EDITORS' CHOICE

edited by Stella Hurtley

MATERIALS PHYSICS

A Route to Cooler Thermoelectrics

Thermoelectric devices generally consist of a junction of two materials possessing different electrical and thermal conductivity properties. When exposed to a thermal gradient, an electrical current flows from one material to the other. Conversely, passing a current through the junction can result in cooling. Such devices are attractive as refrigerators or possibly as power generators to scavenge waste heat.

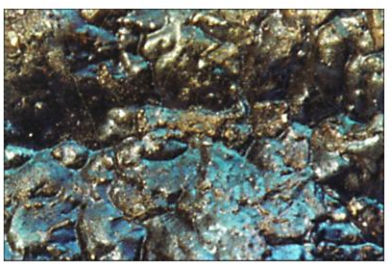
Thermoelectrics should have low thermal conductivity, high electrical conductivity, and high thermopower, properties that can be difficult to optimize simultaneously in a specific material. They are rated by a figure-of-merit, *ZT* (where T is temperature). Most good thermoelectrics have *ZT*s around unity, which is about the break-even point for practical applications. Rontani and Sham propose a method for increasing *ZT* to 3 or 4. Their calculations show that by introducing a layer of rare-earth atoms at the interface of a metal-ferroelectric junction, the electronic interactions should give rise to a sharp variation in the carrier transmission across the junction and a high thermopower. The large thermal impedance mismatch between the two materials should also decrease the thermal conductivity while maintaining good electrical conductivity and lead to a significant increase in *ZT* for low-temperature operations. — ISO

Appl. Phys. Lett. **77**, 3033 (2000).

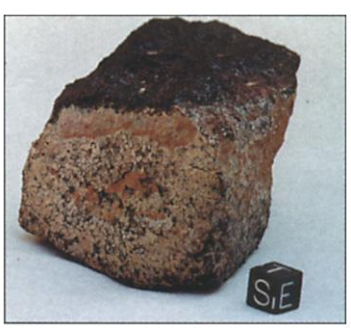
GEOCHEMISTRY

Mars Piece by Piece

The only direct samples we have of Mars come from 16 Martian meteorites. Several new samples have been found in the past few years, including one discovered, or rather recognized, in late 1999 after having resided in a private collection in Los Angeles for some 20 years.



Rubin *et al.* now describe the geochemistry of this Los Angeles meteorite which provides new information on the nature of the Martian crust. The meteorite contains a variety of geochemical fingerprints supporting its Martian origin, including its oxygen and hydrogen isotopic values. Compared to the other Martian meteorites, Los Angeles has a low magnesium:iron ratio and a high abundance of certain trace elements indicating that the meteorite is derived from a more chemically evolved magma on Mars. Its composition, like that of the other meteorites, is not a close match to the Martian soil analyses recorded by the Mars Pathfinder. In a separate study, Jull *et al.* show that another Martian meteorite, Nakhla, contains clear evidence of extraterrestrial organic material. They conclude that the most likely origin of this organic matter is from the accumulation of cometary debris and carbonaceous cosmic dust over time on the Martian surface. — BH



Los Angeles Martian meteorite, here and up close, above.

Geology **28**, 1011 (2000); *Geochim. Cosmochim. Acta* **64**, 3763 (2000).

ASTROPHYSICS

Making More Massive Black Holes

Supermassive black holes reaching millions of solar masses have been detected at the centers of active galaxies, and their formation has been associated with mergers of stars or very active star formation regions.

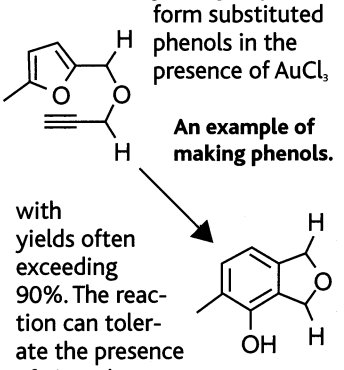
Matsushita *et al.* imaged the distribution of molecular gas in the irregular galaxy Messier 82 (M82) using the Nobeyama Millimeter Array (NMA) in order to understand its dynamical nature and how it may relate to the formation of a supermassive black hole, known as a superbubble. The superbubble is offset from the center of M82 in a starburst region, which also contains a hard X-ray variable point source that is probably due to a massive black hole of about 460 solar masses. The spatial relations between the starburst region, the superbubble, and the massive black hole support a related origin. The authors suggest that about 1000 supernovae exploded in the starburst region to form the superbubble and the massive black hole. This massive black hole, which is offset from the center of M82, may eventually gravitate toward the center and merge with the supermassive black hole. Thus, less massive black holes could form in starburst regions offset from the center of an active galaxy and then drift toward the center to form, or build upon, the central supermassive black hole. — LR

Astrophys. J., in press, astroph0011071.

