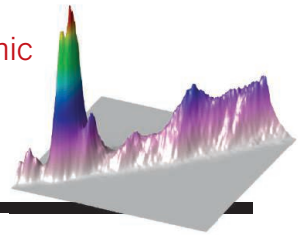
RESEARCH

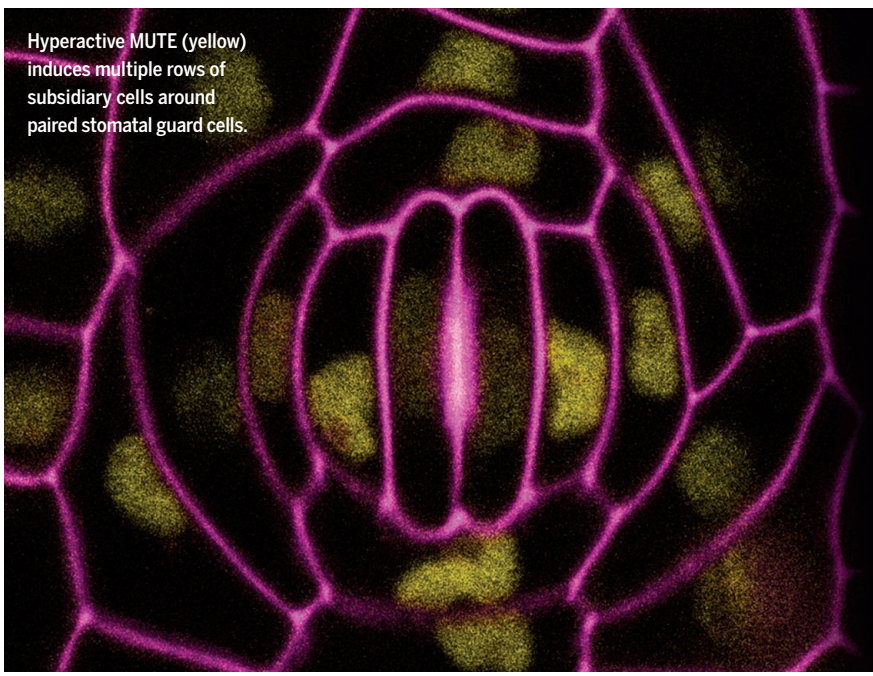
Conductivity links at the atomic scale in gold and platinum

Cui et al., *p. 1192*



IN *SCIENCE* JOURNALS

Edited by **Stella Hurtley**



Hyperactive MUTE (yellow) induces multiple rows of subsidiary cells around paired stomatal guard cells.

PLANT SCIENCE

Making more of your stomata

Stomata on grasses are made up of two guard cells and two subsidiary cells, and they perform better than stomata on broad-leaved plants, which are made up only of two guard cells. Raissig *et al.* found that the MUTE transcription factor in the wheat-like grass *Brachypodium* is a little bigger than the equivalent protein in the model broad-leaved plant *Arabidopsis*. The extension in the grass protein promotes its movement into adjacent cells, prompting them to become subsidiary cells. Mutant *Brachypodium* whose MUTE protein could not move between cells lacked stomatal subsidiary cells and grew poorly. —PJH

Science, this issue p. 1215

CIRCADIAN RHYTHMS

Molecular clockwork from cyanobacteria

The cyanobacterial circadian clock oscillator can be reconstituted in a test tube from just three proteins—KaiA, KaiB, and KaiC—and adenosine triphosphate (ATP). Tseng *et al.* studied crystal and nuclear magnetic resonance structures of complexes of the oscillator proteins and their signaling output proteins and tested the in vivo effects of structure-based mutants. Large conformational changes in KaiB and ATP hydrolysis by KaiC are coordinated with binding to output protein, which couples signaling and the day-night transitions of the clock. Snijder *et al.* provide complementary analysis of the oscillator proteins by mass spectrometry and cryo–electron microscopy. Their results help to explain the structural basis for the dynamic assembly of the oscillator complexes. —LBR

