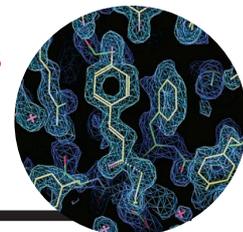


# RESEARCH

X-ray free electron lasers  
reveal protein dynamics

Tenboer et al., p. 1242



## IN SCIENCE JOURNALS

Edited by Stella Hurtley

### OCEANOGRAPHY

## Bringing up the problem of ice shelf melting

**W**arm water intruding from below is heating up the ocean that covers the continental shelf of Antarctica. Schmidtko *et al.* report that Circumpolar Deep Water has been warming and moving further up onto the shelf around Antarctica for the past 40 years, causing higher rates of ice sheet melting (see the Perspective by Gille). These observations need to be taken into account when considering the potential for irreversible retreat of parts of the West Antarctic Ice Sheet. — HJS

*Science*, this issue p. 1227; see also p. 1180

Ice shelf melting  
in the Antarctic



### ANIMAL PHYSIOLOGY

## Eels shock their prey into risky behavior

Electric eels can deliver a shock powerful enough to immobilize a horse, but their true targets are smaller fish and invertebrate prey. Now, Catania suggests that electric eels “remotely control” their prey’s movements. The electrical discharge causes whole-body contraction and twitch in the prey by affecting motor neurons rather than muscles directly. This first stimulates prey to move and reveal itself and then to freeze, allowing its capture. — SNV

*Science*, this issue p. 1231

Sreeramkumar *et al.* found that mouse neutrophils rely on platelets to help find such sites. Neutrophils extended protrusions into blood vessels. When these protrusions came into contact with platelets, the neutrophils migrated into the surrounding tissue to carry out their inflammatory functions. Preventing these neutrophil-platelet interactions alleviated collateral inflammatory damage to tissues in several injury models in mice. — KLM

*Science*, this issue p. 1234

### CHEMICAL KINETICS

## Theoretical chemistry can withstand the pressure

Theoretical methods can predict the chemical consequences of a discrete molecular collision in exquisite detail. However, practical chemistry, whether in a flame, in Earth’s atmosphere, or in an industrial reactor, involves billions of trillions of such collisions. Predicting the aggregate reaction rate requires an accurate means of treating the pressure dependence. Jasper

*et al.* present such a method, which shows strong agreement with experimental measurements (see the Perspective by Pilling). Unlike past approaches that require parameters

derived from empirical fits to data, the new technique relies strictly on simulations. — JSY

*Science*, this issue p. 1212; see also p. 1183

### HERPES SIMPLEX VIRUS

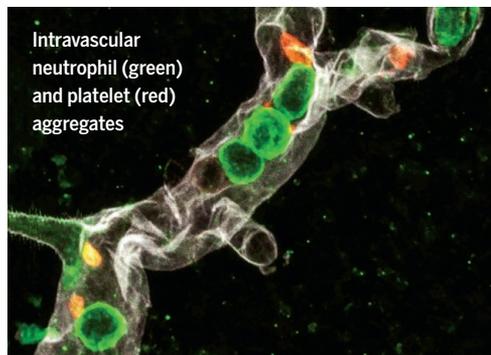
## Epigenetic control during herpes virus infection

Epigenetic modifications are a sort of genetic metadata—they alter gene expression without changing the underlying DNA. Hill *et al.* hypothesized that epigenetic modification could be exploited for treating herpes virus infection. Herpes virus infection and reactivation from latency depends on the histone demethylases LSD1 and JMJD2, which are responsible for making epigenetic marks on chromosomes. Epigenetic modifications inhibited viral infection in animal models that represent three different stages of herpes simplex virus infection: suppression of primary infection, a block

### INFLAMMATION

## A two-cell collaboration for inflammation

Immune cells called neutrophils are first responders to infection. Neutrophils move within and through blood vessels to get to sites of infection quickly.



Intravascular  
neutrophil (green)  
and platelet (red)  
aggregates

PHOTOS: (TOP TO BOTTOM) TENBOER ET AL.; © WORLD TRAVEL COLLECTION/LAMY; SREERAMKUMAR ET AL.

to subclinical shedding, and reduction in recurrent lesions.

— ACC

*Sci. Transl. Med.* **6**, 265ra169 (2014).

