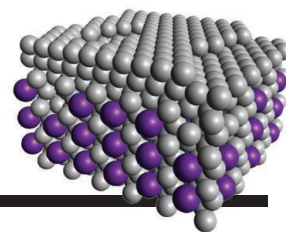


RESEARCH

Leaching platinum alloys to boost fuel cell performance

Escudero-Escribano et al., p. 73



IN SCIENCE JOURNALS

Edited by Stella Hurtley



Increasing carbon dioxide levels could destabilize the Antarctic Ice Sheet

ICE SHEETS

Sensitive ice sheets

Why did the Antarctic Ice Sheet begin to grow 34 million years ago, and what does that have to do with us? Galeotti *et al.* studied a marine sediment core recovered from just off the coast of Antarctica (see the Perspective by Lear and Lunt). The ice sheet did not begin to grow until atmospheric CO₂ concentrations had dropped to below around 600 parts per million. Indeed, the ice sheet was unstable when CO₂ was higher. As modern atmospheric CO₂ concentrations continue their rise, a shift back to an unstable Antarctic Ice Sheet could increase harmful rises in sea level. — HJS

Science, this issue p. 76; see also p. 34

OBESITY

Cell-free DNA and adipose tissue inflammation

Obesity can induce chronic inflammation and subsequent insulin resistance (type 2 diabetes), but how this happens has been a nagging question. Nishimoto *et al.* found that degenerating adipocytes (fat cells) release DNA (known as cell-free DNA or cfDNA) that attracts macrophages to the adipose tissue, thus initiating or exacerbating inflammation. Toll-like receptor 9 was involved in recognizing the cfDNA. Genetic deletion of the receptor reduced both macrophage accumulation in adipose tissue and insulin resistance. Thus, the receptor may represent a therapeutic target for obesity-related diseases. — PLY

Sci. Adv. **2**, 10.1126/sciadv.01332 (2016).

MITOCHONDRIAL DISEASE

Thriving on a breath of low oxygen

Mitochondrial diseases are debilitating and largely untreatable. Most are caused by genetic mutations that impair the mitochondrial respiratory chain, which generates cellular energy. Because these diseases do not affect all tissues equally, it is thought that endogenous mechanisms exist that can help cells cope with mitochondrial defects. Jain *et al.* identified the hypoxia response, a mechanism that helps cells adapt when oxygen is limited, as a potent suppressor of mitochondrial dysfunction (see the Perspective by Shoubridge). Mouse models of the mitochondrial disease Leigh syndrome showed fewer symptoms and a dramatically extended life

span when raised in a hypoxic environment. — PAK

Science, this issue p. 54; see also p. 31

FLOW CHEMISTRY

Drug manufacturing in a fridge-sized box

Commodity chemicals tend to be manufactured in a continuous fashion. However, the preparation of pharmaceuticals still proceeds batch by batch, partly on account of the complexity of their molecular structures. Adamo *et al.* now present an apparatus roughly the size of a household refrigerator that can synthesize and purify pharmaceuticals under continuous-flow conditions (see the Perspective by Martin). The integrated set of modules can produce hundreds to thousands of accumulated

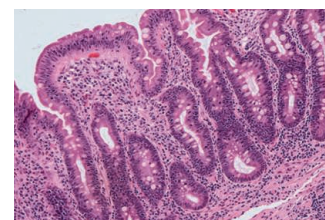
doses in a day, delivered in aqueous solution. — JSY

Science, this issue p. 61; see also p. 44

IMMUNE REGULATION

Long noncoding RNAs in inflammation

Growing evidence suggests that long noncoding RNAs (lncRNAs) are important modulators of gene expression. Castellanos-Rubio *et al.* identified a lncRNA, lnc13,



Small-intestine damage in celiac patient biopsy

that suppresses inflammatory gene expression in macrophages (see the Perspective by Huarte). *Inc13* interacts with proteins that regulate chromatin accessibility. Stimulating macrophages with a cell wall component from bacteria decreased expression of *Inc13* and increased the expression of several inflammatory genes. Decreased levels of *Inc13* in intestinal tissue from individuals with celiac disease hint that *Inc13* may also play a role in the pathogenesis of immune-mediated diseases. — KLM

Science, this issue p. 91;
see also p. 43

CONFLICT BEHAVIOR

How to win a fish fight

When to cease aggression and escape is an important decision that fighting animals must make. Chou *et al.* characterized the role of two nuclei in a brain area of the zebrafish called the dorsal habenula (dHb) during social aggression (see the Perspective by Desban and Wyart). Silencing the lateral dHb reduced the likelihood of winning a fight, whereas silencing the medial dHb increased the likelihood of winning. Thus, these two nuclei antagonistically control the threshold for surrender. — PRS

