designing the antennas, the researchers could engineer the wavefronts of the plasmons and control the direction of propagation. This approach illustrates a versatile approach for the development of nanophotonics. — ISO

Science, this issue p. 1369

TOXIN MECHANISM

Breaking through the epithelial barrier

Botulinum neurotoxin (BoNT) poisons its host when it crosses the intestinal epithelial barrier. To help it cross this barrier, the toxin forms a large complex with three bacterial proteins called hemagglutinins (HAs). To find out what happens when this complex binds to a cell-adhesion protein called E-cadherin, Lee *et al.* crystallized the bound complex and protein. Toxin binding disrupted the way E-cadherin maintains the epithelial barrier. When the researchers prevented the toxin complex from binding to E-cadherin, mice were protected from the toxin's deadly effects. — VV

Science, this issue p. 1405

CELL BIOLOGY

Cell proliferation in hard environments

The extracellular matrix that surrounds cells in tissues and organs can be harder or softer. In damaged blood vessels, the extracellular matrix becomes stiffer around the site of damage. Smooth muscle cells that surround blood vessels then proliferate to repair the damage. Bae *et al.* found that stiff surfaces stimulated cell proliferation through a signaling pathway that included the enzyme Rac. Mice that lacked Rac in their smooth muscle cells were unable to repair damaged blood vessels efficiently. — WW

Sci. Signal. **7**, ra57 (2014).

MULTIPLE SCLEROSIS

A surprising culprit attacks the brain

The brain deterioration in mice with a multiple sclerosis (MS)–like disease is exacerbated by a signaling molecule called interleukin-17 (IL-17), raising hopes that MS patients could be treated with drugs that target this cytokine. In an unexpected twist, however, Noster *et al.* find that in humans the culprit is a different cytokine, GM-CSF, a small molecule that promotes inflammation in many autoimmune diseases. What's more, in human patients IL-17 blocked GM-CSF production, a striking contrast to its effect in mice. These data suggest a new rationale for a therapeutic approach in MS patients: decreasing GM-CSF. — AC

Sci. Transl. Med. **6**, 241ra80 (2014).

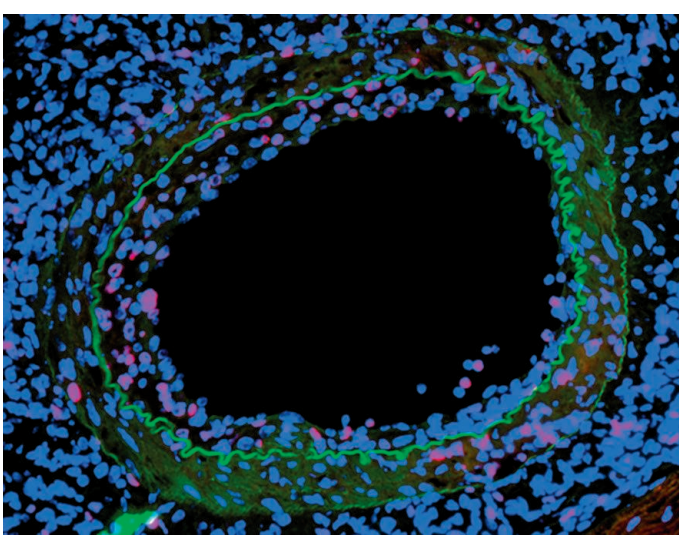
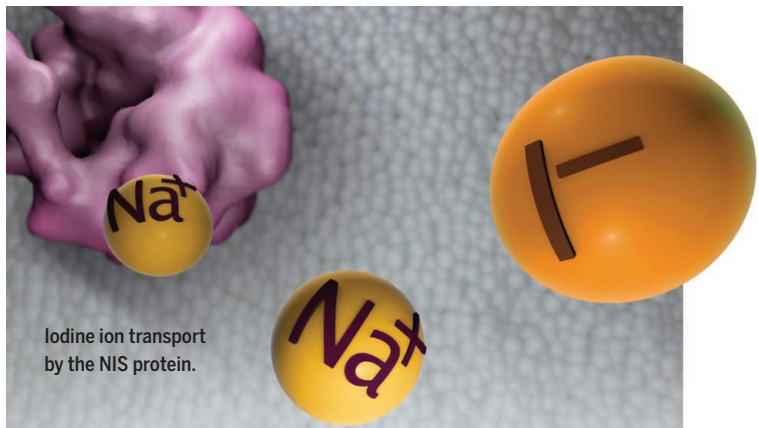


PHOTO: BAE *ET AL.*; ILLUSTRATION: V. ALTOUNIAN/*SCIENCE*

Cross-section of a mouse femoral artery undergoing repair.

