RESEARCH

IN SCIENCE JOURNALS

Edited by Stella Hurtley

GREENLAND ICEBERGS FUELED TROPICAL METHANE PRODUCTION
Chluba et al., p. 968

PHOTOSYNTHESIS
Photosystem I enters into the spotlight
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INORGANIC CHEMISTRY
An aromatic phosphorus and nitrogen ring
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EMBRYO DEVELOPMENT
How to generate head-to-tail polarity in a midge
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IMMUNE TOLERANCE
Innate lymphoid cells keep gut T cells in check
Trillions of bacteria inhabit our guts. So do many types of immune cells, including T cells, which might be expected to attack these bacteria. How, then, do our bodies manage to keep the peace? Working in mice, Hepworth et al. report one such mechanism. A population of immune cells, called innate lymphoid cells, directly killed CD4+ T cells that react to commensal gut microbes. Some of the specifics of this process parallel how the immune system keeps developing self-reactive T cells in check in the thymus. Furthermore, this peacekeeping process may be disrupted in children with inflammatory bowel disease. — KLM

Keeping the peace in the gut

Science, this issue p. 1001

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TYPE 1 DIABETES

A gene therapy approach for diabetes

Gene therapy is being used with increasing success to treat a growing group of diseases. What about diabetes? Akbarpour et al. used a lentiviral vector to express insulin in liver cells of a mouse model of type 1 diabetes. The therapy induced regulatory T cells specific for insulin and halted immune cell infiltration into the pancreatic islets. Moreover, when gene therapy was combined with a single dose of monoclonal antibody to CD3, it stopped disease progression in diabetic mice. Thus, expressing an autoantigen in liver cells can induce antigen-specific tolerance in autoimmune disease. — ACC


SHAPE MEMORY ALLOYS

Memory alloys that avoid exhaustion

Shape memory alloys can pop back into shape after being deformed. However, often these alloys cannot cope with a large number of deformation cycles. Chluba et al. find an alloy that avoids this pitfall, deforming 10 million times with very little fatigue (see the Perspective by James). Such low-fatigue materials could be useful in a plethora of future applications ranging from refrigerators to artificial heart valves. — BG

Science, this issue p. 1004; see also p. 968

COGNITIVE NEUROSCIENCE

Sleep on it: Consolidating implicit learning

A good night’s sleep is one of the best ways to fix recently learned information into long-lasting memory. Recent evidence suggests that recent memories are reactivated during sleep and woven into existing representations of stored information. Hu et al. now demonstrate that triggering memory consolidation during sleep can help set into place recently learned anti-bias training (see the Perspective by Feld and Born). Changes in people’s stereotypical attitudes toward race and gender were maintained for up to 1 week after training. — GJC

Science, this issue p. 1013; see also p. 971

IN OTHER JOURNALS

Edited by Sacha Vignieri and Jesse Smith

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CANCER

A mutant promoter’s partner in crime

Telomerase is an enzyme that maintains the ends of chromosomes. TERT, the gene coding for the enzyme’s catalytic subunit, is not expressed in healthy somatic cells, but its expression is reactivated in the majority of human cancers. The resultant high levels of telomerase help cancer cells survive and multiply. Recurrent mutations in the promoter region of TERT are associated with high telomerase levels in multiple cancer types. Bell et al. show that a specific transcription factor called GABP is selectively recruited to the mutant form of the TERT promoter, which activates TERT gene expression — PAK

Science, this issue p.1036

NEURODEVELOPMENT

Coordinating neurons with blood vessels

The retina develops as interleaved layers of neurons and blood vessels. Usui et al. show that in mice, the development of blood vessel layers depends on signals from amacrine cells, a type of interneuron in the retina. Too much or too little signal resulted in too many or too few blood vessels, particularly affecting the intermediate vascular plexus (a network of blood vessels) embedded within the retina. This cellular crosstalk coordinates neuronal demand for oxygen with the blood’s ability to supply it. With the intermediate-vascular plexus poorly formed, photoreceptors (a type of neuron) degenerate, leading to deficits in vision. — PJH


BIOSYNTHESIS

Harnessing the power of heterologous biosynthesis

Environmentally derived bioactive compounds obtained from filamentous fungi, plants, and bacteria have provided drugs for treating a whole variety of human diseases. However, it is often difficult to produce these compounds industrially or in the laboratory. Zhang et al. introduced different biosynthetic pathways into a surrogate Escherichia coli host to generate diverse chiral pairs of compounds. Several of the generated analogs were active against an erythromycin-resistant Bacillus subtilis strain. — ASH


PHYSICS

Cooling a semiconductor with polaritons

Shining light onto a solid to cool it may seem counterintuitive, because the light will temporarily increase the solid’s energy. To go back to its low-energy state, the solid may then emit photons more energetic than the ones it absorbed initially, effectively lowering its temperature. Such cooling methods are well established, but place stringent requirements on the material being cooled. Klembt et al. show that exciton-polaritons, exotic part-photon, part-exciton quasiparticles, can be used to cool a semiconductor microcavity. The cooling mechanism depends on the ability of the polaritons to absorb the energy of lattice vibrations and shortly thereafter to leave the solid as light. At low enough laser power, this process overpowers a competing heating process in which two photons are absorbed simultaneously. — JS

