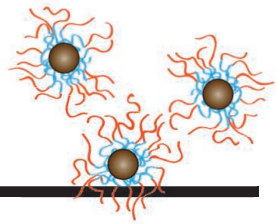
# RESEARCH

Magnetic nanoparticles can stimulate the brain

*Chen* et al., *p. 1477*



## IN *SCIENCE* JOURNALS

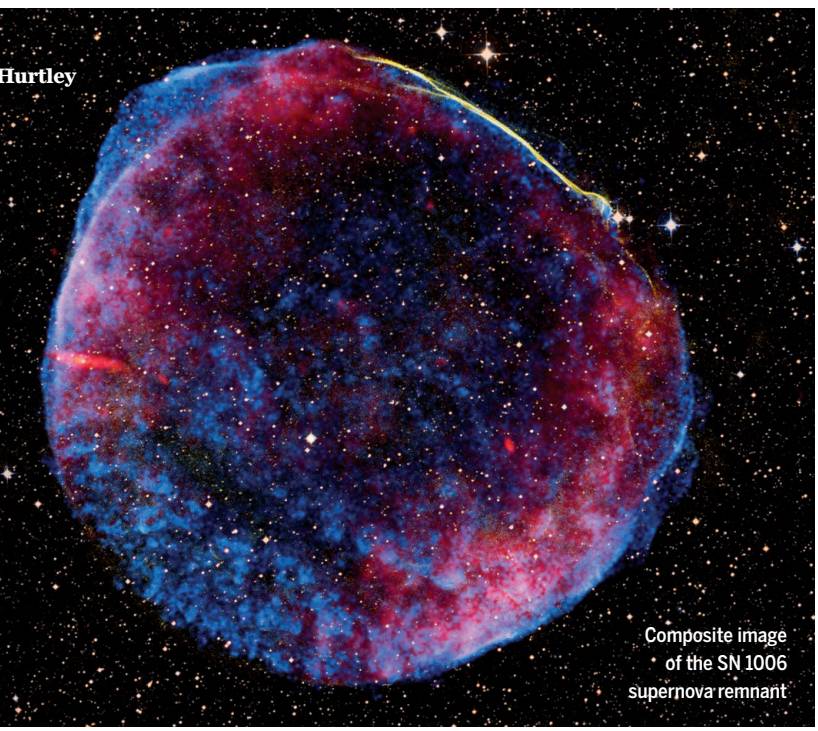
*Edited by* **Stella Hurtley**

SUPERNOVAE

### A place where stars are more predictable

Astrophysicists use reference objects of known brightness to determine distances. For example, type Ia supernova (SN Ia) always reach nearly the same peak brightness. This is because they explode when the progenitor white dwarf exceeds its supportable mass threshold. Kelly *et al.* find that a particular subset of SN Ia—those in environments with high ultraviolet surface brightness and star-formation density—can calibrate distances even more tightly. It seems that only one or two intrinsic parameters may drive the apparent relationship between luminosity, color, and fading with time. — MMM

*Science*, this issue p. 1459



Composite image of the SN 1006 supernova remnant

SOCIAL SCIENCE

### Abuse from generation to generation?

Parents who were abused as children are thought more likely to abuse their own children. Widom *et al.* compared reports from parents, from children, and from child protective service agency records gathered on the same families and on matched controls. They observed different findings depending on which information they used. Increases in sexual abuse and neglect relative to controls were reported by children of abuse victims. However, much of the believed transmission of abuse and neglect between generations could be ascribed to surveillance or detection bias targeted at parents with childhood histories of abuse or neglect. — BJ

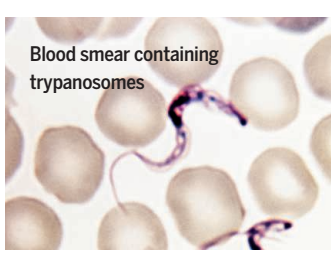
*Science*, this issue p. 1480

PARASITOLOGY

### Trypanosomes reveal tricky tricks in vivo

The sleeping sickness parasite, *Trypanosoma brucei*, is covered with variant surface glycoproteins (VSGs) recognized by the host's immune system. The parasite uses a repertoire of 2000 VSG genes to switch between different surface variants, continually evading the host's defensive responses. Classic experiments showed that one variant succeeded another, causing waves of infection; however, infection in animals shows different behavior. Mugnier *et al.* discovered that several VSGs are expressed simultaneously and that the repertoire for variation is amplified even more by recombination between the genes to make mosaic VSGs. — CA

*Science*, this issue p. 1470



Blood smear containing trypanosomes

ALS GENES

### New players in Lou Gehrig's disease

Amyotrophic lateral sclerosis (ALS), often referred to as "Lou Gehrig's disease," is a progressive neurodegenerative disease that affects nerve cells in the brain and the spinal cord. Cirulli *et al.* sequenced the expressed genes of nearly 3000 ALS patients and compared them with those of more than 6000 controls (see the Perspective by Singleton and Traynor). They identified several proteins that were linked to disease in patients. One such protein, TBK1, is implicated in innate immunity and autophagy and may represent a therapeutic target. — SMH

