Inherited microcephaly exposes Zika culprit

Microcephaly has been the terrifying hallmark of the recent outbreak of Zika virus (ZIKV) in the Americas. How the virus damages brain development in the fetus is enigmatic. Chavali et al. found that in congenital microcephaly, mutations in a neural precursor protein, Musashi-1 (MSI1), impede RNA binding to neural stem cell targets, resulting in abnormal brain development (see the Perspective by Griffin). MSI1 also binds ZIKV RNA to amplify viral replication in cells. This interaction could put a pregnant woman at risk of giving birth to a microcephalic child. Furthermore, MSI1 is expressed at high levels in the mouse testis, which may explain the sexual transmission of this virus. —CA

Science, this issue p. 83; see also p. 33

NMR on diamonds gets down to chemistry

Nuclear magnetic resonance (NMR) spectroscopy is immensely useful for chemical characterization, but it requires relatively large amounts of sample. Recent studies have leveraged nitrogen vacancy centers in diamond to detect NMR signals from samples of just a few cubic nanometers, but with low resolution. Aslam et al. optimized this technique to achieve a resolution of 1 part per million—sufficient to distinguish among alkyl, vinyl, and aryl protons in solution (see the Perspective by Bar-Gill and Retzker). They also demonstrated solid-state implementation and fluorine detection. —JSY

Science, this issue p. 67; see also p. 38

Metastases undergo reconstruction

Cancer cells from primary tumors can migrate to regional lymph nodes and distant organs. The prevailing model in oncology is that lymph node metastases give rise to distant metastases. This “sequential progression model” is the rationale for surgical removal of tumor-draining lymph nodes. Naxerova et al. used phylogenetic methods to reconstruct the evolutionary relationship of primary tumors, lymph node metastases, and distant metastases in 17 patients with colorectal cancer (see the Perspective by Markowitz). The sequential progression model applied to only one-third of the patients. In the other two-thirds, distant metastases and lymph node metastases originated from independent subclones within the primary tumor. —PAK

Science, this issue p. 55; see also p. 35

Genetic analysis of disease emergence

In the 1980s, wheat crops began to fall to the fungal pathogen...
that causes blast disease. First seen in Brazil, wheat blast last year caused devastating crop losses in Bangladesh. Inoue et al. tracked down the shifting genetics that have allowed the emergence of this potentially global threat to wheat crops (see the Perspective by Maekawa and Schulze-Lefert). Wheat varieties with a disabled resistance gene were susceptible to pathogen strains that affected oat and ryegrass crops. Subsequent genetic changes in the pathogen amplified the virulence in wheat. —PJH

Science, this issue p. 80; see also p. 31

MICROBIOME
Diving into the depths of atopic dermatitis

The genus Staphylococcus is a known driver of atopic dermatitis. Byrd et al. used shotgun metagenomic sequencing to analyze the specific species and strains present at baseline and during flares in pediatric atopic dermatitis. Patients with more mild disease had more S. epidermidis in flares, and those with severe disease were dominantly colonized by clonal S. aureus strains. Bacterial strains from the patients were applied to mouse skin, and strains from severe flares induced T cell differentiation and epidermal thickening. Thus, not all Staphylococcus are equal when it comes to atopic dermatitis.—LP


SUPERCONDUCTIVITY
A deeper look into iron selenide

In the past 10 years, iron-based superconductors have created more puzzles than they have helped resolve. Some of the most fundamental outstanding questions are how strong the interactions are and what the electron pairing mechanism is. Now two groups have made contributions toward resolving these questions in the intriguing compound iron selenide (FeSe) (see the Perspective by Lee). Gerber et al. used photoemission spectroscopy coupled with x-ray diffraction to find that FeSe has a very sizable electron-phonon interaction. Quasiparticle interference imaging helped Sprau et al. determine the shape of the superconducting gap and find that the electron pairing in FeSe is orbital-selective.—JS

Science, this issue p. 71, p. 75; see also p. 32

ECONOMICS
How to make traffic worse everywhere

One policy aimed at improving traffic flows in large cities requires vehicles to carry two or three passengers, usually in lanes or road set aside for high-occupancy vehicle (HOV) travel. Whether this actually increases speeds depends on how heavily the HOV roads are used and the availability of alternate routes. Hanna et al. took advantage of an abrupt policy change—the elimination of HOV rules—in Jakarta to collect the travel times from Google Maps for HOV and alternate routes before and after the change (see the Perspective by Anderson). They observed a serious worsening of traffic throughout the city. —GJC

Science, this issue p. 89; see also p. 36

TUBERCULOSIS
Metabolic memory in Mycobacterium

Tuberculosis is a slow disease. Replication of the pathogen, Mycobacterium tuberculosis, can be arrested for decades within hypoxic tubercles. Eoh et al. show that hypoxia shifts the metabolism of M. tuberculosis into the pentose phosphate pathway (PPP) by depleting stores of trehalose. This disaccharide is essential for the mycolyl glycolipids that wax the surface of the bacterium’s cell. The PPP intermediates provide precursors for nucleotide and peptidoglycan synthesis. The pathogen is thus retuned during latency to poised for immediate action when immunocompromise has crept up on the aging host; the tubercles start breaking down, and exposure to oxygen allows the pathogen to restart replication.—CA

