

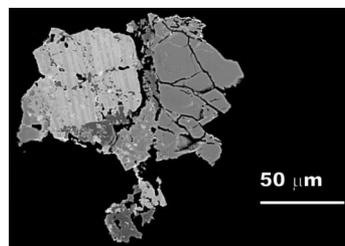
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## ASTRONOMY

## Unique basaltic micrometeorite

Researchers routinely sift Antarctica's snow and ice to find micrometeorites—cosmic dust particles related to chondrites, the most abundant class of meteorites. Matthieu Gounelle et al. report



Electron image of micrometeorite MM40.

the discovery of a unique basaltic micrometeorite, MM40, in the Terre Adélie region of Antarctica. The authors suggest that the micrometeorite is not related to chondrite, and its composition indicates that it was once part of an asteroidal or planetary crust. The sample weighs a few micrograms and consists of two major phases—plagioclase and pyroxene—as well as quartz, typical of basaltic rocks. The presence of a thin magnetite shell at its surface certifies its extraterrestrial nature. The authors conducted numerical dust dynamics simulations, and, based on the results and the nature of the basalt, they say that MM40 may have originated from the recently discovered “non-Vesta” group of basaltic asteroids. — K.M.

*“A unique basaltic micrometeorite expands the inventory of solar system planetary crusts”* by Matthieu Gounelle, Marc Chaussidon, Alessandro Morbidelli, Jean-Alix Barrat, Cécile Engrand, Michael E. Zolensky, and Kevin D. McKeegan (see pages 6904–6909)

## BIOCHEMISTRY

## Turning on catabolism

The catabolite activator protein (CAP) in *E. coli* turns on a variety of energy-generating pathways in response to decreased glucose levels. CAP, a homodimer, binds to DNA, and is activated when it binds the messenger cAMP. Crystal structures have revealed that recognition helices in CAP bind DNA by fitting into successive major grooves, making contact with DNA base pairs and the sugar-phosphate backbone. Although extensive research has been done on cAMP-bound CAP, exactly what conformational change cAMP induces to increase DNA affinity has remained unknown. Nataliya Popovych et al. used solution NMR to obtain the struc-

ture of CAP without cAMP. The authors report that cAMP induces a coil-to-helix transition that lengthens the 2 interacting helices that form the dimerization domain. At the same time, the DNA-binding domains of each monomer are rotated by  $\approx 60^\circ$  and translated by  $\approx 7 \text{ \AA}$ , bringing them into a configuration with high affinity for DNA. The adenine base of cAMP forms hydrogen bonds that cause 2 key residues to reorient, driving the overall transformation; cGMP does not produce the same effect. There are more than 400 members of the CAP/FNR superfamily, and this structure may provide insight into their mechanism of operation, according to the authors. — K.M.



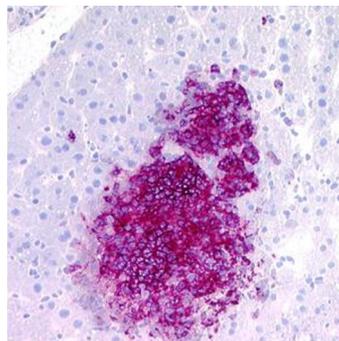
Structural characterization of apo-CAP by NMR.

*“Structural basis for cAMP-mediated allosteric control of the catabolite activator protein”* by Nataliya Popovych, Shiou-Ru Tzeng, Marco Tonelli, Richard H. Ebright, and Charalampos G. Kalodimos (see pages 6927–6932)

## IMMUNOLOGY

## Neutrophil exhaustion in bacterial sepsis

Increased levels of circulating neutrophils, or their absence, can indicate bacterial sepsis. However, the relationship between these contradictory clinical signs and the mechanisms of the body's response to a large influx of bacteria remains unclear. Alexander Navarini et al. inoculated mice with a high dose of *Listeria monocytogenes* and noted an accelerated decrease of bone marrow neutrophils compared to mice inoculated with a low dose of bacteria. In mice with the high dose of *L. monocytogenes*, neutrophils disappeared from organs and bone marrow



Sepsis from *L. monocytogenes* infection.

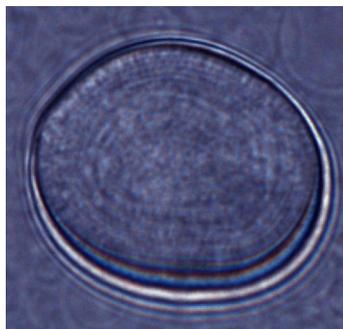
by day 3, and death from sepsis occurred on days 3–5. The administration of bacteria 3 days after a low-dose infection also resulted in signs of neutrophil exhaustion, indicating that activation of the innate immune system played a role in bacterial propagation. Systemic administration of a toll-like receptor 2 ligand during low-dose infection resulted in higher levels of bacterial infiltration with inoculations of *L. monocytogenes*, *Staphylococcus aureus*, *Salmonella typhimurium*, or *Streptococcus pyogenes*. These results suggest a link between activation of the innate immune system and neutrophil exhaustion, a critical factor in mortality from bacterial sepsis, according to the authors. — C.A.

