EDITORS' CHOICE

edited by Gilbert Chin

PLANETARY SCIENCE

Coloring Europa with Impacts

The Galileo spacecraft sent home stunning images of Europa. Its water-ice surface was covered with arcuate cracks, finely to coarsely hachured areas, chaotic terrains, and, perhaps most dramatically, more colors than expected for an icy body. Some of the brown-yellow ice patches may be due to contamination of the water-ice surface by solid organic macromolecules. Laboratory experiments have shown that macromolecules can be produced in gas mixtures and on ices by energetic reactions with carbon, nitrogen, and water.

Borucki *et al.* considered possible sources of energy on Europa and tested the possibility that hypervelocity impacts of small meteors are involved by performing shock wave experiments on ice. Three types of electrical discharges occurred in their experiments: a short-duration pulse associated with the impact; a longer, secondary pulse associated with the propagation of cracks after impact; and a short, tertiary pulse associated with plasma-like reactions. All three types could supply enough energy to create organic macromolecules in Europan ice. — LR

J. Geophys. Res. 10.1029/2002JE001841 (2002).

NEUROSCIENCE

Translating Memories

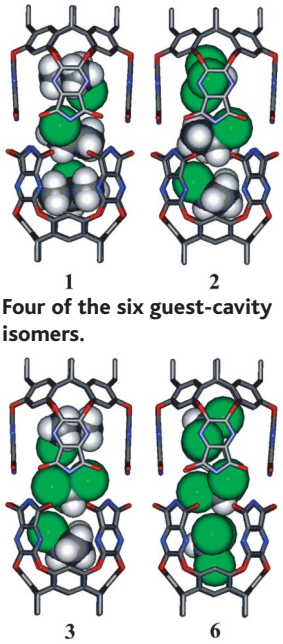
Long-term memory, observed as behavioral plasticity in the whole animal, is expressed at the cellular scale by changes in synaptic transmission (or how neurons communicate with each other). These changes depend on the transcription of genes encoding synaptic proteins and on translation of the corresponding messenger RNAs (mRNAs). To define the molecular players in these acts, Dubnau *et al.* have performed a microarray analysis of flies subjected to a long-term memory protocol and a genetic screen for mutants defective in long-term memory formation. They find a group of candidate genes—including *moesin*, *staufen*, and *pumilio*—whose common characteristic is their involvement in mRNA metabolism (localization, transport, and translation), suggesting that plastic changes in behavior result from synapse-specific mobilization and deployment of mRNAs. — GJC

Curr. Biol. **13**, 286 (2003).

CHEMISTRY

Putting Isomers in Their Place

Normally the isomers of chemical compounds are defined by different sets of covalent bonds or by different stereochemical arrangements at chiral centers. Shivanyuk and Rebek demonstrate a further type of isomerization by trapping guest molecules in molecular capsules. Three molecules of chloroform ($CHCl_3$; 74 cubic angstroms) or isopropyl chloride [$ClCH(CH_3)_2$; 73 cubic angstroms] fit snugly in a 420 cubic angstrom cavity formed by two cavitand molecules. Nuclear magnetic resonance studies show that all six possible arrangements of three guest molecules can be identified. These structures are dynamic, so they can start with the complex containing three isopropyl chloride molecules and titrate in chloroform to create the other isomers. — PDS



Four of the six guest-cavity isomers.

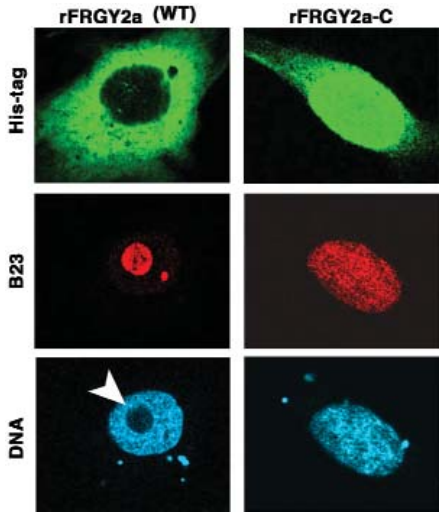
Angew. Chem. Int. Ed. **42**, 684 (2003).

BIOMEDICINE

Tough on the Stomach

About half of the world's population is infected with *Helicobacter pylori*, a bacterial pathogen that can cause stomach ulcers. A major virulence factor in ulcer formation is the bacterial toxin VacA, which appears to disrupt gastric epithelial cell integrity in multiple ways, including alteration of endolysosomal function, enhancement of paracellular permeability, pore formation in the plasma membrane, and apoptosis.

Fujikawa *et al.* describe a new cellular pathway through which VacA may exert its pathogenic effects. VacA-induced gastric injury in mice was found to require Ptprz, a host-encoded protein tyrosine phosphatase receptor expressed on gastric epithelial cells. In an in



Wild-type FRGY2a (green) is excluded from the nucleus (DNA; blue), and nucleoli (B23; red) remain intact (left); C-terminal FRGY2a enters the nucleus and causes nucleoli to disassemble (right).

