EDITORS' CHOICE

edited by Gilbert Chin

PHYSICS

The Rise & Fall of Conductivity

The diversity of electronic properties displayed by single-walled carbon nanotubes (SWNTs) already makes them attractive candidates for applications in molecular electronics. Leonard and Tersoff have studied the transport properties of a modulated-doped SWNT in a model calculation in which one half of the SWNT is doped *n*-type and the other half *p*-type. This junction would be the molecular equivalent of the semiconductor based Esaki diode, which is widely used in microelectronics. Their model predicts that the SWNT should display a large peak in resistance, that is, negative differential resistance (NDR), even at room temperature. Recent experimental work on such devices confirms this predicted NDR behavior (Zhou *et al.*, Reports, 24 Nov., p. 1552). Although the effect was not quite as large in the real device as that predicted in the model, finding qualitative agreement is an encouraging step toward a clearer understanding of the transport properties in these structures. — ISO

Phys. Rev. Lett. **85**, 4767 (2000).

BIOMEDICINE

A Wonder Drug?

In a relatively short time, the group of molecules known as statins has revolutionized the practice of preventive cardiovascular medicine. The well-documented benefits of statins in preventing coronary heart disease arise from their ability to inhibit an enzyme essential for cholesterol synthesis, 3-hydroxy-3-methylglutaryl coenzyme A reductase, which leads in turn to lowering of serum cholesterol levels.

Kwak *et al.* now provide evidence that statins also may modulate the immune system. In cell culture studies, statins were found to inhibit the expression of class II major histocompatibility (MHC) antigens, leading to repression of T cell activation. Should future studies confirm the immunomodulatory activity of statins in vivo, the drugs could have new clinical applications as immunosuppressants in the context of organ transplants and various autoimmune disorders. Meanwhile, in two independent epidemiologic analyses, Wolozin *et al.* and Jick *et al.* report that the use of statins is associated with a reduced risk of developing Alzheimer's disease and dementia. If these observations (and a previous finding that statin use may protect against osteoporosis) survive further scrutiny, statins may one day rival aspirin as a wonder drug. — PAK

Nature Med. **6**, 1399 (2000); *Arch. Neurol.* **57**, 1439 (2000); *Lancet* **356**, 1627 (2000).

ORGANISMAL BIOLOGY

Flying Along a Logarithmic Spiral

Peregrine falcons use two high performance skills—flight speed and visual acuity—to attack their prey. In a trio of papers, Tucker and his colleagues model the quantitative aspects of aerodynamic drag, assess the optimal integration of speed and sight, and present field observations of falcon flight. Drag, particularly at flight speeds in excess of 50 meters per second, is minimized by keeping the head aligned with the body, but this presents a problem: prey of the size of a robin can be seen from a distance of 1 km only by using the deep fovea, which is oriented at an angle of about 40 degrees from the head axis. Thus, it would be impossible for a falcon to see its prey while flying straight at it, and keeping the head angled while flying would increase drag significantly and reduce speed. The solution is for the falcon to fly along a logarithmic spiral, with head and body aligned along the line-of-flight at a 40 degree angle from line-of-sight to the prey, until almost 90 % of the distance has been covered, at which point binocular acuity is sufficient to guide straight-line attack. Several summers of observation with computerized tracking equipment at Deer Valley Ranch, Colorado confirm that peregrine falcons do indeed fly along spiral paths. — GJC

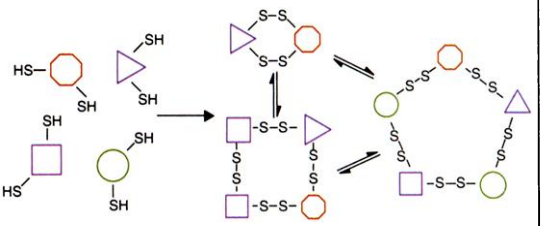
Falco peregrinus.

J. Exp. Biol. **203**, 3733; 3745; 3755 (2000).

CHEMISTRY

Dynamic Libraries

Combinatorial libraries of molecules, once synthesized, usually are static, but the facile interconversion of some chemical species makes it feasible to design dynamic combinatorial libraries (DCLs), so-called because the composition of these libraries can be altered after synthesis. Otto *et al.* show that disulfide exchange reactions are a promising route for constructing DCLs. Several dithiol compounds were reacted in air at pH 7.5 to create macrocyclic compounds. Analysis by mass spectrometry revealed the presence of more than 100 macrocycles, and the time course of DCL growth could be assessed by using acidic conditions to inhibit disulfide exchange. These macrocyclic adducts could find application as synthetic receptors or as ionophores. — PDS



Dithiol building blocks for disulfide macrocycles.

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

IMMUNOLOGY

Subverting Surveillance

Due largely to the vigilance of cytotoxic $CD8^+$ T cells, most malignant tumors regress before reaching detectable size. Terabe *et al.* suggest that the activities of some specialized lymphocytes, called natural killer T (NKT) cells, may undermine this mode of tumor surveillance by repressing the activity of cytotoxic $CD8^+$ T cells.

