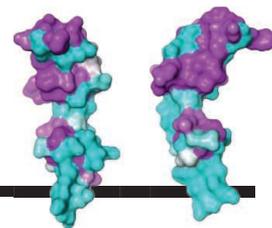


RESEARCH

Chaperones allow plant RuBisCo assembly in *E. coli*

Aigner et al., p. 1272



IN SCIENCE JOURNALS

Edited by Stella Hurtley

An adult male narwhal preparing to dive in Scoresby Sound, Greenland



ECOPHYSIOLOGY

The flight of the narwhal

Animals tend to respond to threats with the well-known behaviors of fight, flee, or freeze, each of which requires a different suite of physiological responses. Marine mammals face particular challenges because they may flee into an environment where oxygen is not available and pressure must be accommodated. Williams *et al.* placed a submersible electrocardiograph, depth, and acceleration recorder on narwhals after they were freed from entanglement. The animals displayed contrary cardiovascular responses simultaneously, which placed extreme stress on the cardiovascular system and the tissues that it protects. —SNV

Science, this issue p. 1328

NEPHROLOGY

Gaining a foothold on kidney disease?

The leading cause of kidney disease worldwide is known as focal segmental glomerulosclerosis (FSGS). FSGS is associated with loss of podocytes, an unusual cell type critical for the kidney's blood filtration function. Podocytes form interdigitating foot processes that wrap around capillaries and prevent leakage of plasma proteins into urine (proteinuria). Zhou *et al.* suppressed proteinuria by preventing podocyte loss in two different rat models of kidney disease, using a compound that selectively inhibits the TRPC5 ion channel (see the Perspective by Chung and Shaw). In short-term studies, this compound had

no detectable side effects. Thus, TRPC5 inhibitors may merit exploration as a therapy for progressive kidney disease. —PAK

Science, this issue p. 1332;
see also p. 1256

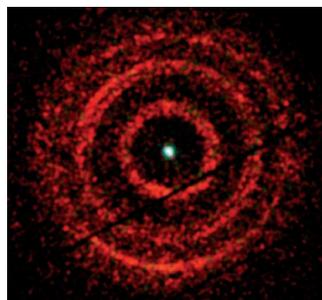
BLACK HOLES

Conditions in a black hole outburst

The binary system V404 Cygni consists of a red giant star orbiting a black hole. In 2015, a surge of accretion by the black hole caused the surrounding plasma to brighten suddenly for the first time since 1989, briefly becoming the brightest x-ray source in the sky. Dallilar *et al.* combined observations from radio, infrared, optical, and x-ray telescopes taken during the out-

burst. They compared how fast the flux decayed at each wavelength, which allowed them to constrain the size of the emitting region, determine that the plasma within it cooled through synchrotron radiation, and measure the magnetic field around the black hole. —KTS

Science, this issue p. 1299



V404 Cygni is a low-mass black hole binary system.

GRAPHENE

Watching electrons lose steam in graphene

Although graphene can be fabricated to be extremely clean, it still has a nonzero electrical resistance. Resistance is associated with turning electrons' energy into heat, but how exactly does this happen? Halbertal *et al.* used a tiny scanning temperature probe based on a superconducting quantum interference device to investigate this problem. As the current flowed through a square-shaped sample of graphene, electrons lost energy predominantly in the vicinity of atomic-scale defects, which were few and far between in the bulk but much more common on the edges of the sample. —JS

Science, this issue p. 1303

CANCER IMMUNOLOGY

FAK directs tumor immune evasion

Tumors are adept at escaping immune system surveillance or suppressing immune system activity. Serrels *et al.* found that focal adhesion kinase (FAK), which is implicated in immune escape mechanisms, activated a transcriptional network that increased interleukin-33 (IL-33) levels in tumor cells. In a mouse model of squamous cell carcinoma, FAK–IL-33 complexes boosted the production and secretion of key immunosuppressive factors. Blocking these FAK-mediated signals may help the immune system find and kill tumors. —LKF

Sci. Signal. **10**, eaan8355 (2017).