CELL BIOLOGY

Reversible Disassembly

In animal cloning, nuclei from somatic cells are transplanted into recipient eggs, and the cytoplasm of the egg reprograms the differentiated nucleus so that early development can begin. One stage in this process is the disassembly of the nucleoli—the sites at which ribosomes are assembled—in the donor nucleus. *Xenopus* eggs do not synthesize ribosomal RNA and do not possess nucleoli, which reappear when the embryo reaches the blastula stage. Using *Xenopus* germ cell cytosol, Gonda *et al.* have characterized two proteins, FRGY2a and FRGY2b, which promote nucleolar disassembly when added to isolated somatic nuclei. These proteins were already known to act as transcription factors and to mask maternal messenger RNA in oocytes. Corroborating the role of the proteins in nucleolar dynamics, transfection of the C-terminal fragment of FRGY2a, which enters the nucleus freely and binds to nucleoli, triggered nucleolar disassembly in cells in culture. — SMH

Nature Cell Biol. 10.1038/ncb939 (2003).

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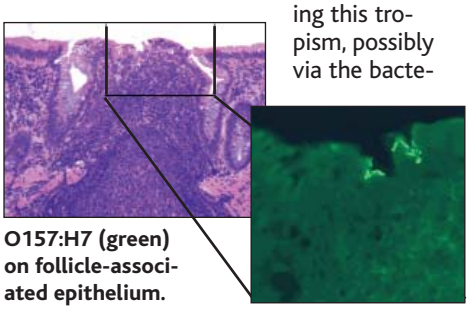
vitro model, binding of VacA to Ptprz caused epithelial cells to detach from the basement membrane, suggesting that ulcers may form because the interaction of these proteins exposes the denuded gastric mucosa to the acidic contents of the stomach. Further study of the cellular pathways affected by VacA will likely facilitate the development of vaccines and diagnostic tests for identifying individuals with a high risk of gastric disease. — PAK

Nature Genet. 10.1038/ng1112 (2003).

MICROBIOLOGY

Supershedders on the Farm

Escherichia coli O157:H7 produce Shiga toxins, which cause bloody diarrhea and potentially fatal systemic infections in humans. Cattle are thought to be the main source of these dangerous organisms, but they themselves show few symptoms of infection. Naylor *et al*. surveyed four strains of O157:H7 in experimentally infected calves. Most bacteria were found in feces, and after necropsy it was observed that the recto-anal tissues contained adherent colonies of O157:H7. These tissues also have a high density of lymphoid follicles, which may be governing this tropism, possibly via the bacterial adhesion protein intimin. By contrast, other *E. coli* serotypes were distributed evenly throughout the large intestine. This is a novel tissue tropism for a pathogen, which appears to be an adaptation to maximizing transmission among natural hosts and one that could also allow ready diagnosis and treatment of the carrier status of a herd. — CA



O157:H7 (green) on follicle-associated epithelium.

CREDITS: NAYLOR *ET AL.*

Inf. Immun. **71**, 1505 (2003).

CLIMATE SCIENCE

Acid Rain = Alkaline Lake

Acid rain has dramatically altered the chemistry of several watersheds and lakes in New England, the western United States, and parts of Europe, particularly in areas where the buffering capacity of soils is low. Many such areas have been studied over the past several decades. But what has the impact been in drainages and lake basins (generally rich in limestone) that are covered in soils with a high pH or buffering capacity? It has been thought that in these areas the impact would be much less or minimal.

Lajewski *et al*. examined this question by studying sediments in the Finger Lakes region of New York, an area that has received copious amounts of acid rain during the 20th century and that has soils with a high buffering capacity. They found that in several of the lakes, authigenic calcite, which had been absent in the sediments for more than 4000 years, began precipitating during the 1970s. Apparently, acid rain in the region, perhaps augmented by soil disturbances, has increased the weathering of carbonate rocks and thus changed the saturation state of carbonate in the lakes. Paradoxically, acid rain in such regions may make waters more basic. — BH

Geol. Soc. Am. Bull. **115**, 373 (2003).

CHEMISTRY

Making a Glowing Polymer

Aluminum tris(8-hydroxyquinoline) or Alq_3 is one of the more stable fluorescent solid-state materials; hence, it is commonly used as the emission and electron transport layers in organic light-emitting diodes (OLEDs). However, the need to deposit Alq_3 in vacuum is incompatible with the current trend toward fabricating OLEDs via a solution process. One option has been to trap Alq_3 within a polymer matrix, and another route has been to couple it to the polymer backbone after polymerization, but these approaches have shown only limited success to date.

Instead, Meyers and Weck have designed a functionalized monomer containing Alq_3. Norbornene was chosen as the polymer backbone because it can be polymerized by ring-opening metathesis, a versatile method that has a high tolerance for many functional groups. The pure polymer exhibited only limited solubility, but this could be remedied by incorporating an aliphatic-norbornene comonomer. The photoluminescence emission spectra of the copolymer in solution was similar to that of the parent Alq_3, and preliminary studies of spin-cast films indicate that this is also the case for the solid-state copolymer. — MSL

Macromolecules 10.1021/ma0259012 (2003).

Making a Glowing Polymer

Marc S. Lavine

Science **299** (5612), 1489.
DOI: 10.1126/science.299.5612.1489c