IN OTHER JOURNALS

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



Iodine ion transport by the NIS protein.

ION TRANSPORT

Solving the mystery of iodine uptake

The thyroid gland produces iodine-containing hormones that regulate metabolism. The cell membrane protein NIS (sodium/iodine symporter) transports iodine into thyroid cells, but because iodine concentrations outside of the cell are so low, how it does so is a mystery. The key? Moving two sodium ions along with the iodine ion, Nicola *et al* found. NIS also does not bind sodium very tightly, but the high concentrations of sodium outside the cell allow one sodium ion to bind. This binding increases the affinity of NIS for a second sodium ion and also for iodine. With the three ions bound, NIS changes its conformation so that it opens to the inside of the cell, where the sodium concentration is low enough for NIS to release its sodium ions. When the sodium goes away, so does NIS's affinity for iodine, leading NIS to release it. — VV

Nat. Commun. 10.1038/ncomms4948 (2014).

DISEASE MECHANISMS

An airborne agent of heart disease?

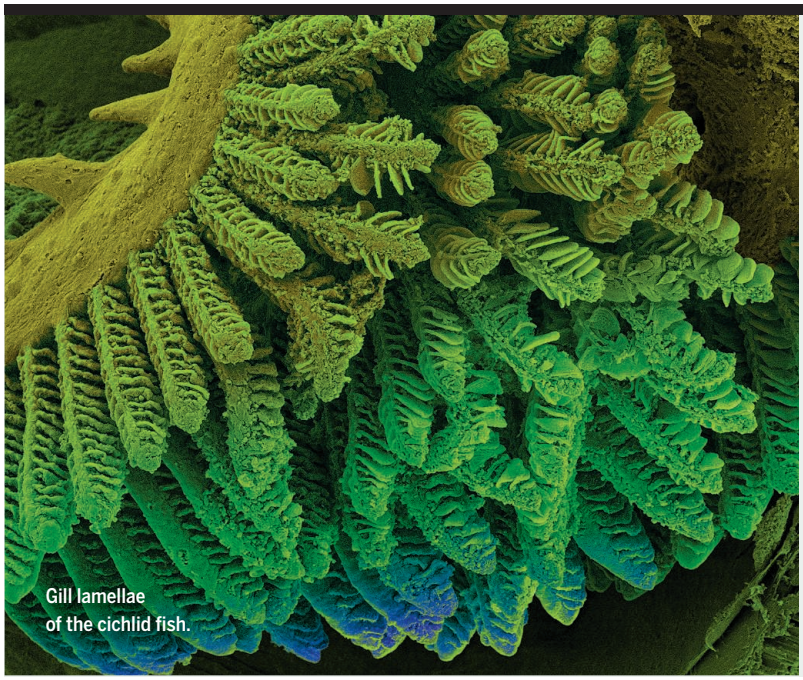
Kawasaki disease is the most common cause of acquired heart disease in children, but even now—40 years after its discovery—doctors still don't know its cause. Infectious and environmental agents are both possibilities. Rodó *et al*. compared daily Kawasaki disease case records in Japan with models of regional air trajectories. Spikes in disease incidence, they found, occurred when the wind blew from an agricultural region in northeastern China. Aerosol samples identified a high abundance of *Candida*, a fungus. Although the results are only a correlation, they support an existing model suggesting that genetically susceptible children may develop the disease when a windborne toxin or environmental agent triggers an aberrant immune response. — BJ

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1400380111 (2014).
Nat. Genet. 10.1038/ng.2982 (2014)

METABOLIC GENETICS

Genetic variation affects blood metabolites

Genetic variation influences human metabolism dramatically. Understanding the process could help researchers identify drugs and develop better treatments for complex diseases. In a study of over 7000 adults, Shin *et al*. reconstructed metabolic


Gill lamellae of the cichlid fish.

