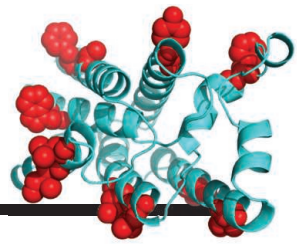
RESEARCH

Rhomboid protein can speed through membranes

Kreutzberger et al., *p. 497*



IN *SCIENCE* JOURNALS

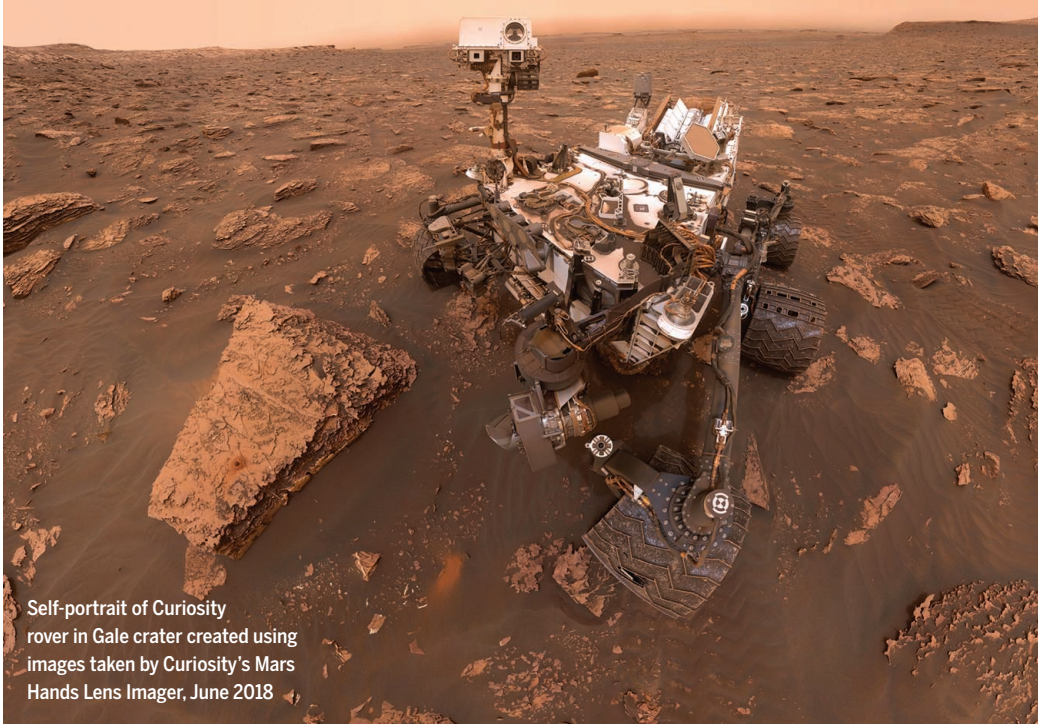
Edited by **Stella Hurtley**

MARTIAN GEOLOGY

Teaching Curiosity to do gravimetry

Gravimetry—the measurement of tiny changes in gravitational fields—can be used to weigh mountains. Large-scale gravimetric mapping can be done from orbit, but examining small details requires a vehicle on the ground. The Curiosity rover on Mars carries several accelerometers used for routine navigation. Lewis *et al*. recalibrated these accelerometers to allow them to be used for gravimetry. They measured how the local gravitational field changed as the rover moved through Gale crater and began to climb Aeolis Mons (Mount Sharp). The resulting density of material under Gale crater shows that it is relativity porous, disproving a theory that the crater floor was once buried under several kilometers of rock. —KTS

Science, this issue p. 535



Self-portrait of Curiosity rover in Gale crater created using images taken by Curiosity's Mars Hands Lens Imager, June 2018

NEUROSCIENCE

Flipping behavior under threat

Could it be that the brain in a state of emergency or under intense threat operates in a fundamentally different way? Seo *et al*. found that mice paused when serotonin neurons were transiently stimulated in low- or medium-threat environments, but when this same neural population was stimulated in high-threat environments, mice tried to escape. Recordings from these neurons indicated that movement-related neural tuning flipped between environments. Neural activity decreased when movement was initiated in low-threat environments but increased in high-threat environments. —PRS

Science, this issue p. 538

PHYSIOLOGY

Sleep-promoting molecule found in flies

Even the humble fruit fly needs sleep. Toda *et al*. screened ~12,000 fruit fly lines and identified a single sleep-promoting molecule encoded by a gene they named *nemuri* (Japanese for "sleep," abbreviated *nur*) (see the Perspective by Oikonomou and Prober). NEMURI (or NUR) is an antimicrobial peptide secreted from neurons that also promotes sleep. Overexpression of NUR helps flies survive a bacterial infection, and increased sleep helps in fighting infection; thus, NUR mediates a two-pronged strategy. Secretion of NUR also appears to underlie the sleepiness observed in sleep-deprived flies. —LBR

