

EDITORS' CHOICE

edited by Gilbert Chin

APPLIED PHYSICS

Turning On (and Off) Superconductivity

Superconducting switching devices offer the potential of processing speeds and low power dissipation inaccessible to conventional microelectronics (see also Schön *et al.*, Reports, this issue, p. 656). So far, however, the devices have been relatively large and the switching circuitry too unwieldy for high-density integration.

Clinton and Johnson have developed a magnetic superconducting valve (MSV) with a simplified design in which the magnetization orientations of the ferromagnetic layers in a magnetically coupled bilayer sitting atop a thin lead film determine whether the thin film is superconducting. When the magnetizations in the bilayer are parallel, the high magnetic fringe fields developed at the lower ferromagnetic layer penetrate into the lead film and are large enough to destroy superconductivity. Switching the magnetization in the upper ferromagnetic material to an anti-parallel orientation pulls the fringe fields into the top layer, leaving the superconducting film undisturbed. The architecture introduced here should allow for the development of high-density superconducting memory devices. — ISO

Appl. Phys. Lett. **76**, 2116 (2000).

CHEMISTRY

Plutonium on the Move

Several tons of plutonium have been released into the biosphere since 1941 through nuclear testing, accidental release, and inadequate waste-handling practices. Plutonium likely enters soils as Pu(IV) hydroxides and oxides, which have low solubility and adsorb strongly to mineral surfaces.

Therefore, environmental migration is generally believed to be low (but see Haschke *et al.*, Reports, 14 January, p. 285).

Neu *et al.* have determined the structure of a siderophore (a small biomolecule that enables microorganisms to chelate and sequester environmental iron) in a nine-coordinate complex with Pu(IV). Formation of this complex demonstrates that the siderophore, desferrioxamine E, is sufficiently flexible to bind a metal center that is much larger than Fe(III). Siderophores such as this one may lead to greater groundwater contamination with plutonium, although bacterial uptake has not yet been demonstrated. — JU

Angew. Chem. Int. Ed. **39**, 1442 (2000).

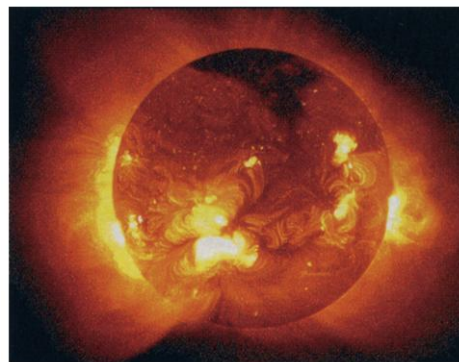
ASTRONOMY

Solar Eruptions

Coronal mass ejections are huge bubble-like pockets of gas that erupt from the solar corona in association with energetic filaments or flares. These ejections offer clues for understanding the transfer of energy into and out of the corona: a practical concern because coronal mass ejections

can create geomagnetic disturbances that disrupt satellite communications and electrical power grids on Earth.

Using x-ray images from the Yohkoh soft x-ray telescope, Khan and Hudson observed events surrounding the disappearance of three transequatorial magnetic



A soft x-ray view of the sun

loops, structures that connect an active region in the north of the sun to an active region in the south. In each case, a solar flare ignited at one active region, emitting soft x-rays. As the x-rays moved outward from the flare, the magnetic loop fractured, and then a mass ejection occurred above the now discontinuous loop. The authors infer that the flare initiates a shock wave and that the shock wave causes the loop to rupture, leading to coronal mass ejection. Thus, coronal mass ejections may occur over loops instead of flares, and these large loops should be watched with care. — LR

Geophys. Res. Lett. **27**, 1083 (2000).

GEOCHEMISTRY

Dating the Source of the Nile

The Nile River flows north from Lake Victoria and Lake Albert. Its rate of flow, its direction of flow, and even its course have varied greatly over time; these variations likely influenced early human evolution and, more recently, have affected the development of early civilizations, the chemistry in the Mediterranean Sea, and the evolution of endemic fish populations in the African Rift Valley. Nineteenth century explorers identified the source of the White Nile as Lake Victoria. In order to resolve the uncertainty over the beginning of the outflow from Lake Victoria (to form the modern Nile), Talbot *et al.* measured Sr iso-

topes in fossil shells and fish bones and thus mapped the late Pleistocene history of Nile River flow. Lake Victoria provides waters with distinctive Sr isotope ratios, and this signature is seen in Nile River fossil deposits starting from about 13,000 years ago (11,500 radiocarbon years ago). — BH

Geology **28**, 343 (2000).

