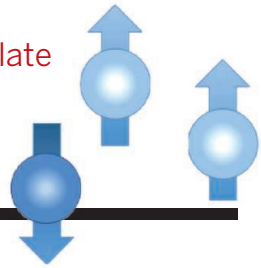
RESEARCH

Nuclear spins simulate complex materials

Alvarez et al., *p. 846*



IN *SCIENCE* JOURNALS

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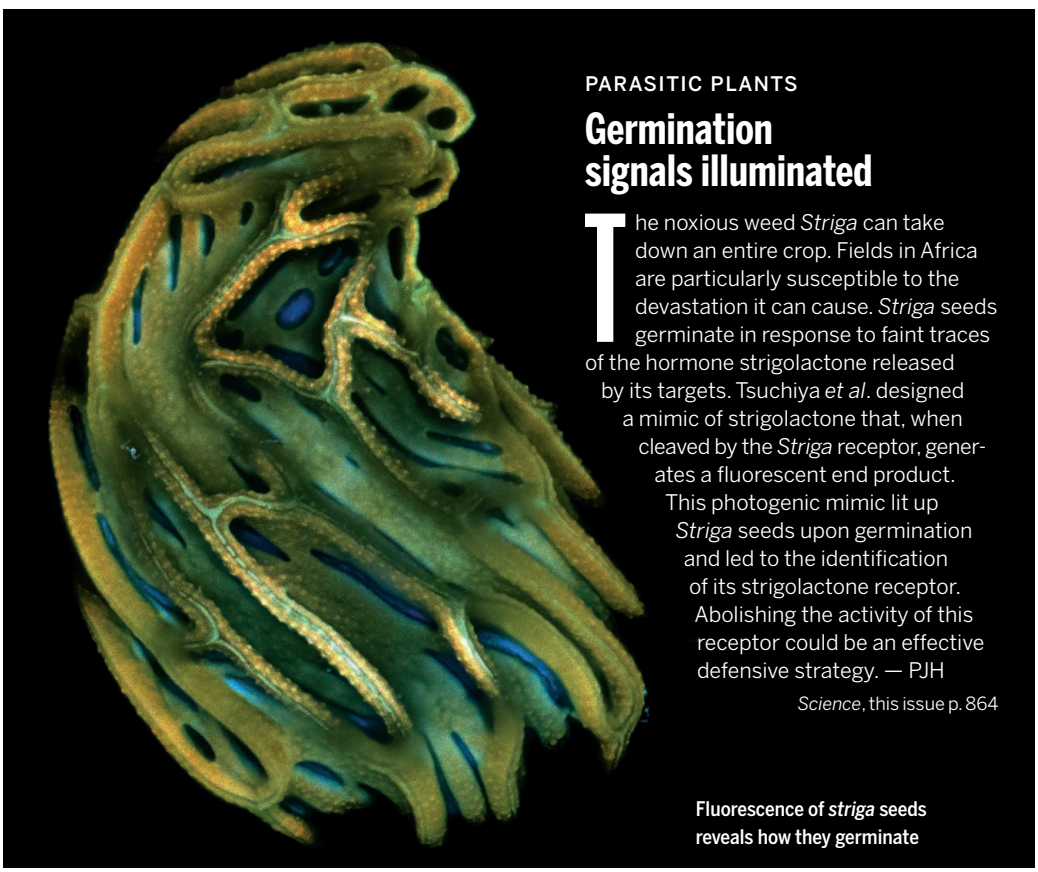


PARASITIC PLANTS

Germination signals illuminated

The noxious weed *Striga* can take down an entire crop. Fields in Africa are particularly susceptible to the devastation it can cause. *Striga* seeds germinate in response to faint traces of the hormone strigolactone released by its targets. Tsuchiya *et al*. designed a mimic of strigolactone that, when cleaved by the *Striga* receptor, generates a fluorescent end product. This photogenic mimic lit up *Striga* seeds upon germination and led to the identification of its strigolactone receptor. Abolishing the activity of this receptor could be an effective defensive strategy. — PJH

Science, this issue p. 864

Fluorescence of *striga* seeds reveals how they germinate

TRANSCRIPTION

Transcription factor shape-shifts DNA

Controlling when a gene is expressed or repressed is vital for cellular metabolism and development. In *Escherichia coli*, a copper-sensing transcription factor, CueR, can repress or activate expression when bound at exactly the same site in the gene promoter. Philips *et al.* used x-ray crystallography to show that CueR dramatically changes the topology of the DNA upon binding copper but does not affect protein-DNA contacts. The DNA shape change allows RNA polymerase to bind the promoter and transcribe the gene. — GR