CHEMISTRY

Golden Route to Arene Compounds

Organic reactions catalyzed by gold compounds in solution are rather rare, but Hashmi *et al.* now report that highly substituted arenes, especially phenols, can be synthesized using gold catalysts. Either mixtures of allenyl and propargyl ketones, or, more conveniently, substituted furans possessing a terminal acetylene group, can form substituted phenols in the presence of $AuCl_3$ with yields often exceeding 90%. The reaction can tolerate the presence of air and water and proceeds at room temperature. The authors suggest that gold activates the triple bond to form an oxygen-bridged six-membered ring through what would normally be an unfavorable Diels-Alder reaction with the furan. This oxygen bridge is broken by subsequent reaction with either a gold(I) or gold(III) species ultimately forming the phenol. — PDS



An example of making phenols.

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

ECOLOGY

Sorry, We're Closed

Local extinctions of species from ecological communities are an inevitable result of human pressure on natural ecosystems. Given the availability of potential replacements from elsewhere, can such extinctions be reversible? Using simulated communities of different sizes and different population growth rates, Lundberg *et al.* show that reduced commu-

CONTINUED ON PAGE 1467

SOURCE: (TWO LEFT IMAGES) RON BAALKE JET PROPULSION LAB / NASA; (RIGHT) HASHMI *ET AL., J. AM. CHEM. SOC.* IN PRESS.

nities can sometimes become resistant to the reinvasion of species previously lost. This "community closure" effect becomes more pronounced when communities have larger initial numbers of species. Model communities with more species also suffered disproportionately from cascading extinctions, whereby failure of a lost species to reinvade can lead to extinctions of further community members. This potential for irreversibility of species loss is a further headache for restoration ecologists and conservation managers. — AMS

Ecology Letters **3**, 465 (2000).

VIROLOGY

Not So Different After All

In studying enveloped animal virus entry into cells the influenza virus has been used to define a general model. Influenza viruses bind to receptors at the cell membrane, are internalized by endocytosis, and inside the endosome are exposed to a low pH, which activates a fusion protein in the viral envelope so that the viral capsid is released into the cytosol for viral replication. The entry of Avian Leukosis Virus (ALV) has been thought to be independent of the low pH of endosomes, and its envelope protein has been considered pH independent in its ability to promote viral membrane fusion.

Antibody staining (brown) of ubiquilin in brain tissue. Neurofibrillary tangles typical of Alzheimer's disease are strongly stained (above).

Mothes *et al.* now challenge this idea and find that the viral envelope protein when bound to its receptor does require an acid bath to promote fusion after all. It is the receptor binding itself that converts the viral envelope fusion protein into a pH-sensitive conformation. In the light of these findings the entry mechanism for a whole variety of animal viruses, including other retroviruses like HIV, may need to be reexamined. — SMH

Cell **103**, 679 (2000).

MICROBIOLOGY

Every Silver Lining Has a Cloud

Many disease-causing filamentous fungi of plants and animals produce toxins, notorious among these is aflatoxin, which can cause liver cancer in people and livestock who have eaten affected nuts and seeds. This intractable agricultural problem urgently requires control.

While investigating how aflatoxin production is regulated, Tag *et al.* discovered that a cellular signaling protein FadA, a heterotrimeric G protein, inhibited the production of aflatoxin and other carcinogens in these fungi, as well as suppressing spore formation. Nevertheless, although aflatoxin production was suppressed, penicillin production was stimulated. In some instances this kind of response might be valuable, but stimulating antibiotic release into the environment may cause other problems. Furthermore, increased antibiotic production was accompanied by a general shift in the production of other metabolites, including other potent toxins. Thus any strategy that targets G-proteins in pathogens in order to control one toxin could lead to the accidental production of an alternative poison. — CA

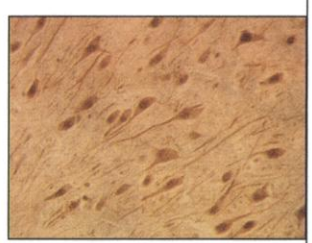
Molec. Microbiol. **38**, 658 (2000).

CELL BIOLOGY

Presenilins Get a Boost

Some patients with early-onset Alzheimer's disease (AD) have mutations in the genes that encode the presenilins. These multispanning membrane proteins are essential for early development but their role in pathogenesis remains poorly understood.

Now Mah *et al.* have identified a human protein called ubiquilin that binds to presenilins and promotes their accumulation. The ubiquilin gene maps to a chromosomal region that is thought to contain a susceptibility gene for late-onset AD. Interestingly, although ubiquilin contains ubiquitin-related domains, which usually target proteins for degradation, it does not alter presenilin turnover but instead appears to increase presenilin synthesis. Like ubiquitin, ubiquilin is present in neuropathological lesions that are characteristic of AD (neurofibrillary tangles) and Parkinson's disease (Lewy bodies). The discovery of ubiquilin may provide a clue to a new mechanism by which presenilin levels are regulated. — PAK



J. Cell Biol. **151**, 847 (2000).

CREDITS: MAH *ET AL.*, *J. CELL BIOL.* **151**, 847 (2000).