MOLECULAR BIOLOGY

Signaling a Switch in Splicing

Alternative splicing generates messenger RNAs containing different combinations of coding sequences, which, when translated, yield a corresponding family of protein variants. One mechanism determining splice site selection is the balance between two sets of RNA-binding proteins, heterogeneous nuclear ribonucleoproteins (hnRNPs) and serine-arginine (SR) proteins, where a relative excess of hnRNP A1 leads to predominant use of the distal 5' splice site. Now, van der Houven van Oordt *et al.* link activation of the p38 protein kinase signaling cascade, which is triggered by stress, to a redistribution of hnRNP A1 from the nucleus to the cytoplasm, thus switching the splicing of a transfected reporter gene towards the proximal 5' site. — GJC

J. Cell Biol. **149**, 307 (2000).

ORGANISMAL BIOLOGY

Statistics and Systematics

Biologists since Linnaeus have routinely used the species as the fundamental unit of classification. Despite the many recent advances of phylogenetic and systematic methodology, the vast majority of species are delimited on the basis of a very small number of preserved specimens that may not be rep-

CONTINUED ON PAGE 579

representative of the true range of variation. Obtaining the ideal sample sizes or conducting detailed morphological and molecular analyses on more than a tiny proportion of the world's species is impractical by any yardstick. Can statistical methods help?

Wiens and Servedio present a new statistical model that allows systematists using traditional character-based methods to determine whether they have sampled enough characters (usually morphological) or individuals to diagnose species differences with confidence. The model promises hope for more standardized approaches to traditional taxonomic methods, still used for the bulk of systematic work. — AMS

Proc. R. Soc. Lond. B 267, 631 (2000).

PHYSIOLOGY

Central and Peripheral Views of Leptin

Leptin regulates body weight by reducing food intake and by altering metabolism in peripheral tissues. To investigate leptin's effects, gene profiling was used to catalogue genes whose expression was altered in leptin-deficient obese mice. In a study of pituitary tissue, Renzi *et al.* found that over 100 genes showed altered expression in leptin-deficient mice, but only five, including the proopiomelanocortin (POMC) and prolactin genes, were normalized by short-term leptin replacement. Working with white adipose tissue, Soukas *et al.* found dramatic alterations in the expression of hundreds of genes in leptin-deficient mice, including genes regulated by sterol regulatory element-binding protein-1, adipocyte differentiation genes, and many others. In this case, normal expression of a significant fraction of these genes was restored by long-term treatment with leptin. — PAK

J. Biol. Chem. 275, 10429 (2000);
Genes Dev. 14, 963 (2000).

IMMUNOLOGY

Exploiting Errors

Errors in translation of messenger RNA produce defective proteins that need to be cleared efficiently in order to avoid deleterious consequences. Protein degradation occurs via the cytosolic proteasome and produces small peptides that are suitable substrates for the transporter associated with antigen processing (TAP), which funnels peptides into the endoplasmic reticulum to

be loaded onto major histocompatibility class I proteins for subsequent exposure on the cell surface. This allows immune cells to monitor which proteins are being manufactured by a cell, and hence to attack cells that appear to be expressing viral proteins.

Schubert *et al.* find that an astonishing 30% of all newly synthesized proteins were degraded by the proteasomal machinery, generating potential TAP substrates. Reits *et al.* showed that in influenza-infected cells—where protein synthesis is subverted to produce influenza virus-encoded proteins—TAP proteins were heavily laden with viral peptides. Thus, the proteasomal and antigen presentation machinery appear to be devoted largely to the processing and presentation of newly synthesized proteins, rather than proteins that have stably resided within the cytosol; this facilitates rapid immune detection of cell infection. — SMH

Nature 404, 770 (2000); *Nature* 404, 774 (2000).

NEUROSCIENCE

Gap + GABA = Gamma

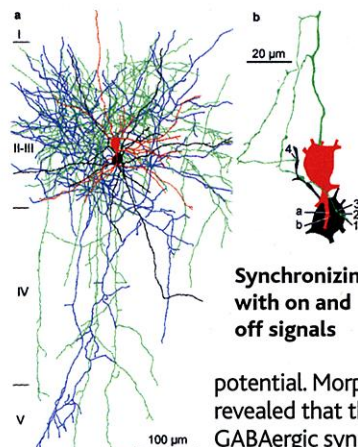
Synchronous oscillations of neuronal populations are observed in many cortical regions and have been hypothesized to participate in perception and attention. Networks of inhibitory interneurons seem to be crucial for the synchronization of groups of pyramidal cells to produce these gamma range (30–70 Hz) oscillations. But how is this achieved?

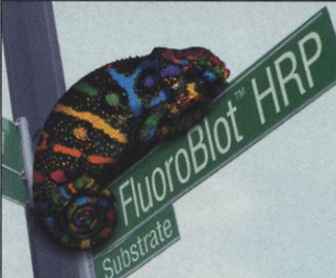
Tamás *et al.* recorded from pairs of coupled interneurons in cortical layer 2/3. One group of interneurons was connected by γ -aminobutyric acid (GABA)ergic synapses; another group made electrical connections via gap junctions. In both cases no gamma range coupling was found. If, however, the

connection between the interneurons comprised both electrical and chemical synapses, then phasing at gamma frequency could be observed. This combination of inputs generates a biphasic post-synaptic compound potential that determines precisely the timing of the post-synaptic action

potential. Morphological analysis revealed that the gap junctions and the GABAergic synapses in these cells are close to each other in a perisomatic position, enforcing local integration of the postsynaptic potentials and minimizing the effect of dendritic filtering. — PRS

Nature Neurosci. 3, 366 (2000).





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