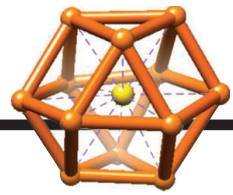
RESEARCH

The caged heart in a cluster of gold atoms
Azubel et al., *p. 909*



IN *SCIENCE* JOURNALS

Edited by **Melissa McCartney** *and* **Margaret Moerchen**

MASSIVE STARS

How huge early stars enriched the universe

How big did the first generation of stars get? Knowing their size is critical to understanding how they enriched the chemistry of the universe through supernova explosions. According to numerical simulations, some of the earliest stars were more than 100 times the Sun's mass. However, no traces of these live-fast, die-young stars had been detected in any low-mass stars still extant from that era. Aoki *et al*. now show spectra of one such metal-poor star that may have recorded the activity of a very massive predecessor (see the Perspective by Bromm). This observational evidence will spur further supernova models, as none predicts this specific chemical signature. — MMM

Science, this issue p. 912; see also p. 868

REEF ECOLOGY

Corals and reef fish choose nice homes

Young animals tend to disperse into new habitats. Can we use populations in protected areas to colonize nearby recovering or overused habitats? It seems that for corals and reef fish, the answer may be no. Dixson *et al.* show that dispersing juvenile corals and reef fish were overwhelmingly attracted to healthy reefs but were repelled by seaweeds that colonize degraded reefs (see the Perspective by Bruno). Thus, even species that appear passive in their choice of habitat may have stronger preferences than we thought. — SNV

Science, this issue p. 892; see also p. 879

QUANTUM OPTICS

Routing one photon with a few others

Single particles of light, photons, are ideal carriers of quantum information because they can travel far and fast and don't interact much with each other. However, this behavior has hampered attempts to control the propagation of single photons using all-optical setups. Shomroni *et al.* coupled a trapped atom to an optic fiber. That allowed them to control the polarization and propagation direction of a single photon in the fiber by controlling the atom's state (see the Perspective by Rempe). Because a faint pulse containing between 1.5 and 3 photons can switch the atom's state, the scheme provides a route to develop all-optical quantum networks. — ISO

Science, this issue p. 903; see also p. 871

SENSORY BIOLOGY

The makings of a powerful sweet tooth

The main attraction of nectar, a hummingbird favorite, is the sweet taste of sugar. Oddly, though, birds lack the main vertebrate receptor for sweet taste, TIR2. Baldwin *et al.* show that a related receptor, TIR1-T1R3, which generally controls savory taste in vertebrates, adapts in hummingbirds to detect sweet (see the Perspective by Jiang and Beauchamp). This repurposing probably allowed hummingbirds to specialize in nectar feeding and may have assisted the evolution of the many and varied hummingbird species seen today. — SNV

Science, this issue p. 929; see also p. 878

BONE BIOLOGY

An inhibitor breaks RANK

Osteoclasts are cells that break down bone; however, excessive bone loss leads to conditions such as osteoporosis. When three proteins called RANKL bind to three receptors called RANK on the osteoclasts' surfaces, the osteoclasts go to work. Warren *et al.* linked three mutant versions of RANKL protein together to generate an inhibitor of RANK (see the Perspective by Ou-Yang and Siegel). Two of the proteins bound more strongly to RANK, and the third protein could not bind to RANK. This engineered RANKL variant bound to RANK without activating the receptor, preventing osteoclasts from breaking down bone in mice. — JFF

Sci. Signal. **7**, ra80 and pe20 (2014).

CREDITS: (X-RAY) NASA/CXC/SAO/F. SEWARD *ET AL.*, (OPTICAL) NOAO/CTIO/MCELS, DSS

Published by AAAS

POLIO ERADICATION

Two vaccines together are better than one alone

Polio is proving difficult to eradicate. Making the choice between administering a live attenuated vaccine orally (Sabin) or an inactivated vaccine (Salk) by injection has been highly controversial. Patients prefer the Sabin vaccine, but it requires many doses to offer immunity. Jafari *et al.* tested the two vaccines together in northern India. The injected vaccine significantly reduced virus shedding and boosted intestinal mucosal immunity in children already given the oral vaccine. Thus, using both vaccines could help speed the eventual global demise of polio. — CA

Science, this issue p. 922

CLIMATE

Deep-sea warming slows down global warming

Global warming seems to have paused over the past 15 years while the deep ocean takes the heat instead. The thermal capacity of the oceans far exceeds that of the atmosphere, so the oceans can store up to 90% of the heat buildup caused by increased concentrations of greenhouse gases such as carbon dioxide. Chen and Tung used observational data to trace the pathways of recent ocean heating. They conclude that the deep Atlantic and Southern Oceans, but not the Pacific, have absorbed the excess heat that would otherwise have fueled continued warming. — HJS