Science, this issue p. 87;
see also p. 42

STELLAR EVOLUTION

Discovery of an oxygen white dwarf

The vast majority of stars will eventually evolve into a white dwarf, a small, hot, and extremely dense object made of leftover material from the star's core. Stellar evolution theory suggests that white dwarfs should be mostly made of helium, carbon, or oxygen, but even a tiny amount of hydrogen or helium floats to the surface and hides the underlying composition. Kepler *et al.* searched through thousands of white dwarf spectra and discovered one that has an atmosphere dominated by oxygen, with no contamination by hydrogen or helium (see the Perspective by Gänsicke). This

pristine object confirms the long-postulated theory and will be an important test case for stellar evolution. — KTS

Science, this issue p. 67;
see also p. 37

MAMMALIAN GERM CELLS

Mouse oocytes receive sister cell factors

Mammalian mature oocytes, the largest cells in the body, are capable of programming and reprogramming embryogenesis. Only about 20% of developing mouse germ cells become oocytes. Lei and Spradling show that organelles and the cytoplasm move through intercellular connections between sister germ cells in mouse fetal ovaries to enrich oocyte cytoplasm just before oocytes arrest to form the ovarian reserve (see the Perspective by Pepling). Similar transfers occur during oogenesis in many invertebrate and lower vertebrate species, possibly providing oocytes their special properties for programming embryo development. — BAP

Science, this issue p. 95;
see also p. 35

PAIN

“WNK”ing away chronic pain

WNK1 is a kinase found in the spinal cord's dorsal horn, which transmits pain signals from the periphery to the brainstem. Mutations in the *HSN2* exon in the gene encoding WNK1 cause a neuropathy that results in loss of touch, temperature, and pain sensation. Kahle *et al.* found that mice lacking this alternatively spliced variant of WNK1 were protected from pain hypersensitivity in an injury-induced model of neuropathic pain. The pain-transmitting nerves in these mice were inhibited by the neurotransmitter GABA, unlike those in control mice. Thus, drugs that inhibit WNK1-dependent signaling might reduce injury-induced neuropathic pain. — NRG

Sci. Signal. **9**, ra32 (2016).

IN OTHER JOURNALS

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



Machine learning can help
model the formation and
evolution of galaxies

GALAXY SIMULATIONS

Machine learning in cosmological models

A cosmological simulation containing only dark matter is relatively easy to run, but adding gas, stars, and galaxies to the model requires sophisticated hydrodynamics and sub-grid physics. These are very computationally expensive, but Kamdar *et al.* have used a machine learning algorithm to massively speed up the process. By training the algorithm on part of a large hydrodynamic simulation, they are able to reproduce many galactic properties in the rest of the simulation just from the dark matter information, and in much less time. The technique could be used to quickly scale up detailed hydrodynamic simulations to larger dark matter-only ones, aiding in the interpretation of observational surveys. — KTS

Mon. Not. R. Astron. Soc. **457**, 1162, (2016).

GERMLINE

Soma regulates germline differentiation

In the *Drosophila* ovary, germline stem cells (GSCs) generate a cystoblast containing 16 cells, only one of which becomes an oocyte. Somatic cells adjacent to germ cells influence cystoblast

proliferation and differentiation. Upadhyay *et al.* show that the histone methyltransferase dSETDB1, located in escort cells that nurture the cystoblast, promotes differentiation and controls GSCs through the signaling factor dWnt4, which in turn regulates adherens junction proteins in escort cells to

ALSO IN SCIENCE JOURNALS

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CELL DEATH PATHWAYS

Apoptosis, necrosis, and pyroptosis

The routes to cell death are many, and distinguishing which path a particular cell may have taken remains a challenge. Wallach *et al.* review current understanding of how programmed necrotic cell death contributes to inflammation. — SMH

Science, this issue p. 51

NONHUMAN GENOMICS

Improving on the gorilla genome

Access to complete, high-quality genomes of nonhuman primates will also help us understand human biology. Gordon *et al.* used long-read sequencing technology to improve genome data on our close relative the gorilla. Sequencing from a single individual decreased assembly fragmentation and recovered previously missed genes and noncoding loci. Mapping short-read sequences from additional gorillas helped reconstruct a “pan” gorilla sequence documenting genetic variation. Comparison with human genomes revealed species-specific differences ranging in size from one to thousands of bases in length, including some that are likely to affect gene regulation. — LMZ