Science, this issue p. 877

ASTROPHYSICS

Limiting unknowns in the dark side

Our knowledge of the inventory of stuff that makes up our universe amounts to a humbling 5%. The rest consists of either dark energy (~70%) or dark matter (~25%). Using atom interferometry, Hamilton *et al.* describe the results of experiments that controlled for dark energy screening mechanisms in individual atoms, not bulk matter. Aprile *et al.* report on an analysis of data taken with the XENON100 detectors aiming to identify dark matter particles directly by monitoring their rare interaction with ordinary matter. In this setup, a large underground tank of liquid xenon forms a target for weakly interacting m assive particles. These combined results set limits on several types of proposed dark matter and dark energy candidates (see the Perspective by Schmiedmayer and Abele). — ISO

Science, this issue p. 849, p. 851; see also p. 786

QUANTUM GASES

Making interacting atoms localize

Disorder can stop the transport of noninteracting particles in its tracks. This phenomenon, known as Anderson localization, occurs in disordered solids, as well as photonic and cold atom settings. Interactions tend to make localization less likely, but disorder, interactions, and localization may coexist in the so-called many-body localized state. Schreiber *et al*. detect many-body localization in a one-dimensional optical lattice initially filled with atoms occupying alternating sites. Externally induced disorder and interactions prevented the system from evolving quickly to a state with a single atom on each site. — JS

Science, this issue p. 842

HUMAN IMPACTS

An anomalous and unbalanced predator

In the past century, humans have become the dominant predator across many systems. The species that we target are thus far in considerable decline; however, predators in the wild generally achieve a balance with their prey populations such that both persist. Darimont *et al*. found several specific differences between how humans and other predatory species target prey populations (see the Perspective by Worm). In marine environments, for example, we regularly prey on other predator species. These differences may contribute to our much larger ecological

IMAGES: (TOP TO BOTTOM) ALVAREZ *ET AL.*; YOSHIKATSU SATO/LIVE IMAGING CENTER/INSTITUTE OF TRANSFORMATIVE BIO-MOLECULES

Published by AAAS

impact when compared with other predators. — SNV

Science, this issue p. 858; see also p. 784

SIGNAL TRANSDUCTION

Membrane potential regulates growth

Changes in electrical potential across the plasma membrane can affect cell growth. Zhou *et al*. discovered that membrane potential influenced the organization of phospholipids in the membrane of cultured mammalian cells and neurons in intact flies (see the Perspective by Accardi). This in turn regulated localization and activity of the small guanine nucleotide binding protein K-Ras, an important regulator of cell proliferation. The cell membrane may thus function analogously to a field-effect transistor by adjusting the strength of mitogenic signaling. — LBR

Science, this issue p. 873; see also p. 789

BIOCHEMICAL PROCESSES

Protonation by "Newton's cradle"

Imagine raising the ball on one end of a Newton's cradle. Upon release and the subsequent collision, the ball at the other end of the device flips up in response. Using high-resolution neutron diffraction, Nakamura *et al*. discovered an enzymatic proton relay chain that may operate in much the same fashion. In a glycoside hydrolase from the mushroom *Phanerocaete chrysosporium*, protons are relayed along a structure created by the enzyme from a distant asparagine to the catalytic asparagine through sequential tautomerizations. — PLY

Sci. Adv. 10.1126/sciadv.1500263 (2015)

PLANT MICRIOBIOME

Immune signals shape root communities

To thwart microbial pathogens aboveground, the plant *Arabidopsis* turns on defensive signaling using salicylic acid. In *Arabidopsis* plants with modified immune systems, Lebeis *et al*. show that bacterial communities change in response to salicylic acid signaling in the root zone as well (see the Perspective by Haney and Ausubel). Abundance of some root-colonizing bacterial families increased at the expense of others, partly as a function of whether salicylic acid was used as an immune signal or as a carbon source for microbial growth. — PJH

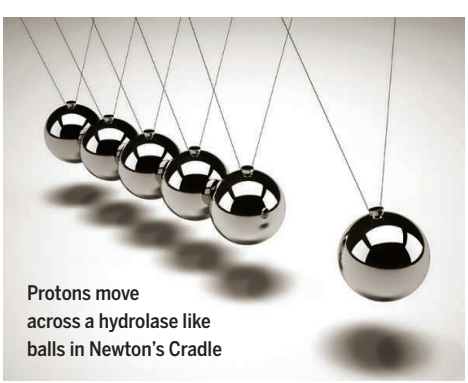
Science, this issue p. 860; see also p. 788

ASTHMA

A tale of two asthmas

Classifying diseases according to symptoms is rapidly becoming an outmoded practice. Targeted therapeutics have shown that sets of symptoms can be caused by different pathogenic mechanisms. Choy *et al*. demonstrate that asthma can be divided into three immunological clusters—T_H2-high, T_H17-high, and T_H2-T_H17-low. The T_H2-high and T_H17-high clusters inversely correlate in a mouse model of asthma, whereby neutralizing one signature promoted the other. Combination therapies targeting both pathways might better treat asthmatic individuals. — ACC

Sci. Transl. Med. **7**, 301ra129 (2015)



Protons move across a hydrolase like balls in Newton's Cradle

PHOTOS: (LEFT TO RIGHT) ORLA/ISTOCK; W.-K. LEE *ET AL*.

