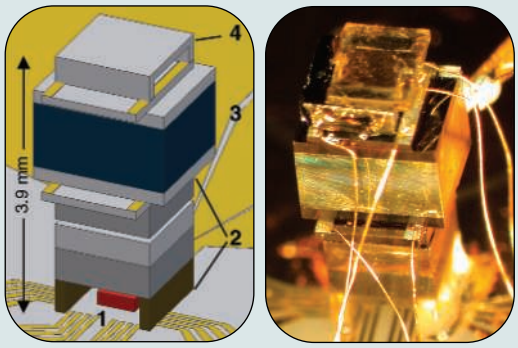
edited by Stella Hurtley

APPLIED PHYSICS

Chip-Scale Magnetic Measurements

The ability to measure tiny magnetic fields with good sensitivity can be found in many applications, from biological imaging to prospecting for buried treasure. However, the most sensitive magnetometers that operate in ambient conditions tend to be power-hungry, bulky, and heavy. Shrinking the size to just several millimeters and the power consumption to hundreds of milliwatts, Schwindt *et al.* have fabricated a sensitive magnetometer using microelectromechanical technology. A cloud of rubidium atoms trapped in a micromachined vapor cell is used to sense the magnetic field. The magnetic field splits the energy levels of rubidium atoms, and the extent of the splitting depends on the strength of the magnetic field. Changes in the magnetic field are then detected and tracked optically by the relative absorption changes of a laser light tuned to the split energy levels. It could be that in the not-too-distant future we could be using handheld battery-operated magnetometers. — ISO



The miniaturized magnetometer.

Appl. Phys. Lett. **85**, 6409 (2004).

NEUROSCIENCE

Making Memories

During learning, in a process termed long-term potentiation or long-term facilitation, synapses are specifically modified by a process that involves transcription. Because the synapse itself is at a distance from the neuronal cell nucleus —separated by the elongated axon or dendrite—the neuron must possess mechanisms to transmit synaptically activated second messengers and transcription factors to its nucleus. Thomson *et al.* now dissect aspects of this pathway in *Aplysia* sensory neurons and in mouse hippocampal neurons. In both cases importins (proteins involved in active nuclear import in many cell types) appear to be involved. In both types of neurons, importins were found localized along axons and dendrites and in synaptic compartments. Stimuli that triggered long-lasting facilitation in *Aplysia* triggered translocation of importin to the nucleus. Similarly, in hippocampal neurons synaptic receptor activation promoted nuclear accumulation of importin. The changes in importin distribution were not observed when only short-term synaptic changes were induced (changes that are known not to involve changes in transcription). It remains to be demonstrated which memory-related substrates may be associated with the translocating importins, but a role for the classical nuclear import pathway in generating long-lasting memories seems likely. — SMH

Neuron **44**, 997 (2004).

CLIMATE SCIENCE

Twinned Thinning

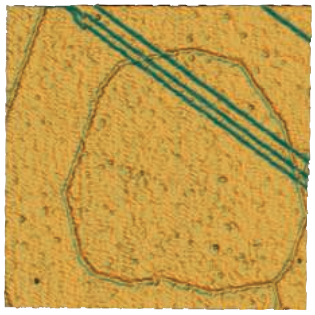
The response of the West Antarctic Ice Sheet (WAIS) to global warming is of great concern because, if it were to melt completely, it is large enough to raise sea level by approximately 7 m. Such massive melting is unlikely to occur soon; nevertheless, there is still the potential for a marked increase in the rate of sea level rise due to accelerated ice loss. The great majority of the ice mass lost presently from the WAIS flows to the sea as ice streams, of which that of Pine Island Glacier is the most important. The Pine Island Glacier, and the adjoining ice shelves of Pine Island Bay, have thinned significantly over the past 3 decades. In two related papers, the extents, causes, and effects of these changes are examined. Shepherd *et al.* use satellite data altimetry to document how ice shelves in that region have thinned, and they attribute the thinning to melting cased by the action of ocean currents that are 0.5°C warmer than freezing on average. The pattern of shelf thinning mirrors that of their grounded tributaries, suggesting that Antarctic ice is more sensitive to changing climates than previously thought. Payne *et al.* test the hypothesis that these changes are triggered by the adjoining ocean, using a numerical ice-flow model to simulate its effects on the dynamics of the Pine Island Glacier. They confirm the idea that recent increases in local ocean temperature are the cause of the observed thinning and find that the thinning of coastal ice shelves is transmitted rapidly to the grounded ice streams above, revealing a tight coupling between the ice sheet interior and surrounding ocean. — HJS

Geophys. Res. Lett. **31**, 10.1029/2004GL021106; 10.1029/2004GL021284 (2004).