Science, this issue p. 1174, p. 1181

NANOMATERIALS

Lifting off gold films

A method for growing and removing single-crystal gold films can be used to create a flexible and transparent substrate for devices. Mahenderkar *et al*. grew gold films on the face of a silicon wafer and then used photoelectrochemistry to undergrow a sacrificial silicon dioxide layer. This layer allowed the gold film to be peeled off with adhesive tape. A 28-nm-thick gold foil showed a minimal increase in sheet electrical resistance after 4000 bending cycles. Flexible films of single-crystal cuprous oxide and of zinc oxide nanowires were then grown on the gold foils. —PDS

Science, this issue p. 1203

GEOCHEMISTRY

Archean cratons get a Hadean mash-up

The vast majority of the rock record over Earth's 4.6-billion-year history has been destroyed through subduction and recycling back into the mantle. Although some slivers of 4-billion-year-old crust remain in the rock record, only isolated zircon mineral grains are dated to be older. However, O'Neil and Carlson found isotopic evidence of reworked basaltic crust more than 4.3 billion years old mixed into some of the 2.7-billion-year-old rocks of the Superior Province in Canada. Thus, our planet's oldest crust was reworked and retained during formation of at least one continental craton. —BG

Science, this issue p. 1199

NANOPHOTONICS

Putting plasmons in a spin

The ability of light to carry angular momentum provides an additional degree of freedom for applications such as optical tweezing and optical communication. Spektor *et al*. show that the optical angular momentum modes of light can be shrunk down to the nanometer scale through plasmonic transfer. They patterned spiral-like structures into an atomically smooth layer of gold, which allowed them to launch plasmons with controlled amounts of angular momentum. —ISO

Science, this issue p. 1187

CREDITS: (TOP TO BOTTOM) CUI *ET AL.*; MICHAEL RAISSIG

Published by AAAS

ANTIBIOTICS

Countering TB prodrug resistance

The arsenal of antibiotics for treating tuberculosis (TB) contains many prodrugs, such as ethionamide, which need activation by normal metabolism to release their toxic effects. Ethionamide is potentiated by small molecules. Blondiaux *et al*. screened for more potent analogs and identified a lead compound called SMARt-420. This small molecule inactivates a TetR-like repressor, EthR2, and boosts ethionamide activation. SMARt-420 successfully promoted clearance of multidrug-resistant strains of *Mycobacterium tuberculosis* from the lungs of mice. —CA

Science, this issue p. 1206

DIAGNOSTICS

Finding the right blood type

Blood type matching is important for pregnancy, blood transfusion, and bone marrow transplantation. Zhang *et al.* developed a blood typing assay based on color changes assisted by a common pH indicator dye. Red blood cells (RBCs) and plasma were separated from small blood samples by using antibodies immobilized on paper test strips. The assays allowed forward grouping (detecting A and/or B antigens on RBCs) and reverse grouping (monitoring agglutination between RBCs and anti-A and/or anti-B antibodies in plasma) within 2 min. The test could also perform Rh and rare blood typing. This economical and robust assay will be useful in time- and resource-limited environments. —CC

Sci. Transl. Med. **9**, eaaf9209 (2017).

A traditional blood typing assay

INFECTION

The parasite of my parasite is my friend?

Virulence factors of pathogenic bacteria can be swapped by means of bacterial viruses called phages. In turn, the pathogenic bacteria are under attack by the hosts' immune responses. Diard *et al*. discovered that SopEϕ, a phage parasite of pathogenic *Salmonella* species, is encouraged to spread between bacteria by the mouse host's inflammatory responses. Conversely, mucosal vaccination against *Salmonella* reduced inflammatory responses and curbed the transfer of SopEϕ to naïve bacteria. —CA

Science, this issue p. 1211

WEARABLE TECHNOLOGY

Sensing touch without touching

Electronic devices that can be integrated into clothing or worn on skin will provide wearable approaches for monitoring human health or motion. Success depends on the development of bendable, stretchable sensors that respond to touch. Sarwar *et al.* developed sensors based on conductive hydrogel polymer electrodes embedded in a flexible polymer framework. The sensors responded to touch, even when bent or stretched, and were also able to sense an approaching finger. The low-cost, easily manufactured sensors could accelerate the adoption of wearable technology. —LA

Sci. Adv. 10.1126. sciadv.1602200 (2017).