PHYSIOLOGY

Gill-on-a-chip illuminates evolution

Fish gills are natural microfluidic devices that evolution has optimized to extract oxygen from water. The spacing between the lamellae, the tiny protrusions that cover gill filaments, varies little between fish of wildly different sizes, which suggests that this spacing is important for gill function. To test this, Park *et al*. developed a mathematical model for oxygen transfer across lamellae. Indeed, they found, lamellae spacing is critical for gill function, as is the way fish pump water through their gills. The researchers then tested their model against an artificial gill—a microfluidic chip where oxygen diffuses across synthetic membranes. When they varied the distance between the membranes, the artificial gill extracted the most oxygen with membrane spacing similar to that of lamellae in fish gills. — GR

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1403621111 (2014).

pathways by combining genetics with metabolomics, the study of small molecules (aka metabolites) in biological systems. They identified 145 genetic loci, 84 previously unidentified, that they predicted would affect a wide range of biological functions. These 145 genetic loci were connected in a network to 400 biochemically relevant blood metabolites, forming an atlas of metabolites in the blood. Identifying these genetic variants that affect blood metabolites helps us gain a better understanding of human biology and potential treatments for disease. — LMZ

Nat. Genet. 10.1038/ng.2982 (2014).

PALEOCLIMATE

Seasonal rainfall and Indonesian vegetation

Both gradual and abrupt changes in rainfall—similar in many ways to those happening today—had dramatic effects on the vegetation of Indonesia over the past 25,000 years. Dubois *et al.* report that variations in the seasonality of rainfall there, and the resulting water stress during the dry season, caused large swings in the balance between grasslands and forests. Vegetation type depended more on the depth of seasonal dry cycles than on the amount of annual rainfall, they found. These results, obtained by analyzing the stable isotopic composition of fatty acids produced by vascular plants and preserved in marine sediments, reflect the importance of the monsoonal precipitation that's so vital to Indonesian agriculture and human well-being. — HJS

Nat. Geosci. 10.1038/ngeo2182 (2014).

GREEN CHEMISTRY

Making plastic bottles more renewable

All of the components of the plastic used to make clear soda bottles now can be supplied by renewable materials. The polymer polyethylene terphthalate is made from two monomers, ethylene and terphthalic acid (PTA). Chemists already can make ethylene from ethanol produced from plants, but PTA is made by oxidizing *p*-xylene, a petroleum derivative. Pachero and Davis show that a chemical derived on a commercial scale from biomass, 5-hydroxymethylfurfural (HMF), can be converted to PTA with the help of a catalyst called tin-beta. This process opens a route to more environmentally friendly plastic bottle manufacture. — PDS


Plastic bottle made from all-green stock.

Proc. Natl. Acad. Sci U.S.A. 10.1073/pnas.1408345111 (2014).

PHYSICS

A second hump in a superconducting dome

Pure strontium titanate ($SrTiO_3$) does not conduct electricity, but adding tiny amounts of impurities can turn it into a perfect conductor: a superconductor. Lin *et al.* found that, for a particular concentration of extra electrons introduced by adding Nb to the samples, the temperature at which $SrTiO_3$ becomes superconducting (T_c) has a maximum. This concentration coincides with the state when the electrons have filled up one energy band of the material and are just starting to fill up another. By measuring the electrical resistivity of the samples, they found that the overall shape of the T_c dependence on the electron concentration was a two-humped dome. Unlike superconducting domes in other materials, the base of the dome was quite broad and spanned a range of over three orders of magnitude of carrier concentration. — JS

Phys. Rev. Let. **112,** 207002 (2014).

POLAR ECOLOGY

Iceberg scours alter seafloor diversity

The ocean seabed is a patchwork quilt of colors and species. But along the West Antarctic Peninsula, increased iceberg activity—due to climate change and fewer days of frozen seas—is reducing sea floor biodiversity. Icebergs scouring the sea floor temporarily destroy habitat; different species recover at different rates. Barnes *et al.* examined spatial distribution, diversity, interactions between and within species, and ice scour hits near Rothera Research Station from 1997 to 2013. One species, *Fenestrulina rugula*, was quickest to recover; it now dominates, and is involved in, 96% of all interactions. Such reduced diversity could mean more vulnerability to invasive species. — CG

Curr.Biol. 10.1016/j.cub.2014.04.040(2014).

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Gill-on-a-chip illuminates evolution

Guy Riddihough

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