Using a mouse tumor model, the authors observed that regression was permanent in mice lacking the receptor for interleukin-4 (IL-4), but not in mice deficient in IL-4 itself. Cytokine-inhibition studies were used to confirm that IL-13, which also uses the IL-4 receptor, was in fact the primary cytokine responsible for allowing the tumors to reappear. This effect could be recapitulated in mice

CONTINUED ON PAGE 1859

CREDIT: (LEFT) VANCE TUCKER; (RIGHT) OTTO *ET AL.*, *J. AM. CHEM. SOC.*, IN PRESS.

deficient in CD1 proteins, which are required for the development of IL-13—producing NKT cells. These results suggest a role for these unusual lymphocytes in regulating tumor surveillance, and the authors propose that NKT cells could serve as a complementary target in cancer immunotherapy. — SJS

Nature Immunol. **1**, 515 (2000).

GEOCHEMISTRY

Gold Goes with the Flow

Gold can be found in ore deposits in and around igneous intrusions in magmatic arcs. Fluid flow and reactions of fluids with host rocks concentrate gold in these deposits, but the origin of the gold itself has been debated widely. It could originate in the mantle and be carried upward in the magma, as seems to be the case for copper, which is often associated with gold in this setting; it could also, however, be derived from crustal rocks.

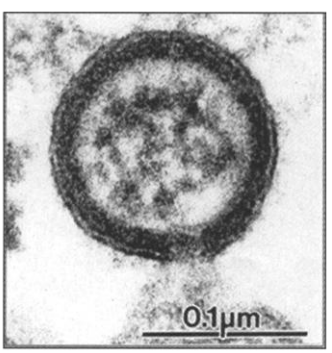
Mathur *et al.* measured osmium isotopes in sulfides in the world's largest porphyry copper-gold deposit, the Grasberg Mine in central Irian Jaya. Their data imply that the gold was derived from shale near the deposit and not from the mantle or the magma. Fluid flow driven by intrusion of the hot magma apparently extracted the gold from the shale. –BH

Earth Planet. Sci. Lett. **183**, 7 (2000).

VIROLOGY/CELL BIOLOGY

This Bud's For Me

In order to be released from their host cell, newly formed envelope viruses must bud from the plasma membrane. In examining the mechanism of budding of the retroviruses Rous sarcoma virus (RSV) and HIV, three groups have discovered a role for ubiquitin in the budding process. Ubiquitin is a small cellular protein that becomes covalently linked to other proteins and is commonly thought to function as a tag that leads to protein degradation; in some instances, ubiquitin can act as a signal for protein internalization via endocytosis.



An immature HIV particle attached to a budding-deficient cell.

Now it appears that ubiquitin also participates in virus budding. The Gag protein of retroviruses provides the structural components required to build virus particles, but the processes of budding and viral maturation are not completely understood. Schubert *et al.* and Patnaik *et al.* show that by reducing the levels of ubiquitin available in HIV- or RSV-infected cells, viral budding is inhibited at a late step in the process. Strack *et al.* show that engineered HIV and RSV Gag proteins only caused budding when they were able to recruit the enzyme ubiquitin ligase to the budding site at the host cell surface. A fourth study by Harty *et al.* demonstrates the ubiquitination of VP40, a protein involved in late budding stages of Ebola virus. Taken together, these papers suggest that ubiquitin helps these viruses to complete the budding process, and it is tempting to suppose that the endocytosis-promoting activity of ubiquitination has been commandeered by these viral interlopers. — SMH

Proc. Natl. Acad. Sci. U.S.A. **97**, 13057; 13069; 13063; 13871 (2000)

ATMOSPHERIC SCIENCE

Up with Bromine

Major volcanic eruptions eject particles and gases into the stratosphere, including the halogens chlorine (Cl) and bromine (Br), both of which contribute to the catalytic destruction of ozone, but the magnitude of the volcanic contribution of these gases is uncertain. Although enlarged polar ozone holes were observed after the Pinatubo eruption in 1991, these were attributed primarily to the effects of sulfate aerosols and other particles from the eruption on the formation of polar stratospheric clouds. Most of the volcanic Cl (which forms HCl) is likely scavenged before it reaches the stratosphere, but the potential effects of Br, which is much more potent at destroying ozone than Cl, are not well studied.

Bureau *et al.* now present a series of experiments which suggest that the Pinatubo eruption and other comparable eruptions could inject as much Br into the atmosphere as the annual budget from all other natural and anthropogenic sources. Their results show that in magmas, Cl, Br, and I partition strongly into a hydrous fluid phase, which is responsible for driving violent eruptions. Bromine seems less likely to be washed out in the eruption column than Cl, although further study of this is needed. — BH

Earth Planet. Sci. Lett. **183**, 51 (2000).

CREDIT: SCHUBERT *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* **97**, 13057 (2000).