Science, this issue p. 509; see also p. 455

POLYMERS

Working harder, getting stronger

Self-healing polymers attempt to restore mechanical strength after deformation. Polymer gels tend to be too soft for this to occur. Matsuda *et al*. generated self-healing hydrogels composed of a double-network material (see the Perspective by Craig). A mechanical stress breaks the more brittle of the two networks, while the other retains stability. On breakage, the fractured chains create radical initiators that polymerize new network material. With repeated network breakage and a supply of monomers, the gel gets stronger. —MSL

Science, this issue p. 504; see also p. 451

OCEAN CIRCULATION

An array of overturning data

The Atlantic meridional overturning circulation (AMOC) has

(PHOTO) NASA/JPL-CALTECH/MSSS; (GRAPHIC) KREUTZBERGER *ET AL.*

a strong influence on climate, so it is important to understand how global warming may affect it. Lozier *et al*. report initial results from the Overturning in the Subpolar North Atlantic Program (OSNAP) (see the Perspective by Rhein). OSNAP has been measuring the flux of water transported by overturning in the high latitudes in the North Atlantic. The measurements reveal the strong variability of transport in the region and show that deep water formation in the Labrador Sea may not, as previously believed, be the major determinant of AMOC variability. —HJS

Science, this issue p. 516; see also p. 456

ATOMIC PHYSICS

Seeing patterns in atomic jets

Atomic interactions in a Bose-Einstein condensate (BEC) can lead to complex collective behavior. Experimentally, these interactions are often tuned by varying an external magnetic field. Feng *et al*. modulated the interaction among cesium atoms in a BEC. The collisions between atoms exposed to the modulated field sent the atoms flying out of the condensate in jets of seemingly random directions. A pattern-recognition technique revealed that certain directions were associated with particularly large numbers of scattered atoms. The pattern of the scattering maxima could be attributed to secondary collisions. —JS

Science, this issue p. 521

CANCER

Sending tumors a message

T cells need to overcome an immunosuppressive environment for successful cancer immunotherapy. Hewitt *et al*. leveraged a platform for messenger RNA (mRNA) delivery to devise a combination of factors that would ramp up antitumor immunity. Intratumoral injection of three specific mRNAs led to tumor regression in several cancer models. The triplet therapy also rendered normally resistant tumors susceptible to immunotherapeutic checkpoint blockade, activity which could one day be translated to human patients. —LP

Sci. Transl. Med. **11**, eaat9143 (2019).

MACHINE LEARNING

A robot combines senses to learn Jenga

A robot exploring a collapsed building has to both see and feel in order to learn what observed objects can be moved. This integration of different sense data is difficult, so most robots learn with only one. Fazeli *et al*. taught a robot with both a camera and force sensors to play Jenga. The robot started by looking at the tower and lightly pushing blocks and observing the effects. It integrated this sight and touch information to learn "concepts" of how the blocks moved. Using these concepts, the robot successfully extracted 11 blocks in a row. —RLK

Sci. Robot. **4**, eaav3123 (2019).

GENETIC EVOLUTION

How natural selection affects mouse coat color

Evolution, at its core, involves changes in the frequency of alleles subject to natural selection. But identifying the target of selection can be difficult. Barrett *et al*. investigated how allele frequencies affecting pigmentation change over time (see the Perspective by Pelletier). Wild-caught mice (*Peromyscus maniculatus*) were exposed to avian predators against naturally occurring dark or light backgrounds. Natural selection yielded shifts in coloration owing to genetic variants in the mouse coat color *Agouti* gene. —LMZ

Science, this issue p. 499; see also p. 452

IN OTHER JOURNALS

Edited by **Caroline Ash** *and* **Jesse Smith**

A single pathway protects against skin infection and wrinkling.

SKIN BIOLOGY

Benefits of fat

Wrinkles are a natural part of aging and are largely caused by the breakdown of the nutrient-rich fat layer under our skin. Subcutaneous fat cells (adipocytes) not only provide volume and plumping but also produce antimicrobial peptides that help protect against skin infection. Zhang *et al*. studied how specialized cells called dermal fibroblasts transform into adipocytes from birth to adulthood. Activation of the protein transforming growth factor–β (TGF-β) reduced the production and quality of adipocytes and impaired antimicrobial defense. The study raises the possibility that drugs targeting the TGF-β pathway might have a double benefit of tackling wrinkles and skin infection. —PNK

Immunity **50**, 121 (2019).