Science, this issue p. 897

Oceans stow recent heat excesses

PHOTOS: (TOP TO BOTTOM) TUFTS UNIVERSITY; GETTY IMAGES/ISTOCKPHOTO

TUBERCULOSIS

How immune cells fight TB and show it

Mycobacterium tuberculosis causes an infection that can sometimes kill, but it proceeds to disease in only about 10% of individuals. Now, Montoya *et al*. provide a clue to how most people keep this bacterium in check. They show that when people fight tuberculosis, their immune cells secrete the cytokine interleukin-32, which may work through an antimicrobial pathway that uses vitamin D. The researchers analyzed five different clinical data sets and found that interleukin-32 may indicate latent tuberculosis. Interleukin-32 therefore may both contribute directly to the host response to tuberculosis and reflect protection against the disease. — ACC

Sci. Transl. Med. **6**, 250ra114 (2014).

IMMUNOGENETICS

Opening and closing blood enhancers

As cells develop and differentiate into different types, the shape and accessibility of their DNA can change. Lara-Astiaso *et al.* studied this phenomenon in blood. They developed a technique that examines a relatively small number of cells to identify the changes that affect DNA during blood development. They found that the DNA of noncoding regions, called enhancers, is set in an open position when cells are undifferentiated and able to take on a variety of roles and gradually closes as cells mature into their final forms. — LMZ

Science, this issue p. 943

IN OTHER JOURNALS

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

NEUROSCIENCE

Tissue mimics brain's cortical layers

They may look like Play-Doh, but these colorful spongy rings are alive and may one day even learn. Tang-Schomer *et al.* engineered the rings to mimic the structure and function of the six layers of human cortical brain tissue. The researchers coaxed the neurons to grow around a matrix of silk proteins immersed in collagen gel. The cells cling to the structure as they branch out and connect, forming 3D networks resembling real neural circuits, the authors say. The team hopes to keep the neuronal sponge alive for 6 months, longer than any previous model, to study how its neural networks respond to insults such as disease or traumatic injury, and perhaps to see if its activity is altered by experience, a form of learning. — EU

Brainlike tissue is a practical test bed

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1324214111.(2014).

CANCER TREATMENT

How to boost cancer immunotherapy

Why does our immune system protect us so well against infection but not against cancer? In part, this is because cancer cells use clever ways to escape immune responses designed to destroy them. A therapeutic strategy called "immune checkpoint blockade" thwarts these escape tactics and renders cancer cells vulnerable to immune attack. Although remarkably effective, only a subset of patients respond to it. Seeking possible explanations for this limited response, Kim *et al.* identified a specific immune cell population that interferes with the therapy in mouse tumor models. When the authors coadministered drugs that reduced the levels of these cells (called myeloid-derived suppressor cells), the efficacy of immune checkpoint blockade therapy greatly improved. — PAK

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1410626111 (2014).

EDUCATION

Students produce assessment materials

If teaching someone else is the best way to learn, what will students gain from writing their own test questions? Every week, as part of an introductory undergraduate physics class, Bates *et al.* required students to contribute one original test question, answer five others, and critique an additional three. The researchers used Bloom's taxonomy criteria for cognitive

ALSO IN *SCIENCE* JOURNALS

Edited by **Melissa McCartney** *and* **Margaret Moerchen**

GLACIERS

Putting the heat on Mother Nature

Humans are now the biggest cause of glacier melting. Until recently, that was not true. Glaciers take a long time—decades to centuries—to respond to the environmental changes that control their sizes. They have been retreating gradually from the peak levels they reached in the middle of the 19th century, at the end of a 500-year-long cold period called the Little Ice Age. Marzeion *et al.* show that that has recently changed though, as climate warming has continued: Over the past 20 or so years, the anthropogenic contribution to glacial mass loss has increased markedly (see the Perspective by Marshall). — HJS

Science, this issue p. 919; see also p. 872

STEM CELL THERAPY

Challenges for stem cell–based therapies

Patient-derived pluripotent stem cells (PSCs) hold promise in the treatment of injury and disease. An ever-increasing number of specific cell types can be generated from PSCs, but technical challenges remain in applying these cells in the clinic. Fox *et al.* review the challenges in attaining this goal. These include gene modification, cell rejection, and delivery and localization issues involved in transplantation of cells for the treatment of diabetes and disorders of the blood, liver, heart, and brain. — BAP