CHEMISTRY

Maintaining Chains

Coupling reactions of organic molecules on surfaces can proceed at modest temperatures. McCarty and Weiss have used low-temperature scanning tunneling microscopy (STM) to observe molecules aligning into chains before such reactions can proceed. At room temperature, diiodobenzene dissociates on the atomically flat Cu(111) surface to create mobile phenylene radicals that can be pinned at defect sites. Images taken at 77 kelvin show that the phenylene species align in noncovalently bonded chains—the STM tip could be used to pull a phenylene monomer out of the chain. At higher surface coverages, a second layer of chains can align on a surface already covered with phenylene chains. Parts of the upper-level chains could be nudged to new locations



Phenylene chains hang together, even over surface steps.

CREDITS: (TOP) SCHWINDT *ET AL., APPL. PHYS. LETT.* **85**, 6409 (2004); (BOTTOM) WEISS *ET AL., J. AM. CHEM. SOC.* 10.1021/JA038930G (2004)

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on the surface, where they would return to their original length by recruiting more monomer units. — PDS

J. Am. Chem. Soc. **126**, 16672 (2004).

ECOLOGY/EVOLUTION

Eats Roots or Shoots

Recently, plant ecologists have increasingly focused on the role of soil organisms in determining plant community processes. Below-ground herbivores, such as worms, tend to promote plant diversity when they feed on dominant plant species. However, van Ruijven *et al.* show that the combined effects of above- and below-ground herbivores cannot be predicted from their separate effects. Different combinations of invertebrate herbivores (nematodes and

Experimental plot.

wireworms below ground, and grasshoppers above ground) were added to experimental species-rich grassland plant communities. When added separately, the nematodes and wireworms had positive effects on diversity, whereas the grasshoppers had neutral effects. When added together, however, the combined effect on diversity was negative. The different feeding preferences of the two groups of herbivores appeared to alter the competitive interactions among the plant species within the communities, eventually producing the nonadditive effects observed. Differential distributions of above- and below-ground herbivores may well contribute to locally heterogeneous diversity levels. — AMS

Ecol. Lett. **8**, 30 (2005).

BIOTECHNOLOGY

Library Science

Bacteria are everywhere and can eat just about anything, including such unappetizing fare as petroleum sludge. Therefore, they must possess the enzymes (and the genes encoding the enzymes) that catabolize hydrocarbons. In the past, the challenge has been to identify and cultivate the desired species; advances in technology have made it feasible to bypass cultivation and to browse for specific genes (enzyme activities) in metagenome (expression) libraries. Uchiyama *et al.* take the next step in devising a method of sorting the library contents on the basis of substrate specificity and then searching for genes of interest. Their approach succeeds because bacteria rely on gene regulatory networks (and even riboswitches) that, in many cases, are induced or repressed by small molecules—either the substrate itself or chemically related compounds. Starting with a metagenome library made from petroleum-contaminated groundwater, they end up with a P450 enzyme that catalyzes hydroxylation (which makes hydrocarbons more polar and amenable to catabolism) of 4-hydroxybenzoate. — GJC

Nature Biotechnol. **23**, 88 (2005).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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Specificity Through Degradation

Yeast use partially overlapping kinase modules to specify discrete cellular responses. For example, the upstream kinases in the mitogen-activated protein kinase (MAPK) cascade, Ste11 and Ste7, are both activated during mating response signaling and during filamentous growth signaling. The MAPK Kss1 then triggers the filamentous growth transcriptional cascade and the MAPK Fus3 triggers the mating response genes. In the absence of Fus3, pheromone signaling stimulates Kss1 and filamentous growth gene expression, suggesting that Fus3 has a role in suppressing filamentous growth responses during pheromone signaling. Chou *et al.* and Bao *et al.* now report that Fus3 triggers the degradation of a transcription factor required for filamentous growth, Tec1, to maintain signaling specificity through the shared MAPK pathways. The abundance of Tec1 decreased after mating stimulated by pheromone and this destabilization required Fus3 but not Kss1. Tec1 Thr273 was phosphorylated by Fus3. Degradation was mediated by a SCF ubiquitin ligase complex. Thus, selective degradation of a transcriptional regulator represents a mechanism for generating specificity during intracellular signaling. — NG

Cell **119**, 981 (2004).

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