PHOTO: ERIN SCOTT

ALSO IN *SCIENCE* JOURNALS

Edited by **Stella Hurtley**

MEMBRANE PROTEINS

How rhomboid proteases act so quickly

How enzymes catalyze reactions in the viscous cell membrane is poorly understood. Kreutzberger *et al*. visualized single molecules of rhomboid intramembrane proteases diffusing in defined nanofabricated membranes and live cells (see the Perspective by Wolfe). They found that the rhomboid protein fold distorts surrounding lipids to reduce local membrane viscosity and enhance enzyme diffusion. The rate of catalysis in cells relies on rapid diffusion, revealing that rhomboid's diffusion has been boosted beyond the normal "speed limit" of the membrane, augmenting the search for substrates. —SMH

Science, this issue p. 497; see also p. 453

TUBERCULOSIS

A wrench in the gears of life

Tuberculosis is a global health crisis that threatens to become worse as resistance to existing drugs emerges. Identifying ideal targets for drug development requires knowledge of weak points in biochemical pathways that are specific for the pathogen but are absent in hosts. Ballinger *et al*. identified a small molecule that inhibits the enzyme phosphopantetheinyl transferase (PptT), which is crucial for biosynthesis of mycobacterial structural and virulence lipids (see the Perspective by Mizrahi and Warner). Treatment resulted in selective killing of the bacteria in vitro and in a mouse model. The target pathways were made sensitive to PptT inhibition by a second enzyme, phosphopantetheine hydrolase, whose activity opposes that of the transferase. —MAF

Science, this issue p. 498; see also p. 457

ELECTRON MICROSCOPY

Mapping isotopically labeled alanine

Electron microscopy of organic materials must avoid the destructive effects of electron beam impact. One approach is to measure vibrational spectra with electron energy-loss spectroscopy in a mode where the electron beam grazes the sample and couples to it through evanescent modes. Hachtel *et al*. used such methods to probe carbon-12– and carbon-13–labeled alanine crystals, which exhibited an isotopic shift in the asymmetric carbon-oxygen stretching mode. They used this property to map the distribution of labeled clusters of alanine on length scales of tens of nanometers. —PDS

Science, this issue p. 525

QUANTUM IMAGING

Quantum beacons for enhanced imaging

Imaging an object is simply a case of collecting the light that is scattered from that object. However, if the object is embedded in or separated by a complex medium (tissue or atmosphere, for example), then the light is scattered, the wavefront of the light is muddled, and the image quality is reduced. Adaptive optics techniques use "guidestars" or "reference beacons" to undo the wavefront mixing and sharpen up the image. Kim and Englund show that nitrogen vacancy centers in diamond can be used as quantum reference beacons to enable superresolution focusing inside a scattering medium. The technique should be useful for quantum enhanced imaging and sensing applications. —ISO

Science, this issue p. 528

BLACK HOLE PHYSICS

Oscillating x-rays reveal black hole spin

When a star passes close to a massive black hole (MBH), it is ripped apart by the strong tidal forces. As the resulting debris falls toward the MBH, it heats up, emitting light and x-rays in a tidal disruption event (TDE). Pasham *et al*. examined x-ray observations of a TDE that occurred in 2014. The x-ray emissions varied in a quasi-periodic oscillation every 131 seconds. The rapid rate of this oscillation could only have arisen from material orbiting close to the MBH's event horizon, which indicates that the MBH is spinning rapidly. —KTS

Science, this issue p. 531

TUMOR IMMUNOLOGY

Rescuing T cell glycolysis

One reason T cells in the tumor microenvironment (TME) become dysfunctional is that they compete with cancer cells for nutrients, particularly glucose. Gemta *et al*. studied the glucose metabolism of $CD8^+$ T cells in the TME of mouse B16 and human melanomas. They found that the activity of enzyme enolase 1 was impaired. Enolase 1 catalyzes the synthesis of phosphenolpyruvate, which is dephosphorylated to generate pyruvate, the end product of glycolysis. In vitro, provision of pyruvate considerably improved the effector functions of $CD8^+$ T cells isolated from murine melanomas. Pinning down enolase 1 as the rate-limiting step in glucose metabolism of tumor-infiltrating T cells may suggest that targeting enolase 1 activity could be used to improve cancer immunotherapy. —AB

Sci. Immunol. **4**, eaap9520 (2019).

PHARMACOLOGY

SP3 is key to Smac mimetic efficacy

Finding drugs that selectively target tumor cells and spare healthy tissue is challenging. Smac is a mitochondrial protein that is released into the cytosol during apoptosis. Smac mimetic compounds block antiapoptotic machinery and induce production of the cytokine tumor necrosis factor–α. Smac mimetics have emerged as promising cancer therapies. Beug *et al*. found that the transcription factor SP3 critically mediates the effects of Smac mimetics and is more abundantly expressed in tumors than in normal tissues from the same patients. Thus, SP3 may provide a biomarker for patients that will best respond to and tolerate these drugs. —LKF

Sci. Signal. **12**, eaat9563 (2019).

BIOPHYSICS

Magnetic fields and cell growth

Our world is saturated with low-level magnetism. Powerful magnetic fields can alter biological processes like the growth of cells and tissues, but what about lower levels? Van Huizen *et al*. applied magnetic fields of less than 1 millitesla to the stem cells of flatworms. Fields from 100 to 400 microtesla slowed cell growth, whereas fields greater than 500 microtesla increased growth. A 45-microtesla field, corresponding to ambient magnetism typical of Earth, provided a control condition. Although therapeutic applications are still far off, these findings hold promise for stimulating cellular generation or for muting growth of cancer cells. —PJB

Sci. Adv. 10.1126/sciadv.aau7201 (2019).