IN OTHER JOURNALS

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

Hierarchical wrinkles made by three generations of sequential wrinkling

MATERIALS SCIENCE

When wrinkling is a good thing

A common feature of gecko feet, which show strong adhesion to many surfaces, and the lotus leaf, which can repel water, is a hierarchical, patterned surface that extends across many length scales with controlled regions of order and disorder. Textured surfaces can be synthetically mimicked, but can require complex lithographic methods to make. Lee *et al.* use a hierarchical wrinkling approach to achieve large-scale patterning, where both the wavelength and orientation of previous-generation wrinkles can be preserved and built upon. Reactive ion etching creates a skin layer on a polystyrene substrate, leading to wrinkling. By adjusting the etching time, they control the wavelength of the wrinkles, with the orientation tuned by prestretching the substrate in one or two directions. — MSL

Nano Lett. 10.1021/acs.nanolett.5b02394 (2015).

MEMBRANE PROTEINS

Probing the activity of two proteases

Presinilin (PS), the transmembrane catalytic subunit of the enzyme γ-secretase, is a drug target of high interest. This is because it cleaves both amyloid precursor protein, which is implicated in Alzheimer's disease, and Notch, a protein involved in several cancers. How potential therapeutics may affect related proteins, such as signal peptide peptidase (SPP), an enzyme that has an active site similar to that of PS, is unclear. To

ALSO IN *SCIENCE* JOURNALS

Edited by **Nick Wigginton**

TRANSCRIPTION

Keeping gene transcription in check

Transcription of all genes is carried out by RNA polymerase (RNAP). The enzyme is thus a pivotal regulation point for many cell and developmental processes. In bacteria, sigma factors play a vital role in transcription regulation, with σ54 being critical for transcription of many stress response genes. Yang *et al.* determined the x-ray crystal structure of RNAP bound to σ54, as well as promoter DNA. In the initial inhibited state of the RNAP-σ54 complex, the σ54 blocks the template DNA from entering the RNAP active site and the downstream DNA channel. — GR

Science, this issue p. 882

POPULATION GENETICS

Genetic history of Native Americans

Several theories have been put forth as to the origin and timing of when Native American ancestors entered the Americas. To clarify this controversy, Raghavan *et al*. examined the genomic variation among ancient and modern individuals from Asia and the Americas. There is no evidence for multiple waves of entry or recurrent gene flow with Asians in northern populations. The earliest migrations occurred no earlier than 23,000 years ago from Siberian ancestors. Amerindians and Athabascans originated from a single population, splitting approximately 13,000 years ago. — LZ

Science, this issue p. 841

RNA SPLICING

Regulation of splicing regulators

The messenger RNAs of most eukaryotic genes are formed by splicing together a series of exons and removing the intervening introns. The identity and order of the exons can vary between mRNAs for the same gene. The alternatively spliced products can generate an increased diversity of protein products. Gueroussov *et al*. show that the alternative splicing of a mammalian splicing regulatory factor affects, in turn, the alternative splicing of a wide range of target RNAs. This regulation mechanism controls a brain-specific alternative splicing program. —GR

Science, this issue p. 868

ECOLOGICAL THEORY

A model for who eats and who is eaten

There are many types of interactions between those that eat and those that are eaten. A multitude of theoretical equations describe these dynamics, from predator and prey to parasite and host. Lafferty *et al*. show that all forms of these relationships come down to fundamental consumer-resource interactions. Derived from the myriad complex interactions, a simple model can accommodate any such interaction, simplifying past models into a general theory of eat and be eaten. — SNV

Science, this issue p. 854

QUANTUM SIMULATION

The dynamics of dipolar interactions

Well-controlled systems, such as cold atomic gases, can simulate more complicated materials. Applying this quantum simulation concept to the study of magnetism, Alvarez *et al*. add an interesting twist. Instead of cold atoms, a network of nuclear spins of hydrogen in polycrystalline adamantane serves as a simulator. Using nuclear magnetic resonance techniques, the authors could induce a transition from a state in which all spins coupled to each other to a state in which coherent spins grouped into clusters. — JS

Science, this issue p. 846

CANCER

Inhibiting two pathways is better than one

The ERK and JNK pathways are mitogen-activated protein kinase pathways that can be hijacked by cancer cells. Many melanoma patients have activating mutations in an upstream kinase in the ERK pathway, but its inhibitors produce only short-term improvement in these patients. Ramsdale *et al*. show that increased levels of a transcription factor activated by the JNK pathway were responsible for inhibitor resistance in the ERK pathway and contributed to metastatic potential. ERK kinase inhibitors were more effective at killing melanoma cells in culture and in mice if transcription cofactor levels or their activation by the JNK pathway also decreased. — LKF

Sci. Signal. **8**, ra82 (2015).