

adsorptive membranes through the incorporation of porous aromatic framework (PAF) nanoparticles into ion exchange membranes such as those made from sulfonated polymers. Salts are removed using a series of cation and anion exchange membranes, and the PAF particles can be selected to capture specific target ions, such as those of copper, mercury, or iron. This allows for simultaneous desalination and decontamination of the water. —MSL

*Science*, this issue p. 296

## QUANTUM NETWORKS

### A three-node quantum network

Future quantum networks will provide the means to develop truly secure communication channels and will have applications in many other quantum-based technologies. Pompili *et al.* present a three-node remote quantum network based on solid-state spin qubits (nitrogen-vacancy centers in diamond) coupled by photons. The implementation of two quantum protocols on the network, entanglement distribution and entanglement swapping, illustrates a key platform for exploring, testing, and developing multinode quantum networks and quantum protocols. —ISO

*Science*, this issue p. 259

## 2D MATERIALS

### Twisted and nematic

Electrons in quantum materials can break rotational symmetry even when the underlying crystal lattice does not. This phenomenon, called nematicity, has been observed in many unconventional superconductors. Cao *et al.* found that magic-angle twisted bilayer graphene, in which superconductivity was recently discovered, also exhibits nematicity. The breaking of rotational symmetry was observed through transport measurements, which exhibited characteristic anisotropy. —JS

*Science*, this issue p. 264

## TUMOR IMMUNOLOGY

### Sequence of immunotherapy matters

Immune checkpoint blockade is clinically successful in various cancer types, yet many treated patients relapse. Determining effective combination therapies that induce systemic antitumor immunity is crucial. Immune checkpoint blockade combined with local radiation can improve antitumor responses, but it remains unclear how the sequence of these therapies alters efficacy. Wei *et al.* used mouse tumor models to demonstrate that treatment with anti-PD-1 after stereotactic body radiation therapy (SBRT) elicited superior systemic antitumor immunity, abscopal effects, and protection compared with anti-PD-1 given before SBRT. These data were correlated with improved intratumoral CD8<sup>+</sup> T cell responses and decreased CD8<sup>+</sup> T cell death in local and distant tumors. This work provides preclinical rationale for giving anti-PD-1 after SBRT in patients with cancer. —DAE

*Sci. Immunol.* **6**, eabg0117 (2021).

## IMAGING

### Pathogen-specific PET

*Enterobacterales* infections can affect diverse locations within the body, and multidrug-resistant strains are difficult to diagnose and treat. Ordonez *et al.* used an <sup>18</sup>F-labeled sugar alcohol as a bacteria-specific imaging agent to detect and monitor infections in patients. Positron emission tomography (PET)/computerized tomography imaging showed selective uptake of the tracer in *Enterobacterales* infections as opposed to other types of inflammation or cancer. Signal was reduced in sites of drug-susceptible infections in patients after treatment with antibiotics. The authors also showed that the imaging agent could differentiate bacterial infection from severe acute respiratory syndrome coronavirus 2 in a hamster model, supporting its use for bacteria-specific imaging. —CC

*Sci. Transl. Med.* **13**, eabe9805 (2021).

## IN OTHER JOURNALS

Edited by **Caroline Ash**  
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## EVOLUTION

### One problem, several solutions

Climate change is increasing desertification and increasing demands on heat and desiccation tolerance. To understand how species adapt to similar challenging environments, Colella *et al.* undertook a comparative genomic study of three species of *Peromyscus* mice that live in overlapping arid North American environments. *Peromyscus maniculatus* and *Peromyscus eremicus* are more closely related to each other than to *Peromyscus crinitus*. However, *P. maniculatus* occupies a broad range of habitats, and *P. eremicus* and *P. crinitus* are restricted to desert environments. The genes under selection for the desert species were found to be functionally similar, but overlapping selection was only observed for a gene involved in ribosomal function. Selective sweeps within the *Peromyscus* genomes have occurred, but each species appears to be under selection for different genes rather than following parallel evolutionary tracks. Therefore, even under similar environmental pressures, species can show different genomic adaptations. —LMZ

*J. Hered.* **esab009** (2021).

The deer mouse, *Peromyscus maniculatus*, and its relatives have special genomic signatures for survival under desert conditions.

