing LMP2A exhibit impaired B cell receptor (BCR) activation. Dykstra *et al.* show that LMP2A acts to prevent the BCR-initiated cascade of phosphorylation by blocking BCR translocation into lipid rafts (plasma membrane microdomains rich in cholesterol and sphingolipid); this also serves to block antigen complex processing because the requisite BCR internalization from rafts is diminished. Thus, LMP2A interferes with the immune clearance of virus by dampening B cell activation and inhibiting the T cell–mediated recognition of virus-infected B cells. — JN

Immunity **14**, 57 (2001).

CREDITS: (LEFT) IHARA *ET AL.*, *J. AM. CHEM. SOC.*, IN PRESS; (RIGHT) HE *ET AL.*, *EMBO J.* **20**, 330 (2001).