Science, this issue p. 889

POLITICAL SCIENCE

Censorship of social media in China

Figuring out how many and which social media comments are censored by governments is difficult because those comments, by definition, cannot be read. King *et al.* have posted comments to social media sites in China and then waited to see which of these never appeared, which appeared and were then removed, and which appeared and survived. About 40% of their submissions were reviewed by an army of censors, and more than half of these never appeared. By varying the content of posts across topics, they conclude that any mention of collective action is selectively suppressed. — GJC

Science, this issue p. 891

PLANT DEVELOPMENT

Removing the nucleus in sieve elements

Although a cell's nucleus performs critical command and control functions, some cell types, such as enucleated red blood cells, seem to do without. Sieve element cells in plants similarly carry out their function of transporting nutrients and signals from one end of the plant to the other without the guidance of a nucleus. Furuta *et al.* watched how the nucleus self-destructs during the development of sieve element cells (see the Perspective by Geldner). The process is regulated under the control of transcription factors, even as the entire nuclear edifice crumbles into nothingness. – PJH

Science, this issue p. 933; see also p. 875

RIBOSWITCHES

A dual-action RNA switch for expression

Riboswitches are short segments of RNA that bind small molecules and switch between two different conformations, thereby regulating gene expression (see the Perspective by Chen and Gottesman). DebRoy *et al*. and Mellin *et al.* find a new class of riboswitches—in two different species of bacteria—that are both part of and regulate the production of a noncoding RNA. Each riboswitch ensures that a particular metabolic pathway is only activated in the presence of an essential small-molecule cofactor. In the absence of the cofactor, the full-length noncoding RNA is made and binds a regulator protein, preventing the regulator protein from inappropriately activating the metabolic pathway. — GR

Science, this issue p. 937 and p. 940; see also p. 876

NANOPARTICLE GROWTH

Watching platinum nanocube growth

Size and shape drive the properties of metal nanoparticles. Understanding the factors that affect their growth is central to making use of the particles in a range of applications. Liao *et al.* tracked the growth of platinum nanoparticle shapes at high resolution using state-of-the-art liquid cells for in situ monitoring inside an electron microscope. The authors tracked changes in the growth rates at different

crystal facets caused by differences in the mobility of the capping ligand. — MSL

Science, this issue p. 916

NANOPARTICLE IMAGING

Detailed structure of a gold nanoparticle

Adding only a few atoms or changing the capping ligand can dramatically change the structure of individual metal nanoparticles. Azubel *et al.* used aberration-corrected transmission electron microscopy to derive a three-dimensional reconstruction of water-soluble gold nanoparticles. Small-angle x-ray scattering and other techniques have also corroborated this model. They used this to determine the atomic structure, which compared favorably with density functional theory calculations, without assuming any a priori structural knowledge or the use of model fitting. — MSL

Science, this issue p. 909

HELIUM SUPERFLUIDITY

X-raying superfluid helium droplets

When physicists rotate the superfluid ^{4}He, it develops a regular array of tiny whirlpools, called vortices. The same phenomenon should occur in helium droplets half a micrometer in size, but studying individual droplets is tricky. Gomez *et al.* used x-ray diffraction to deduce the shape of individual rotating droplets and image the resulting vortex patterns, which confirmed the superfluidity of the droplets. They found that superfluid droplets can host a surprising number of vortices and can rotate faster than normal droplets without disintegrating. — JS

Science, this issue p. 906

PLANT GENETICS

The genomic origins of rape oilseed

Many domesticated plants arose through the meeting of multiple genomes through hybridization and genome doubling, known as polyploidy. Chalhoub *et al.* sequenced the polyploid genome of *Brassica napus*, which originated from a recent combination of two distinct genomes approximately 7500 years ago and gave rise to the crops of rape oilseed (canola), kale, and rutabaga. *B. napus* has undergone multiple events affecting differently sized genetic regions where a gene from one progenitor species has been converted to the copy from a second progenitor species. Some of these gene conversion events appear to have been selected by humans as part of the process of domestication and crop improvement. — LMZ

Science, this issue p. 950

CARBON CYCLE

Illuminating the pathway to destruction

Arctic lakes are an important source of atmospheric CO_2 and therefore play a role in climate change. It is thus vital to know how the rapid Arctic warming will affect them. Cory *et al.* now show that light is the biggest culprit in the breakdown of carbon from thawing permafrost soils (see the Perspective by Tranvik). This carbon then moves out into Arctic lakes and streams. Contrary to previous expectations, these photochemical processes cause much more destruction of the organic molecules in fresh water than bacterial respiration does. — HJS

Science, this issue p. 925; see also p. 870