Science, this issue p. 52

SYNTHETIC BIOLOGY

Programming circuitry for synthetic biology

As synthetic biology techniques become more powerful, researchers are anticipating a future in which the design of biological circuits will be similar to the design of integrated circuits in electronics. Nielsen *et al.* describe what is essentially a programming language to design computational circuits in

living cells. The circuits generated on plasmids expressed in *Escherichia coli* required careful insulation from their genetic context, but primarily functioned as specified. The circuits could, for example, regulate cellular functions in response to multiple environmental signals. Such a strategy can facilitate the development of more complex circuits by genetic engineering. — LBR

Science, this issue p. 53

COLLOIDAL ORDERING

Competing forces drive ordering

The power and beauty of liquid crystals come from their tendency to order loosely over long length scales. This ordering can be tweaked using external fields, or via tailored boundary conditions, or embedded objects. Mundoor *et al.* deposited luminescent nanorods into a liquid crystal solvent (see the Perspective by Blanc). This caused a competition between local electrostatic interactions and the elastic ordering of the liquid crystal. The nanorods ordered into a triclinic structure not otherwise attainable. The authors further adjusted the structure using external fields. — MSL

Science, this issue p. 69;
see also p. 40

ELECTROCATALYSIS

A lanthanide boost for platinum

High loadings of precious platinum are needed for automotive fuel cells, because the kinetics of the oxygen reduction reaction (ORR) are relatively slow. Escudero-Escribano *et al.* studied a series of platinum alloys with lanthanides and alkaline earth elements. When the surfaces were leached to leave pure platinum, they developed compressive strain that boosted the ORR activity—up to a factor of 6 for terbium. Enthalpy effects

helped to stabilize these alloys under operating conditions. — PDS

Science, this issue p. 74

ORGANIC CHEMISTRY

Beyond textbook S_N2 chemistry

In one of best-studied organic reactions, a negatively charged ion such as chlorine replaces another atom or group of atoms in an organic molecule. According to the traditional understanding of this S_N2 reaction, pre- and post-reaction complexes form, and the configuration at the carbon that binds the ion is inverted during the reaction. In a Perspective, Xie and Hase highlight recent studies that have revealed a host of other mechanisms in the gas-phase S_N2 reaction. In some of these mechanisms, the configuration of the resulting molecule is not inverted. The dominant mechanism depends on the nature of the reactants and on the reaction conditions. For one S_N2 reaction, 28 different mechanisms have been found. — JFU

Science, this issue p. 32

ATMOSPHERIC METHANE

Getting a rise out of agriculture

Methane, a powerful and important greenhouse gas, has been accumulating nearly uninterruptedly in the atmosphere for the past 200 years, with the exception of a mysterious plateau between 1999 and 2006. Schaefer *et al.* measured methane's carbon isotopic composition in samples collected over the past 35 years in order to constrain the cause of the pause. Lower thermogenic emissions or variations in the hydroxyl-driven methane sink caused the plateau. Thermogenic emissions didn't resume to cause the subsequent rise. Instead, the ongoing rise is most likely due to

biogenic sources, most notably agriculture. — HJS

Science, this issue p. 80

CLIMATE CHANGE

Birds populations allied in abundance

Changes in climate can cause populations of species to decline, to increase, or to remain steady. Stephens *et al.* looked across species of common birds in Europe and the United States. Despite many differences between the two regions, expectations about how a species might respond to climate change did predict actual responses. Species predicted to benefit from increasing temperatures, or their associated effects, tended to increase, whereas those predicted to be negatively affected declined. Thus, even across widely varying ecological conditions and communities, climate change can be expected to alter population sizes. — SNV

Science, this issue p. 84

INFLAMMATION

Guarding inflammation

The innate immune system is genetically hardwired in each of us to protect against infection. Mutations in these protective genes can lead to uncontrolled inflammation and disease. Masters *et al.* describe a family with a hereditary autoinflammatory disease caused by a mutation in the pathogen sensor pyrin. This mutation disrupts pyrin regulation so that it acts as if it detects pathogens, even in their absence, leading to proinflammatory interleukin-1 β production. Indeed, inhibiting this interleukin in one patient eliminated the disease. Thus, pyrin regulation can guard against destructive autoinflammation in humans. — ACC

Sci. Transl. Med. **8**, 332ra45 (2016).

IMMUNOLOGY

Dialing down allergic responses

Immunity to parasites and worms, termed type 2 immunity, is a double-edged sword. The same immune cells that keep these pests at bay can go awry, causing allergy and asthma. Chan *et al.* found that an enzyme called TYRO3, a receptor tyrosine kinase, dampens type 2 immunity in mice and humans. Worm infection or an allergic stimulus caused T cells to express PROS1, which bound to TYRO3 on dendritic cells and inhibited proinflammatory mediator production. — KLM

Science, this issue p. 99



Dialing down allergic responses

Kristen L. Mueller (March 31, 2016)

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Editor's Summary

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