*Science*, this issue p. 1436; see also p. 1422

DNA ORIGAMI

### Reconfigurable DNA structures

DNA origami—nanostructures created by programming the assembly of single-stranded DNA through base pairing—can create intricate structures. However, such structures lack the flexible and reversible interactions more typical of biomolecular recognition. Gerling *et al.* created three-dimensional DNA nanostructures that assemble though nucleotide base-stacking interactions (see the Perspective by Shih). These structures cycled

PHOTOS FROM TOP: X-RAY: NASA/CXC/RUTGERS/G.CASSAM-CHENAÏ, J.HUGHES *ET AL.*; RADIO: NRAO/AUI/NSF/GBT/VLA/DYER, MADDALENA & CORNWELL; OPTICAL: MIDDLEBURY COLLEGE/F.WINKLER, NOAO/AURA/NSF/CTIO SCHMIDT & DSS; BIOPHOTO ASSOCIATES/SCIENCE SOURCE

from open to closed states with changes in salt concentration or temperature. — PDS

Science, this issue p. 1446; see also p. 1417

NUCLEAR PHYSICS

## Weighing the neutron against the proton

Elementary science textbooks often state that protons have the same mass as neutrons. This is not far from the truth—the neutron is about 0.14% heavier (and less stable) than the proton. The precise value is important, because if the mass difference were bigger or smaller, the world as we know it would likely not exist. Borsanyi *et al.* calculated the mass difference to high precision using a sophisticated approach that took into account the various forces that exist within a nucleon. The calculations reveal how finely tuned our universe needs to be. — JS

*Science*, this issue p. 1452

BONE BIOLOGY

## Rebuilding bone in osteoporosis

The skeleton undergoes continuous turnover because osteoblast cells build bone and osteoclasts break it down. Too much turnover can cause osteoporosis. The receptor tyrosine kinase DDR2 tilts the balance in favor of bone formation. Zhang *et al.* found that DDR2 both enhanced the development of osteoblasts and prevented osteoclasts from fully developing and breaking down bone. Viral delivery of DDR2 increased bone density in a mouse model of osteoporosis. Thus, increasing DDR2 levels in both types of bone cells may benefit osteoporosis patients. — LKF

*Sci. Signal.* 8, ra31 (2015).

NEURODEVELOPMENT

## Build the builders before the brain

Humans are much smarter than mice—key to this is the relative thickness of the human brain's neocortex. Florio *et al.* combed through genes expressed in the progenitor cells that build the neocortex and zeroed in on one gene found in humans but not in mice. The gene, which seems to differentiate humans from chimpanzees, drives proliferation of the key progenitor cells. Mice expressing this human gene during development built more elaborate brains. — PJH

*Science*, this issue p. 1465

SNARE PROTEINS

## An explosive way to fuse membranes

The molecular machine that promotes membrane fusion during intracellular transport involves a number of so-called SNARE proteins. Ryu *et al.* describe the molecular mechanism by which two proteins —NSF and α-SNAP—disassemble SNARE complexes. A combination of single-molecule techniques resolved intermediate steps of the reaction. Surprisingly, unlike previously assumed, NSF did not unwind SNARE complexes processively. Instead, built-up tension was released in a single burst to "tear" the SNARE complex apart in a one-step global unfolding reaction. — SMH

*Science*, this issue p. 1485

1D NANOSTRUCTURES

## Crafting organic-inorganic shish-kebabs

Functionalized inorganic nanocrystals can be assembled on polymeric chains like shish-kebabs. Xu *et al.* developed a clever and unconventional route for the synthesis of one-dimensional (1D) nanostructures. They capitalized on rationally designed amphiphilic wormlike precursors as nanoreactors. The approach opens the door for the design of intriguing hybrid materials with yet to be discovered properties. – ZHK

*Science Advances* 10.1126/sciadv.1500025 (2015).

# IN OTHER JOURNALS

*Edited by* **Kristen Mueller** *and* **Jesse Smith**

Weaning enhances the regenerative potential of pancreatic beta cells

CELL REGENERATION

## Weaning means more than no more milk

Nursing mothers provide much needed nutrition to offspring, but the full effects of weaning on offspring's physiology is unknown. Stolovich-Rain *et al.* now show that in mice, weaning affects the function of insulin-producing beta cells in the pancreas. The ability of beta cells to regenerate after injury or to modulate their insulin secretion decreases with age. However, beta cells also regenerated poorly in response to injury in very young mice and only gained this function upon weaning. These results suggest that at least for mouse beta cells, weaning jump-starts the cell cycle and modulates insulin production in response to glucose. — BAP

*Curr. Biol.* **24**, 2733 (2014).