MOLECULAR BIOLOGY

Understanding splicing from the 3' end

The spliceosome removes introns from eukaryotic mRNA precursors and yields mature transcripts by joining exons. Despite decades of functional studies and recent progress in understanding the spliceosome structure, the mechanism by which the 3' splice site (SS) is recognized by the spliceosome has remained unclear. Liu *et al.* and Wilkinson *et al.* report the high-resolution cryo-electron microscopy structures of the yeast postcatalytic spliceosome. The structures reveal that the 3'SS is recognized through non-Watson-Crick base pairing with the 5'SS and the branch point, stabilized by the intron region and protein factors. —SYM

Science, this issue p. 1278, p. 1283

SUSTAINABLE CHEMISTRY

A sweet source to make acrylonitrile

Much of the attention directed toward displacing petroleum feedstocks with biomass has focused on fuels. However, there are also numerous opportunities in commodity chemical production. One such candidate is acrylonitrile, a precursor to

a wide variety of plastics and fibers that is currently derived from propylene. Karp *et al.* efficiently manufactured this compound from an ester (ethyl 3-hydroxypropanoate) that can be sourced renewably from sugars. The process relies on inexpensive titania as a catalyst and avoids the side production of cyanide that accompanies propylene oxidation. —JSY

Science, this issue p. 1307

HEALTH ECONOMICS

One cause of accidental deaths

The number of accidental deaths involving a firearm might be expected to correlate with the number of firearms, but claims that a causal relationship exists have not been persuasive (see the Policy Forum by Cook and Donohue). The 2012 mass shooting at an elementary school in the eastern United States resulted in the deaths of 20 children. Levine and McKnight used the random timing of this event and the subsequent increase in gun purchases (as recorded by an increased number of background checks) to show that the increased exposure to guns resulted in ~60 accidental deaths. —GJC

Science, this issue p. 1324; see also p. 1259

HEALTH AND MEDICINE

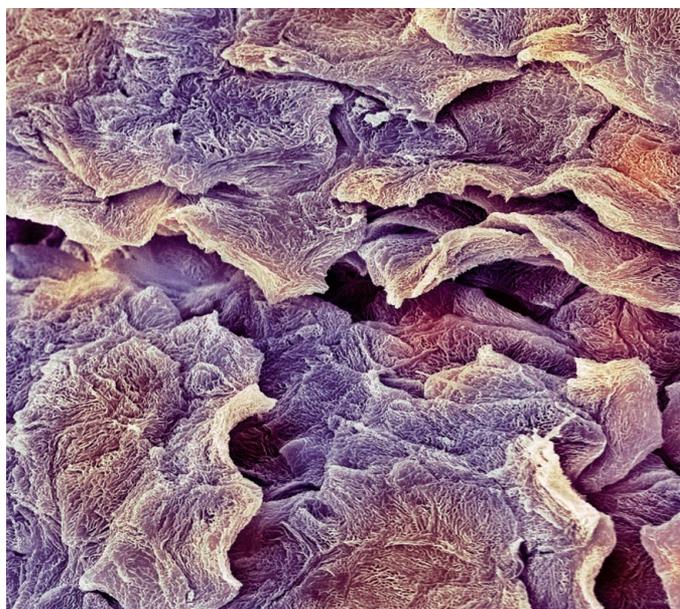
Taking a direct route to the brain

Hematopoietic stem and progenitor cells (HSPCs) rapidly generated myeloid and microglial cells in diseased mice when injected directly into the brain. To circumvent the blood-brain barrier, Capotondo *et al.* injected human HSPCs into cerebral lateral ventricles in a mouse model of neurodegenerative disease. The approach resulted in the rapid and robust production of HSPC-derived myeloid and microglia cells at the site where they are needed most. —JAP

Sci. Adv. **10**, 1126/ sciadv.1701211 (2017).

IN OTHER JOURNALS

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



Skin stem cells have been successfully used in life-saving therapy.

STEM CELLS

Skin stem cells regenerate a human epidermis

In a landmark study, Hirsch *et al.* used engineered autologous skin stem cells to replace more than 80% of the epidermis of a critically ill 7-year-old boy. The child suffered from junctional epidermolysis bullosa (JEB), a rare skin condition affecting fewer than 1 in 1 million people. Affected individuals have fragile skin that is prone to blisters and erosions, making them susceptible to life-threatening infections. The researchers obtained a small biopsy from a nonblistering skin section, which was used to grow keratinocyte cultures in the laboratory. Cells were engineered to express a skin protein called LAMB3 (which is defective in JEB), and grafts were transplanted onto the boy's denuded surfaces during multiple surgeries. At the 21-month follow-up stage, the boy's skin had healed normally, was blister-free, and was deemed fully functional with normal elasticity. —PNK

Nature **10.1038/nature24487** (2017).