## EVOLUTIONARY COGNITION

### I know what I saw

Over the past several decades, evidence has accumulated showing that some nonhuman animals have conscious awareness. Some argue that despite high-level cognitive function, this may be occurring without conscious awareness of self. Unfortunately, we cannot ask animals to report

their experiences. Ben-Haim *et al.* exploited the human faculty for crossover double dissociation between nonconscious and conscious processing and applied it to rhesus macaques. People perform in completely opposite ways when they are aware of stimuli compared with when they are not. In the authors' visual tests, the macaques showed nearly identical responses to those of humans,

Bioluminescent bacteria in the Hawaiian bobtail squid, *Euprymna scolopes*, use a small molecule to coordinate light production and symbiosis.



## MICROBIAL SIGNALING

### Light conversation

In dedicated symbioses, a host organism can communicate with and provide a favorable environment for a single microbial species or even a single strain. The Hawaiian bobtail squid, *Euprymna scolopes*, has such a relationship with the bioluminescent bacterium *Vibrio fischeri*, which colonizes the squid's light organs. Zink *et al.* used imaging mass spectrometry to identify the cyclic dipeptide cyclo(D-histidyl-L-proline) as a contributor to biofilm formation, which is important for successful colonization. This molecule, which is likely produced by the bacteria in response to signals from the squid, was present in the colonized squid light organ and stimulated luminescence by the bacteria *in vitro*. —MAF *mBio* 12, e03636-20 (2021).

indicating that the monkeys reacted differently when they were consciously aware that they had seen a stimulus compared with when they were not. —SNV

*Proc. Natl. Acad. Sci. U. S. A.* 118, e2017543118 (2021).

## GEOLOGY

### Clay-driven compaction

Active gas reservoirs often subside during fossil fuel production. The mode of deformation, elastic or inelastic, is critical for assessing the production impact and hazard associated with extraction. Verberne *et al.* compared two drill cores from before and 50 years after gas production began in the Groningen field in the Netherlands. Detailed observations revealed that the permanent deformation was due to the fracture of feldspar grains,

which was driven by deformation of weak clay films. Better understanding this compaction is vital for modeling this site, along with others in various stages of production. —BG

*Geology* 10.1130/G48243.1 (2020).

## SIGNAL TRANSDUCTION

### Taking control of networks

Cell-regulatory signaling pathways can be mapped as binary interaction graphs and Boolean networks. Disruption of such networks might be translatable into cancer therapies, for instance, but it is difficult to predict the best ways to do this. Part of the problem may be the redundancy of causal connections in networks, which likely buffers critical circuits to

unintended perturbations but makes intended adjustments harder to define. Gates *et al.* propose a method to define the “effective graph” for interventions that can switch a system into a more desirable state. The method showed promise in analyzing complex networks controlling flower development and in a breast cancer model. Further testing in other biological systems will determine whether this difficult problem might yield to an effective graph method. —LBR

*Proc. Natl. Acad. Sci. U. S. A.* 118, e2022598118 (2021).

## VACCINES

### Vaccines, economics, and evolution

Persistent respiratory tract infections caused by *Streptococcus*

*pneumoniae* (pneumococcus) lead to chronic antibiotic misuse. However, the dangers of death from antibiotic resistance, which leads to invasive disease, are growing. Using an agent-based model, Lu *et al.* demonstrate that, to some extent, we can vaccinate our way out of trouble. China accounts for about 12% of global childhood pneumococcal infections. Increasing pneumococcal conjugate vaccine coverage in this country would reduce the use of several common antibiotics. The authors tested various scenarios, including accelerated vaccine coverage, which after 5 years reduces antimicrobial resistance by up to 17% and cumulative costs by up to \$586 million USD. Thus, government investment in pneumococcal vaccination can bring both economic and evolutionary benefits. —CA

*Proc. Natl. Acad. Sci. U. S. A.* 118, e2004933118 (2021).

## SCIENCE COMMUNICATION

### Creative destruction by review papers

Reviews allow scientists to curate, synthesize, and simplify individual findings into a coherent overview of a specific field. However, once the review is available, what happens to the individual findings themselves? McMahan and McFarland analyzed data from millions of journal articles to determine the consequences of review articles for the publications they cite. In general, the review is cited instead of the specific findings contained within, resulting in a loss of future citations for individual papers. Additionally, reviews lead to focused attention around key findings and the relations between them, resulting in a substantial simplification of a domain of knowledge. The authors describe this as “creative destruction,” in which those who do the science become overshadowed by those who summarize the science. —MMC

*Am. Sociol. Rev.* 10.1177/0003122421996323 (2021).

PHOTO: JEFFREY MILLSEN