CANCER BIOLOGY

## A CRISPR view of tumor metastasis

Large tumors metastasize more often than small tumors. Is this simply because large tumors release a greater number of malignant cells into the circulation? Or is it because the genetic changes in tumor cells that drive them to proliferate rapidly are the same as those that promote their metastatic behavior? To explore this question, Chen *et al.* designed a screen based on a genome-editing technology called CRISPR-Cas9 to identify genes that, when inactivated, enhance tumor growth, lung metastasis, or both in mice. The small set of inactivated genes found in metastatic lesions largely overlapped with the set found in late-stage primary tumors, implying that functional loss of these genes drives both growth and metastasis. — PAK

*Cell* 10.1016/j.cell.2015.02.038 (2015).

CELL BIOLOGY

## Fatty acid trafficking in starvation

Starving cells switch their metabolism from glucose-based to mitochondrial oxidation of fatty acids (FAs). This requires FAs to move from lipid droplets, their home during times of ample nutrition, to the mitochondria. Because free FAs in the cytoplasm are toxic to cells, cells stringently control their trafficking and metabolism. To better

PHOTO: TOM MCHUGH/SCIENCE SOURCE

## ALSO IN *SCIENCE* JOURNALS

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POLLINATION

### Conserving pollinator services for crops

If pollination fails, ecosystems are eroded and we will lose reliable sources of many critical foodstuffs. Focusing on the pollination services provided by bees, Goulson *et al.* review the stresses bees are experiencing from climate change, infectious diseases, and insecticides. We can mitigate some of the stress on bees by improving floral resources and adopting quarantine measures, and by surveillance of bee populations. Crucially, we need to resolve the controversy surrounding prophylactic use of pesticides. — CA

*Science*, this issue p. 1435

MOLECULAR MOTORS

### Making a molecular motor fit for purpose

Dynactin is an essential cofactor of the microtubule motor, cytoplasmic dynein. Dynactin contains 23 subunits built around a short filament of an actin-related protein (Arp1). How dynactin is assembled, how it functions with dynein, and why it is built around an actin-like filament is unclear. Urnavicius *et al.* combined cryo–electron microscopy structural studies and a crystal structure to determine the three-dimensional architecture of dynactin and how it interacts with dynein. — SMH

*Science*, this issue p. 1441

INFECTIOUS DISEASE

### Improving treatment options for fungal infections

Fungal diseases are common around the world. Many respond readily to treatment. However, infections such as invasive aspergillosis can be very difficult to treat, leading to high mortality. Drug resistance in fungal pathogens is also a growing problem. In a Perspective, Denning and Bromley explain the challenges encountered in developing new antifungal treatments. Although few antifungal drugs are currently coming to market, there are some reasons for hope: For example, some compounds in clinical or preclinical development are active against novel targets, and much improved diagnostics are making the early stages of drug development more straightforward. — JFU

*Science*, this issue p. 1414

GEOMICROBIOLOGY

### Building a biogeochemical battery

Iron acts as both a source and sink of electrons for microorganisms in the environment. Some anaerobic bacteria use oxidized Fe(III) as an electron acceptor, whereas phototrophic bacteria can use reduced Fe(II) as an electron donor. Byrne *et al.* show that the iron-bearing mineral magnetite, which contains both Fe(II) and Fe(III), can serve as both an electron acceptor and donor. Cocultures of iron-reducing and iron-oxidizing bacteria exposed to simulated day/night cycles or changes in organic matter altered the ratio of Fe(II) to Fe(III) in magnetite particles. — NW

*Science*, this issue p. 1473

DARK MATTER

### Uncloaking the influence of the invisible actor

The idea of dark matter enjoys popular support, but two major concerns persist: the so-called Standard Model excludes it, and it cannot be directly detected by any telescope. For now, astronomers can only observe dark matter's influence indirectly, such as when watching unseen creatures perturb the surface of a pond. Harvey *et al.* observed 72 galaxy collisions to compare the resulting centers of mass for the gas and stars (from direct observations) and for the dark matter (by inference). Based on these offsets, dark matter is clearly present. — MMM

*Science*, this issue p. 1462

NEUROTECHNIQUES

### Exciting nerve cells deep inside the brain

Current techniques to stimulate regions inside the brain need a permanently implanted wire or an optical fiber. Working in mice, Chen *et al.* developed a method to overcome this problem (see the Perspective by Temel and Jahanshahi). They introduced heat-sensitive capsaicin receptors into nerve cells and then injected magnetic nanoparticles into specific brain regions. The nanoparticles could be heated by external alternating magnetic fields, which activated the ion channel–expressing neurons. Thus, cellular signaling deep inside the brain can be controlled remotely without permanent implants. — PRS

*Science*, this issue p. 1477; see also p. 1418

QUANTUM GASES

### Atoms behaving in an orderly manner

In physics, interactions between components of a system can cause it to become more orderly in an attempt to minimize energy. Such ordered phases appear, for example, in magnetic systems. Schauss *et al.* simulated these phenomena using a collection of neutral atoms at low temperatures. By shining laser light on the atoms, the authors brought some of them into a high-energy state called the Rydberg state. By carefully varying the experimental parameters, they coaxed these Rydberg atoms into patterns reminiscent of crystal lattices in rod- and disk-shaped atomic samples. — JS

*Science*, this issue p. 1455