PLANT SCIENCE

Multifactorial response to drought

Drought is not just characteristic of the desert, but also occurs as transient dry spells in agricultural settings. Plants respond to drought by waterproofing their surfaces, closing pores, and adjusting internally, largely in response to the hormone

abscisic acid. The hormones strigolactone, which triggers germination of parasitic plants, and karrikin, a component of smoke that triggers seed germination after fire, also promote tolerance to drought. The signaling pathways for strigolactone and karrikin converge on MAX2, which functions as part of the ubiquitin-regulated protein degradation system. Studying

ALSO IN SCIENCE JOURNALS

Edited by Stella Hurtley

PALEOANTHROPOLOGY

The peopling of Asia

In recent years, there has been increasing focus on the paleoanthropology of Asia, particularly the migration patterns of early modern humans as they spread out of Africa. Bae *et al.* review the current state of the Late Pleistocene Asian human evolutionary record from archaeology, hominin paleontology, geochronology, genetics, and paleoclimatology. They evaluate single versus multiple dispersal models and southern versus the northern dispersal routes across the Asian continent. They also review behavioral and environmental variability and how these may have affected modern human dispersals and interactions with indigenous populations. —AMS

Science, this issue p. 1269

SUSTAINABILITY

Optimizing flow in dammed rivers

Hydropower dams radically alter river flow regimes, often with consequences for the functioning and productivity of the waters downstream. Where fisheries in large tropical river systems are affected, there can be knock-on effects on food security. For the Mekong River, Sabo *et al.* used a data-based time series modeling approach to estimate the features of the flow regime that optimize the fishery that is crucial to food security in Cambodia (see the Perspective by Poff and Olden). Fish futures can be maximized within a managed hydrologic system with careful prescription of flows. Such data-driven approaches can be used to link hydrology to ecology and food production and specify design principles that could help to deliver food security in other river systems. —AMS

Science, this issue p. 1270;
see also p. 1252

MACHINE LEARNING

Computer or human?

Proving that we are human is now part of many tasks that we do on the internet, such as creating an email account, voting in an online poll, or even downloading a scientific paper. One of the most popular tests is text-based CAPTCHA, where would-be users are asked to decipher letters that may be distorted, partially obscured, or shown against a busy background. This test is used because computers find it tricky, but (most) humans do not. George *et al.* developed a hierarchical model for computer vision that was able to solve CAPTCHAs with a high accuracy rate using comparatively little training data. The results suggest that moving away from text-based CAPTCHAs, as some online services have done, may be a good idea. —JS

Science, this issue p. 1271

SOLID-STATE PHYSICS

Probing an excitonic condensate

Excitons—bound states of electrons and holes in solids—are expected to form a Bose condensate at sufficiently low temperatures. Excitonic condensation has been studied in systems such as quantum Hall bilayers where physical separation between electrons and holes enables a longer lifetime for their bound states. Kogar *et al.* observed excitons condensing in the three-dimensional semimetal 1T-TiSe₂. In such systems, distinguishing exciton condensation from other types of order is tricky. To do so, the authors used momentum-resolved electron energy-loss spectroscopy, a technique developed to probe electronic collective excitations. The energy needed to excite an electronic mode became negligible at a finite momentum, signifying the formation of a condensate. —JS

Science, this issue p. 1314

NEURODEVELOPMENT

Building a brain

The human brain is built in an inside-out manner as a series of layers. Although progenitor cells spin off new neurons in a seemingly organized fashion, the devil is in the details. Nowakowski *et al.* analyzed the transcriptomes of single cells from the developing brain to elucidate the hidden complexity of brain construction. For each cell, its position within the brain matters, as well as what type of neuron is being made at what point during overall development. These individual expression patterns result in organized diversity in the brain's cortex. —PJH

Science, this issue p. 1318

TOPOLOGICAL MATTER

A magnetic tip reconfigures edge states

Topological phases of matter are characterized by invariants such as Chern numbers, which determine their global properties. On the boundary of two domains with different Chern numbers, chiral edge states are expected to form. Yasuda *et al.* engineered such states in samples of a quantum anomalous Hall material by creating magnetic domains using the tip of a magnetic force microscope. The existence of chiral edge states along the domain walls was confirmed with electrical transport measurements. The ability to reconfigure and manipulate these states may improve spintronics. —JS