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Edited by Caroline Ash and Jesse Smith

GEOCHEMISTRY
A sizzling mantle under the Galapagos

The temperature of Earth’s mantle is relatively uniform, but certain “hot spots” responsible for some surface volcanism require locally hotter regions. Trela et al. find evidence for a much hotter mantle region by looking at the chemistry of a recent Tongan lava suite from the Galapagos hot spot. The chemistry requires mantle temperatures that are a surprising 400°C higher than average. The result indicates a very hot region isolated from mantle convection, likely preserved from many billions of years ago. —BG

Nat. Geosci. 10.1038/NGEO2954 (2017).

NONLINEAR OPTICS
The interaction of solitons

As light propagates through a medium such as a lens or window, scattering and dispersion processes usually result in the light diffusing. In a nonlinear medium, however, the dispersion processes can be balanced by nonlinearities to produce localized structures known as solitons, or optical bullets. Krupa et al. find that when pairs of solitons propagate in an optic fiber, they can interact, attracting and repelling each other. Liking the interactions to those of molecules, the authors suggest that the temporal motion of the solitons and the energetics associated with the interactions could be exploited for new optical effects in different classes of laser systems. The enhanced interactions could also possibly be used to increase the capacity of optical communication networks.—ISO


IN OTHER JOURNALS

Staphylococcus epidermidis is a normally harmless resident on human skin.

PHOTOS: (FROM LEFT) EYE OF SCIENCE/SCIENCE SOURCE; MINT IMAGES, FRANS LANTING/GETTY IMAGES

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NEURODEVELOPMENT

Following the yellow brick road

The adrenal glands affect a variety of processes such as stress responses and metabolism. The mature adrenal gland is formed from multiple tissue sources, including cells of neural origin. Furlan et al. traced the origins of these cells. The cells first become Schwann cell precursors and follow along nerves to travel from the dorsal root ganglia of the spine to the adrenal gland. Once there, the cells differentiate into chromaffin cells. The authors used single-cell transcriptomics to reveal the shifts in functional programs during migration, development, and differentiation. —PJH

Science, this issue p. 46

TOPOLOGICAL MATTER

Corner-dwelling topological states

Computing the electric polarization of a crystal is surprisingly tricky, but it can be tackled with the help of a topological concept, the so-called Berry phase. Extensions to higher multiple moments, such as quadrupole and octupole, are even trickier. Benalcazar et al. built a theoretical framework for dealing with these moments in certain types of solids. In the presence of some crystalline symmetries, the quadrupole moment is quantized, and the corners of the system play host to fractionally charged, topologically protected states. These predictions may be testable in cold atom and photonic systems. —JS

Science, this issue p. 61

PLANT GENOMICS

Genomics and domestication of wheat

Modern wheat, which underlies the diet of many across the globe, has a long history of selection and crosses among different species. Avni et al. used the Hi-C method of genome confirmation capture to assemble and annotate the wild allotetraploid wheat (*Triticum turgidum*). They then identified the putative causal mutations in genes controlling shattering (a key domestication trait among cereal crops). They also performed an exome capture-based analysis of domestication among wild and domesticated genotypes of emmer wheat. The findings present a compelling overview of the emmer wheat genome and its usefulness in an agricultural context for understanding traits in modern bread wheat. —LMZ

Science, this issue p. 93

INFECTIONIOUS DISEASE

Function follows form

Congenital human cytomegalovirus (HCMV) is the most common infectious cause of disabilities in newborn infants. It is the leading cause of deafness in children, which highlights the need for a vaccine that can block maternal-fetal transmission of HCMV. Chandramouli et al. report crystal structures of neutralizing antibodies bound to the HCMV pentameric complex (Pentamer), a key determinant of viral entry. These structural and functional studies identify potential entry receptor–binding sites on Pentamer, as well as other functional sites that may serve as targets for vaccine development and antibody and small-molecule therapeutics. —ACC


VASCULAR BIOLOGY

Intercellular signal for vasodilation

Vasoconstriction must be balanced with vasodilation in the arterioles that supply tissues with blood. The second messenger IP_3_ has been thought to be the signal that passes from smooth muscle cells through gap junctions to endothelial cells to trigger vasodilation. However, Garland et al. found that Ca^{2+} rather than IP_3_, entered vascular smooth muscle cells through voltage-gated Ca^{2+} channels in response to vasoconstricting stimuli. The Ca^{2+} ions subsequently passed through gap junctions into endothelial cells and initiated vasodilatory responses that are dependent on this cell type. —WW