## HUMAN CAPITAL

### An ounce of prevention is better than violence

Children and adolescents spend a large fraction of their lives in schools. Many discussions about improving adult behavior focus on improving cognitive skills. Nevertheless, retrospective analyses also highlight the importance of noncognitive skills. Heller reports on the positive effects of a Chicago program that offered disadvantaged youths 25 hours per week of summer employment. Youths enrolled in this program committed fewer violent crimes for at least a year after the summer job ended. — GJC

*Science*, this issue p. 1219

## VALLEYTRONICS

### Using light to manipulate atomic valleys

The electronic structure of atomic layers of transition-metal dichalcogenides, such as  $WSe_2$ , has two distinct valleys with equal energies. Knowing which valley an electron comes from can make it a carrier of information. Kim *et al.* used optical methods to distinguish between the valleys. They shone circularly polarized light on a sample of  $WSe_2$ , which caused the energy needed to create an exciton—a bound state of an electron and a hole—to shift in one valley but not the other. The method may enable the manipulation of the valley degree of freedom for use in quantum information processing. — JS

*Science*, this issue p. 1205

## TRANSCRIPTION

### Unpacking for travel to the nuclear interior

The position of a gene within the cell nucleus is correlated with its activity. Those near the nuclear periphery are generally repressed, whereas those in the

center are (or will be) active. It is not clear whether this relocalization is a cause or a consequence of gene regulation. Therizols *et al.* found that transcriptional activation or simply chromatin decondensation both drove the relocation of genes to the interior of the nucleus. The nuclear position was maintained in daughter cells, suggesting that the cell has an epigenetic memory of the gene's position within the nucleus. — GR

*Science*, this issue p. 1238

## PLANT GENETICS

### Dominance cascades in self-incompatibility

Plants often cannot use their own pollen to set seed. This is known as self-incompatibility. Although some of the underlying genetics and mechanisms of self-incompatibility are understood, the evolution and maintenance of the system have remained mysterious. Durand *et al.* identified a collection of small RNAs and their respective matching targets within a self-incompatibility locus in *Arabidopsis halleri*. A subset of these alleles functioned in a dominant manner, which helps to explain how self-incompatibility is maintained. — LMZ

*Science*, this issue p. 1200

## BIOCHEMISTRY

### Cancer by activating a binding partner

Some cancers are associated with mutations that increase the activity of members of the EGFR family of tyrosine receptor kinases, such as HER1. Although HER3 has little kinase activity, it can contain cancer-associated mutations. HER3 binds to other EGFR family members that do have kinase activity. Littlefield *et al.* crystallized the kinase domain of HER1 bound to the kinase domain of normal HER3 or HER3 with cancer-associated mutations. Cancer-associated mutations in HER3 increased its binding to and allosteric activation of HER1. — NRG

*Sci. Signal.* **7**, ra114 (2014)

## IN OTHER JOURNALS

Edited by Kristen Mueller and Jesse Smith



A shipworm removed from its wooden burrow

## MICROBIOLOGY

### Aiding shipworms' appetite for destruction

Shipworms are in fact mollusks that consume wood. They can cause devastation to wooden ships but they also clean up wreckage. Mollusks cannot eat wood unaided (they lack the right enzymes) so O'Connor *et al.* puzzled over the absence of symbiotic wood-digesting organisms in the gut of shipworms. To their surprise, they discovered that the gills of a shipworm called *Bankia setacea* harbored *Teredinibacter turnerae* bacteria, which produce several wood-digesting enzymes. It seems the shipworm's tissues not only tolerate but also selectively transfer these foreign enzymes into their guts for digesting its formidable meals. —CA

*Proc. Natl. Acad. Sci. U.S.A.* 10.1073/pnas.1413110111 (2014).

## STEM CELLS

### An inhibitor to expand mouse stem cells

Among their many side effects, treatments such as chemotherapy and radiation deplete stem cells. Therapies to boost their numbers may positively affect patient outcomes. One possible therapeutic target is the protein phosphatase SHIP1. Hematopoietic stem cells expand in mice lacking SHIP1;

however, they also develop inflammatory disease. To boost stem cells numbers while hopefully avoiding inflammation, Brooks *et al.* developed a SHIP1 inhibitor. Adult hematopoietic and mesenchymal stem cell numbers increased in normal mice treated transiently with the inhibitor. The inhibitor also helped mice recover their hematopoietic-lineage cells after radiation treatment. — BAP

*Stem Cells* 10.1002/stem.1902 (2014).