IN OTHER JOURNALS

Edited by **Sacha Vignieri** *and* **Jesse Smith**

AGRICULTURE

Remote sensing for analyzing smallholder farm yields

Smallholder farmers are key to local food security, but their productivity, or lack thereof, is buried when agricultural statistics are discussed at the scale of regions and nations. Household surveys are hampered by errors in self-reporting, and on-the-ground field surveys are constrained by limited personnel. Burke and Lobell combined high-resolution satellite imagery (at the scale of 1 m) with ground-truthed data to estimate yields from maize agriculture in western Kenya, where many of the fields are less than half an acre in size and irregularly shaped. Measurements of canopy greenness captured evidence of nutrient deficiencies. Productivity differed by as much as threefold even between neighboring plots, suggesting opportunities for yield improvement through changes in field management. —PJH

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1616919114 (2017).

Remotely sensed estimates of nutrient value reveal differences among local farms in Kenya.

GEOPHYSICS

Sand-driven magnetic field

Earth's magnetic field is due to convection of its liquid iron-nickel core, which also contains an unknown amount of lighter elements such as silicon, oxygen, and sulfur. Hirose *et al.* performed experiments that show that silica unexpectedly crystallizes out of a liquid iron alloy at high pressures and temperatures. This discovery identifies a source of compositional buoyancy that would have driven the convection needed for a magnetic field very far back in Earth's history. It also sets a limit on how much silicon and oxygen remain in the outer core today. —BG

Nature 10.1038/nature21367 (2017).

PSYCHOLOGY

Microaggression actions outpace evidence

Efforts to combat prejudice in workplaces and on campuses by targeting microaggressions lack solid foundations in psychological research. Lilienfeld, who supports microaggression research, surveyed evidence and identified 18 research priorities—for example, better define what is not a microaggression, and do not confound the frequency of microaggressions with the subjective distress that they evoke. He suggests tempering assertions about causal links between microaggressions and adverse mental health and proposes a moratorium on intervention programs that may create more problems than they solve. —BW

Perspect. Psychol. Sci. 10.1177/1745691616659391 (2017).

MALARIA

Softening up your target

During infection, malaria parasites must invade erythrocytes. Erythrocytes are flexible cells that can easily deform to make it through the tight spaces of the vasculature, but they are nevertheless fortified by a

PHOTOS: (LEFT TO RIGHT) BSIP SA/ALAMY STOCK PHOTO; HAILEY TUCKER/ONE ACRE FUND

ALSO IN *SCIENCE* JOURNALS

Edited by **Stella Hurtley**

NEURODEVELOPMENT

The lights go on in order

Grid cells and place cells in the brain function as part of a circuit that helps us figure out where we are in our physical world. Donato *et al*. examined how that circuit develops in the brains of mice. Expression patterns of doublecortin and parvalbumin revealed that neurons in the circuit mature in the order in which information flows. Maturation of each piece of the circuit depends on excitatory neuronal activity from the preceding portion. Stellate cells, in contrast, follow an endogenous maturation program. The stellate cells are responsible for initiating the circuit's developmental progression. —PJH

Science, this issue p. 1172

PHYSIOLOGY

Uridine's rise and fall: Food for thought

The nucleoside uridine is well known for its role in critical cellular functions such as nucleic acid synthesis. Its role in whole-animal physiology has received comparatively little attention. In mammals, plasma uridine levels are tightly regulated, but the underlying mechanisms are unclear. Studying mouse models, Deng *et al*. show that plasma uridine levels are controlled by feeding behavior (see the Perspective by Jastroch and Tschöp). Fasting causes an adipocyte-mediated rise in plasma uridine, which triggers a lowering of body temperature. Feeding causes a bile-mediated drop in plasma uridine, which enhances insulin sensitivity in a leptin-dependent manner. Thus, uridine is part of a complex regulatory loop that affects energy balance and potentially contributes to metabolic disease. —PAK