*“Innate immune-induced depletion of bone marrow neutrophils aggravates systemic bacterial infections”* by Alexander A. Navarini, Karl S. Lang, Admar Verschoor, Mike Recher, Annelies S. Zinkernagel, Victor Nizet, Bernhard Odermatt, Hans Hengartner, and Rolf M. Zinkernagel (see pages 7107–7112)

## MEDICAL SCIENCES

### Liposomes release long-lasting local anesthetic

Once the effect of a local anesthetic wears off after surgery, a patient can feel considerable pain. Researchers have attempted to develop slow-release formulations to extend the duration of local anesthesia, but have run into difficulty because conventional anesthetics are toxic to muscle and nerve cells. Hila Epstein-Barash et al. report that saxitoxin, a site 1 sodium-channel blocker, can be effective as a long-term local anesthetic in rats if the compound is formulated in liposomes. Liposomes, which enclose water, are ideal vehicles because saxitoxin is extremely hydrophilic. The authors experimented with 2 lipid formulations—resulting in fluid



Saxitoxin-loaded liposome.

or solid liposome bilayers—and compared the effect of saxitoxin with or without dexamethasone, a potent steroid known to augment the action of encapsulated anesthetics. Saxitoxin liposomes proved to be effective slow-release anesthetics without the tissue toxicity of the conventional anesthetic bupivacaine, which was used as a control. Solid liposomes had the slowest release and provided nerve block for 48 hours if they contained saxitoxin alone, or 7 days if partnered with dexamethasone. Extensive work is needed to optimize the formulation before the method could be used in humans, according to the authors. — K.M.

*“Prolonged duration local anesthesia with minimal toxicity”* by Hila Epstein-Barash, Iris Shichor, Albert H. Kwon, Sherwood Hall, Michael W. Lawlor, Robert Langer, and Daniel S. Kohane (see pages 7125–7130)

## NEUROSCIENCE

### Steroids not the only story

Testosterone imparts the dimorphic nature of the neurons that control sexual function differently in males and females, but the hormone is not present during the most extensive period of fe-

tal brain development. Recent mouse studies have revealed that the cause of sex-linked behavioral traits goes beyond testosterone, bringing to light a role for the hormone Müllerian inhibiting substance (MIS). Pei-Yu Wang et al. investigated the potential role of MIS, which is responsible for regression of the Müllerian ducts, or uterine precursors, in male fetuses. Although MIS levels in males remain high until puberty, researchers are unsure of the compound’s effects on the animals. The authors found that most neurons in mice have an MIS receptor, then they charted the behaviors of male and female mice missing the gene for MIS or its receptor. Male mice missing either of these, while still undoubtedly male, showed a feminization of some behavioral traits, implicating a role for MIS well beyond gestation, according to the authors. — T.H.D.



Neuron-specific expression of MIS-RII in the cerebellum.

*“Müllerian inhibiting substance contributes to sex-linked biases in the brain and behavior”* by Pei-Yu Wang, Anna Protheroe, Andrew N. Clarkson, Floriane Imhoff, Kyoko Koishi, and Ian S. McLennan (see pages 7203–7208)

## PLANT BIOLOGY

### Male flower parts produce perfume

Exactly which parts of a flower synthesize its scent has been explored in only a few plant species, such as snapdragon, tobacco, and roses. Focusing specifically on the *V. vinifera* L. cv. Cabernet Sauvignon species, Diane Martin et al. traced the source of the potent perfume to the male floral parts. The authors linked fragrant compounds called sesquiterpenoid volatiles to the tiny green flowers that speckle the common grapevine. Perfume release, the authors found, is light dependent and occurs only once a day, early in the morning. The actual sesquiterpene volatiles are concentrated in the anthers before and while the flowers bloom. Initially, the compounds are stored inside the pollen grains, and later on the outer surface. The fragrances emitted by the flowers not only attract pollinators, but deter herbivores and pathogens, according to the authors. — B.P.T.



Pollen is released from the anthers. Courtesy Diane M. Martin.

*“The bouquet of grapevine (Vitis vinifera L. cv. Cabernet Sauvignon) flowers arises from the biosynthesis of sesquiterpene volatiles in pollen grains”* by Diane M. Martin, Omid Toub, Angela Chiang, Bernard C. Lo, Sebastian Ohse, Steven T. Lund, and Jörg Bohlmann (see pages 7245–7250)