## ALSO IN SCIENCE JOURNALS

Edited by Stella Hurtley

## LUNAR GEOLOGY

**Lunar magnetism persisted via dynamo**

Today the Moon has no magnetic field, but this was not always the case. Remnant magnetization in lunar rock and crust samples indicates that substantial fields existed billions of years ago. Weiss and Tikoo review how modern magnetic studies have established that these fields were powered by a magnetic dynamo that lasted from 4.2 to 3.56 billion years ago. However, the possible mechanics behind the dynamo, such as mantle precession or core crystallization, remain under investigation. To find out how and when the dynamo came and went now requires improvements in magnetohydrodynamic models and more accurate paleointensity measurements, possibly even those that show the field direction. — MMM

*Science*, this issue p. 1198

## CELL COMPETITION

**Cell competition and immunity**

Even in what appears to be homogeneous tissue, cell variability exists. The presence of mutant cells can compromise the functional integrity of a tissue and ultimately the organism's health. Cell competition is an internal cell surveillance mechanism that monitors cell fitness to eliminate compromised cells and prevent them from contributing to the tissue. However, how cells recognize fitness differences has remained elusive. Meyer *et al.* report that this recognition uses signaling pathways from the innate immune response system. Cell-cell differences in fitness activate distinct NF- $\kappa$ B/Rel factors in the

weaker population that lead to activation of distinct pro-apoptotic genes, leading to cell death in the losing cells. — BAP

*Science*, this issue p. 1199

## HEAVY FERMIONS

**Teasing out the topological character**

When theoretical physicists proposed the existence of an exciting class of materials called topological insulators (TIs), they had in mind a material that is electrically insulating in the bulk but conducts electricity on its surface. Experimentally discovered TIs, however, still have considerable bulk conductivity. Theoreticians then noticed that the material  $\text{SmB}_6$ , which has long been known as an insulator with peculiar conduction properties, may be a TI. However, confirming that  $\text{SmB}_6$  is a TI has been an arduous process. Li *et al.* traced the electronic structure of  $\text{SmB}_6$  in high magnetic fields and found that it does indeed have two-dimensional surface states. — JS

*Science*, this issue p. 1208

## SURFACE STRUCTURE

**Stabilization of the surfaces of magnetite**

Accurate structures of iron oxide surfaces are important for understanding their role in catalysis, and, for oxides such as magnetite, applications in magnetism and spin physics. The accepted low-energy electron diffraction (LEED) structure for the surface of magnetite, in which the bulk surface termination undergoes an undulating distortion, has a relatively poor agreement with experiment. Bliem *et al.* show

that the LEED structure is much more accurately described by a structure that includes subsurface cation vacancies and occupation of interstitial sites (see the Perspective by Chambers). Such cation redistribution occurs in many metal oxides and may play a role in their surface structures. — PDS

*Science*, this issue p. 1215; see also p. 1186

## PALEOCLIMATE

**Greenhouse gases drove African rainfall**

Much of equatorial Africa suddenly became much wetter ~14,700 years ago, ushering in an "African Humid Period" that continued well into the Holocene. Why? Otto-Bliesner *et al.* use a climate model to show that a reduction in the Atlantic Meridional Overturning Circulation (AMOC) at the beginning of the last deglaciation caused a reduction in precipitation in northern and southeastern equatorial Africa. When the AMOC became stronger again, wetter conditions developed in response to a combination of increasing greenhouse gas concentrations and strong summer sun. As atmospheric greenhouse gas concentrations continue to increase, these results may have implications for the future of African hydroclimate, water resources, and agriculture. — HJS

*Science*, this issue p. 1223

## STRUCTURAL BIOLOGY

**Watching a protein molecule in motion**

X-ray crystallography has yielded beautiful high-resolution

images that give insight into how proteins function. However, these represent static snapshots of what are often dynamic processes. For photosensitive molecules, time-resolved crystallography at a traditional synchrotron source provides a method to follow structural changes with a time resolution of about 100 ps. X-ray free electron lasers (XFELs) open the possibility of performing time-resolved experiments on time scales as short as femtoseconds. Tenboer *et al.* used XFELs to study the light-triggered dynamics of photoactive yellow protein. Electron density maps of high quality were obtained 10 ns and 1  $\mu$ s after initiating the reaction. At 1  $\mu$ s, two intermediates revealed previously unidentified structural changes. — VV

*Science*, this issue p. 1242

## GEOLOGY

**What drives Earth's thermodynamic engine?**

The asthenosphere lies right below Earth's tectonic plates. The asthenosphere is a thin layer of partially molten rock that has long been thought to play a minor role in Earth's thermodynamic engine. In a Perspective, Anderson and King highlight recent studies that point to a much more active role for the asthenosphere. They argue that this layer is hotter than the mantle below. It may thus be a source of hotspot volcanoes that have been widely attributed to plumes rising up from the lower mantle. Furthermore, model studies suggest that the asthenosphere has a strong effect on patterns of mantle flow. — JFU

*Science*, this issue p. 1184