Science, this issue p. 1311

BIOCHEMISTRY

A biotech tour de force

RuBisCo, the key enzyme of photosynthesis, is a complex of eight large and eight small subunits. It mediates the fixation of atmospheric CO₂ in the Calvin-Benson-Bassham cycle. In addition to being enzymatically inefficient, RuBisCo has

a problem with distinguishing between CO₂ and O₂. The fixation of O₂ results in the energetically wasteful reaction of photorespiration. Thus, there is a strong incentive to improve RuBisCo's catalytic properties by engineering. However, for decades, it has been impossible to express the enzyme from plants in an easily manipulatable bacterial host. Aigner *et al.* succeeded in functionally expressing plant RuBisCo in *Escherichia coli* (see the Perspective by Yeates and Wheatley). This should allow for the systematic mutational analysis of RuBisCo and selection of favorable variants for improved crop yields. —SMH

Science, this issue p. 1272;
see also p. 1253

CHEMICAL PHYSICS

Clocking departures from chiral origins

Just as the atoms in a molecule can be arranged in a left- or right-handed manner, the field in a beam of light can circulate like a left- or right-handed corkscrew. Matches or mismatches in this mutual handedness give rise to an asymmetric distribution of trajectories as electrons are ejected during photoionization. Beaulieu *et al.* used an interferometric approach to uncover the temporal dynamics associated with this asymmetry. They probed the mirror-image isomers of camphor with circularly polarized light, which revealed the angle-dependent delays between trajectories that spanned up to 24 attoseconds. —JSY

Science, this issue p. 1288

BIOLOGICAL MATERIALS

Many roads to being tough

A number of routes exist to increase toughness in both natural and human-made materials—for example, using

secondary phases and precipitates or exploiting tailored architectures and shaped crystals. Polishchuk *et al.* detail the nanoscale internal structure of calcitic microlenses formed by a brittlestar (see the Perspective by Duffy). The segregation of magnesium-rich particles forms a secondary phase that places compressive stresses on the host matrix. This toughening mechanism resembles Guinier–Preston zones known in classical metallurgy. —MSL

Science, this issue p. 1294
see also p. 1254

STRUCTURAL BIOLOGY

A source of methane in the upper ocean

Methane concentrations are high in oxygenated surface waters. Methylphosphonate (MPn) is a suggested source, but an enzyme that synthesizes MPn (MPnS) has so far only been identified in one ocean microbe, albeit an abundant one: the archaeon *Nitrosopumilus maritimus*. Born *et al.* describe the crystal structure of MPnS and of a related enzyme that acts on the same substrate but makes a different product. By comparing the structures, they determined sequence markers that allowed them to identify MPnS in other ocean microbes, including the abundant microbe *Pelagibacter ubique*. These findings support the proposal that MPn is a source of both methane and phosphorus in the upper aerobic ocean. —VV

Science, this issue p. 1336

ATMOSPHERE

An even longer road to recovery?

The ozone layer is on the path to recovery after concerted efforts to control the production of ozone-depleting substances under the Montreal Protocol. In the latter half of the 21st century, the ozone layer will be controlled mainly by atmospheric carbon dioxide concentrations. In a Perspective, Liang *et al.* explain

that ozone layer recovery may slow down. This is because of incomplete compliance with the Montreal Protocol, rising emissions of ozone-depleting substances that are not controlled, and increasing emissions of natural ozone-destroying substances owing to climate change. Full recovery of the ozone layer to its 1980 state will require improved compliance with regulations and successful efforts to limit climate change. —JFU

Science, this issue p. 1257

DENDRITIC CELLS

Priming T follicular helper cells

In our immune systems, T follicular helper (Tfh) cells modulate antibody production by B cells. Krishnaswamy *et al.* examined the ability of conventional dendritic cell (cDC) subsets to prime Tfh commitment in response to intranasal immunization in mice. CD11b⁺ migratory type 2 cDCs (cDC2s) played an essential role in promoting commitment of activated T cells to the Tfh lineage. The authors imaged trafficking of cDC2s after intranasal immunization and found that they carried antigens to the site within the lymph node where Tfh cell priming occurs. These findings have important implications for vaccine design and delivery. —AB

Sci. Immunol. **2**, eaam9169 (2017).

BONE

Detecting skeletal growth

During development, bone is created by a process called endochondral ossification, which results in the production of a fragment of type X collagen. Endochondral ossification also occurs during long bone growth and fracture healing. Coghlan *et al.* discovered that the type X collagen fragment could be isolated from blood and that its concentration correlated with skeletal growth velocity. Fragment concentration was inversely correlated with age and fluctuated during fracture healing in adults. The assay to

quantify the fragment could be useful as a real-time marker of skeletal growth in children or for monitoring response to treatment for growth and bone disorders. —CC

Sci. Transl. Med. **9**, eaan4669 (2017).