POROUS MATERIALS

It’s all about the holes

From kitchen sieves and strainers to coffee filters, porous materials have a wide range of uses. On an industrial scale, they are used as sorbents, filters, membranes, and catalysts. Slater and Cooper review how each application will limit the materials that can be used, and also the size and connectivity of the pores required. They go on to compare and contrast a growing range of porous materials that are finding increasing use in academic and industrial applications. — MSL

Science, this issue p. 988

T CELL METABOLISM

LEM gets T cells the energy they need

During an infection, T cells proliferate extensively to build a sufficient army to defeat the invading pathogen. Carefully regulated changes in metabolism let T cells do this, but the specific nature of these changes is not fully understood. Using forward genetics in mice to screen for genes that regulate T cell immunity, Okoye et al. identified a mutation in the gene that encodes a protein they named lymphocyte expansion molecule (LEM) (see the Perspective by O’Sullivan and Pearce). LEM enhanced T cell immunity, including both proliferation and memory cell generation, in response to chronic viral infection. LEM facilitated these changes through effects on mitochondrial respiration. — KLM

Science, this issue p. 995; see also p. 976

MEMORY

Experimental recovery from retrograde amnesia

When memory researchers induce amnesia, they normally assume that the manipulations prevent the memory engram from effective encoding at consolidation. In accordance with this, Ryan et al. found that after the injection of protein synthesis inhibitors, animals could not retrieve a memory. However, to their surprise, the memory could nevertheless be reactivated by light-induced activation of the neurons tagged during conditioning. Increased synaptic strength that is the result of cellular consolidation is thus not a critical requisite for storing a memory. — PRS

Science, this issue p. 1007

PALEOClimate

The tropical impact of iceberg armadas

The massive discharges of icebergs from the Greenland ice sheet during the Last Glacial Period are called Heinrich events. But did Heinrich events cause abrupt climate change, or were they a product of it? Methane levels represent a proxy for climate, because methane production increases mostly due to wetter conditions in the tropics. Rhodes et al. report a highly resolved record of atmospheric methane concentrations, derived from an ice core from Antarctica. Methane levels varied—i.e., the tropical climate changed—in response to cooling in the Northern Hemisphere caused by Heinrich events. — HJS

Science, this issue p. 1016

MICROBiAL DIVERSITY

Quasi-sexual microbe populations

ASTRONOMING levels of fine-scale microbial diversity have been uncovered by DNA sequencing of natural populations. How this diversity is shaped and maintained and what its environmental or clinical implications might be is unclear. Using custom-made advanced statistical methods, Rosen et al. analyzed the evolutionary structure of a photosynthetic bacterium that grows in the hot springs of Yellowstone Park (see the Perspective by Desai and Walczak). The populations behaved neither as clones nor “ecotypes” but more like sexual organisms. These cyanobacteria have high recombination rates that maintain diversity and prevent selective sweeps that would otherwise reduce diversity. — CA

Science, this issue p. 1019; see also p. 977

STRESS RESPONSES

Identification of a memory drug target

ISRIB is a potent inhibitor of the integrated stress response (ISR), which involves the activation of elf2α-specific kinases, phosphorylation of elf2α, and consequent down-regulation of global translation levels. ISRIB is also a candidate drug for treating certain memory disorders. ISRIB does not prevent elf2α phosphorylation and must therefore act downstream of this step. Sekine et al. now report that ISRIB reverses the inhibitory effect of elf2α phosphorylation on the activity of elf2B, a dedicated guanine nucleotide exchange factor, enhancing its activity independently of phosphorylation (see the Perspective by Hinnebusch). The authors isolated ISRIB-resistant cells and identified a genetic lesion in a short N-terminal region of elf2Bβ that appears to be responsible for the observed phenotype. — SMH

Science, this issue p. 1027; see also p. 967

CELL ADHESION

Stretching cell sheets promotes proliferation

Mechanical strain regulates the development, organization, and function of multicellular tissues. But how? Cadherins mechanically couple neighboring epithelial cells through extracellular interactions and sequester the transcription factors β-catenin and Yap1. To find out more, Benham-Pyle et al. stretched epithelial cell sheets. This mechanical strain induced rapid cell cycle reentry, DNA synthesis by sequential nuclear accumulation, and transcriptional activation of Yap1 and β-catenin. — WW


INFECTIONous DISeases

The battle against kinetoplastid diseases

Diseases caused by protist parasites called kinetoplastids are endemic in many lower-income countries, infecting millions of people worldwide. The most widespread of these diseases is leishmaniasis, with 350 million people in 98 countries at risk of infection; another is Chagas disease, which infects an estimated 6 to 7 million people. Transmitted by insects, these diseases are often highly disfiguring and can be fatal. Many existing drug treatments, however, have serious side effects and are difficult to administer. In a Perspective, Bille outlines the challenges faced in developing drugs against these neglected diseases and highlights advances toward more effective, orally administered drug treatments. — JFU

Science, this issue p. 974

CELL MIGRATION

Moving to that electric feel

Cell movement can be guided by chemical gradients (chemotaxis) or by electrical fields (electrotaxis), both of which contribute to wound healing. The mechanisms that control electrotaxis are not as well characterized as those controlling chemotaxis. The slime mold Dictyostelium discoideum has been widely used in chemotaxis studies. Gao et al. developed a high-throughput screening method to analyze electrotaxis in genetically modified Dictyostelium strains. Components of the TORC2 pathway, a pathway involved in chemotaxis, were also required for electrotaxis. — WW

Science, this issue p. 1024