Science, this issue p. 1173; see also p. 1124

METALLURGY

Heavy hydrogen gets frozen in place

Hydrogen embrittlement contributes to the failure of steel in a wide variety of everyday applications. Various strategies to mitigate hydrogen embrittlement, such as adding carbides into the steel, are hard to validate because we are unable to map the hydrogen atoms. Chen *et al*. combined fluxing steel samples with deuterium and a cryogenic transfer protocol to minimize hydrogen diffusion, allowing for detailed structural analysis (see the Perspective by Cairney). Their findings revealed hydrogen trapped in the cores of the carbide precipitates. The technique will be applicable to a wide range of problems, including corrosion, catalysis, and hydrogen storage. —BG

Science, this issue p. 1196; see also p. 1128

NANOSCALE TRANSPORT

Calorimetry reaches an atomic junction

Electrical and thermal conductivity in metals are linked at the macroscopic length scale because electrons carry both heat and current. Cui *et al*. found that this relationship, the Wiedemann-Franz law, holds down to the atomic scale in gold and platinum (see the Perspective by Segal). They made thermal and electrical conductance measurements through a point contact only one atom thick. In gold, the thermal and electrical conductance was quantized, owing to the electronic band structure of the metal. The experiments pave the way for high-resolution calorimetry and other thermal measurements at the nanoscale. —BG

Science, this issue p. 1192; see also p. 1125

AGING

Protein aggregation–mediated aging in yeast

Old age in yeast cells results in insensitivity to mating pheromone. Reduced activity of the histone deactylase Sir2 and consequent alteration of chromatin at mating loci have been implicated in the decreased sensitivity of old cells. However, Schlissel *et al*. found a different mechanism in the yeast strains that they studied (see the Perspective by Gitler and Jarosz). Proper response to mating pheromone requires arrest of the cell cycle mediated by an RNA-binding protein, Whi3. If aggregation of Whi3 in old cells was inhibited by deletion of a glutamine-rich region that promotes aggregation, loss of sensitivity to mating pheromone was partially prevented, and replicative life span was slightly increased. —LBR

Science, this issue p. 1184; see also p. 1126

CROP DEVELOPMENT

Promise and challenges of gene editing

With traditional plant breeding approaches, it can take a decade or more to develop a new crop. In a Perspective, Scheben and Edwards highlight recent efforts to use the gene editing technology CRISPR-Cas9 for faster plant breeding. This technology can yield an improved experimental crop in just one generation, but the genetic sequence and function of the target gene must be known. Public acceptance and appropriate regulation by governments will be necessary for the technology to be adopted widely. —JFU

Science, this issue p. 1122

LANGUAGE DEVELOPMENT

Nonhuman primates model language evolution

Nonhuman primates were long seen as lacking many of the key elements that enable language in humans. In a Perspective, Snowdon discusses recent research that challenge this assumption: Marmosets and chimpanzees are able to take turns, macaques and baboons have a vocal tract that is capable of human-like speech, and several primate species can learn or modify sounds in response to environmental or social variables. Apes also communicate through complex gestures. As long as the many components that make up speech and language are considered, much can be learned about language evolution from studying nonhuman primates. —JFU

Science, this issue p. 1120

CANCER

Melanoma cells talk to keratinocytes

Although identifying cancer-driving mutations is important, therapeutics usually target proteins, and tumor progression is affected by nearby cells. Ostalecki *et al.* performed protein profiling in skin samples from human melanoma patients. They observed changes in the levels and subcellular localization of proteins in melanocytes and keratinocytes that were associated with various stages of melanoma development. Early-stage melanoma cells transferred a pair of proteins to adjacent normal keratinocytes, leading to altered protein levels and secretion. Inhibiting this intercellular communication might be therapeutically beneficial for melanoma patients. —LKF

Sci. Signal. **10**, eaai8288 (2017).

ASTHMA

NK cells in severe asthma: Failed resolution

Anti-inflammatory corticosteroids are a first line of defense against many types of asthma, but individuals with severe asthma frequently do not respond to this therapy. Duvall *et al.* report that this lack of response may be due in part to defects in natural killer (NK) cells, which are important mediators of inflammation resolution. NK cells from patients with severe asthma had impaired killing abilities, and corticosteroids inhibited the function of these cells further. The proresolving mediator LXA_4 preserved NK cell effector mechanisms. Thus, corticosteroids may be counterproductive for severe asthma, and specifically activating NK cells may provide an alternate therapeutic target. —ACC

Sci. Immunol. **2**, eaam5446 (2017).