RESEARCH HIGHLIGHTS

Selections from the scientific literature

NEUROSCIENCE

Brain signature for thermal pain

Brain activity could one day help physicians to monitor pain, for which there is no reliable physiological test.

Using a type of magnetic resonance imaging that shows when certain parts of the brain are activated, Tor Wager at the University of Colorado Boulder and his colleagues started out by scanning the brains of 20 volunteers as they experienced warm to painfully hot sensations on their arm. They used these data to find a pattern of neural activation and deactivation that consistently appeared when the volunteers were exposed to painful heat. Further tests showed that this signature could discriminate physical pain from other stimuli, such as social pain and recollections of pain. The signature was reduced by analgesics. Such patterns could one day lead to more-objective assessments of pain.

N. Engl. J. Med. 368, **1388–1397 (2013)**

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CLIMATE CHANGE

Desert plants reap no rewards

Atmospheres that are enriched with carbon dioxide can boost plant productivity in some ecosystems, but drought may prevent faster or greater growth in desert plants, such as those of the Mojave Desert (pictured) in the southwestern United States.

Researchers led by Beth Newingham then at the University of Nevada in Las Vegas measured productivity above and below ground for plants that were exposed to high levels of atmospheric carbon dioxide at experimental sites in the Mojave Desert for a decade.

They found that dominant shrub and grass species that were exposed to higher levels of carbon dioxide showed some gains in weight and photosynthesis in wet years compared with plants at control sites that were exposed to ambient carbon dioxide, but that these gains were not sustained during drought.

Desert ecosystems, which cover around one-third of Earth's land surface, may be more limited by water than by carbon, the authors suggest.

Glob. Change Biol. **http://dx.doi.org/10.1111/gcb.12177 (2013)**

SYMBIOSIS

Roots spur on helpful biofilms

Components of plant cell walls can induce a bacterium that is used as a plant fertilizer to assemble itself into sticky mats known as biofilms.

Biofilms are often associated with hard-to-treat infections in animals, but those formed by the soil bacterium *Bacillus subtilis* actually protect plants from pathogens. A team led by Roberto Kolter at Harvard Medical School in Boston, Massachusetts, reports how signals from the roots of the model plant *Arabidopsis thaliana* prompt bacteria to join up. Pectin and other polysaccharides on the surface of plant cell walls activate bacterial genes known to induce biofilms. The polysaccharides also form the raw materials that bacteria use to synthesize the extracellular matrix that holds the biofilm together. The plant, therefore, provides both the environmental cue and the building blocks to promote beneficial colonization of its roots.

Proc. Natl Acad. Sci. USA **http://dx.doi.org/10.1073/pnas.1218984110 (2013)**

CONSERVATION BIOLOGY

Old evidence for fewer fish

The price of fish in the 1800s has helped to reveal the long-term effects of bottom trawling, a fishing practice in which nets are dragged across the seabed.

Ruth Thurstan, now at the University of Queensland in Brisbane, Australia, and her colleagues examined the testimonies of hundreds of fishermen in the northeast of England about changes to fish stocks and practices during the nineteenth century.

Statements about catch rate, price and fish size, which were given during two Royal Commissions of Enquiry (in 1863–66 and in 1883–85), revealed a perception by fishermen that numbers of

white fish, such as cod, had fallen by 64% during their careers. Many fishermen blamed the declines on trawling. These largely forgotten records suggest that trawling began to affect fish stocks long before scientific monitoring and official statistics began.
***Fish Fish*. http://dx.doi.org/10.1111/faf.12034 (2013)**
For a longer story on this research, see go.nature.com/5rbcvq

BIOMATERIALS

Leafy trap for bedbugs' legs

A natural Eastern European folk remedy catches bedbugs more effectively than synthetic mimics.

Catherine Loudon at the University of California, Irvine, and her colleagues used scanning electron microscopy and videography to document why bean leaves, which are traditionally scattered around an infected bed to trap bedbugs (*Cimex lectularius*) are effective. Tiny hairs on the leaves, known as trichomes, trap the insects by impaling their feet and hooking their legs (**pictured**). The researchers designed a synthetic mimic of the hairs with a polyvinylsiloxane moulding material often used in dentistry, and a hybrid mimic made of synthetic stalks and natural trichome tips. Although both mimics snagged the bugs, they could not impale them. This suggests that a better bug trap may need to recapitulate the mechanical properties of bean leaf trichomes more closely.
J. R. Soc. Interface 10, **20130174 (2013)**

MEGAN SZYNDLER/CATHERINE LOUDON

CELL BIOLOGY

Super-enhancers rule genes

The myriad biomolecules that regulate gene expression are governed by an unanticipated layer of control.

Researchers led by Richard Young at the Massachusetts Institute of Technology in Cambridge have found assemblies of enhancers — segments of DNA that associate with regulatory proteins and attach to genes to switch them on — that they have named super-enhancers. Compared with ordinary enhancers, super-enhancers bind to more proteins that activate gene transcription and are more sensitive to perturbation. The teams found that some cancer cells assemble pathological super-enhancers. Human cells contain tens of thousands of genes and many more enhancers, but most are controlled by only a few hundred super-enhancers that bestow characteristic properties on each cell type, the authors suggest.
Cell 153, **307–319; 320–334 (2013)**
For a longer story on this research, see go.nature.com/spue5g

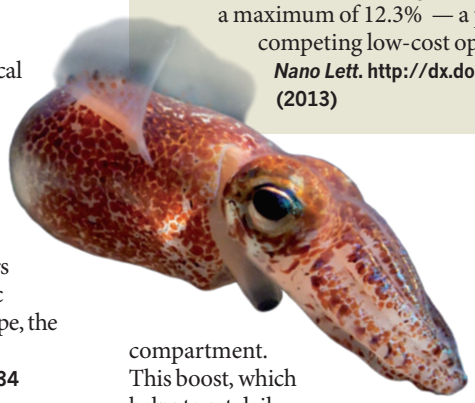
ECOLOGY

Symbionts set squid's clock

The tick-tock of an animal's daily clock can be set, in part, by beneficial bacteria.

At night, the bacterium *Vibrio fischeri* glows in a compartment in the underbelly of its symbiotic host, the Hawaiian bobtail squid (*Euprymna scolopes*; **pictured**), hiding the squid's shadow in the moonlight. Margaret McFall-Ngai at the University of Wisconsin—Madison and her colleagues have found that the light-producing bacteria also cause the squid to boost expression of its light-responsive gene *escry1* in the colonized compartment. This boost, which helps to set daily rhythms, did not occur in bacteria-free squid, even if they were exposed to blue light to mimic bacterial glow. But when researchers provided squid with light as well as bits of the bacterium's cell envelope, *escry1* cycling returned. The researchers suggest that microbiota could also set daily rhythms in mammals.
mBio 4, **e00167-13 (2013)**

CHRISTOPHER FRAZEE



IMMUNOLOGY

Proteins that rouse also quash

Signalling pathways that initially orchestrate potent antiviral attacks can, paradoxically, also help to sustain chronic infections.

Proteins called type I interferons (IFN-I) curb viral replication during early stages of infection, but are unable to clear chronic infections. To solve this long-standing puzzle, independent groups led by David Brooks at the University of California, Los Angeles, and Michael Oldstone at the Scripps Research Institute in La Jolla, California, studied mice infected with strains of lymphocytic choriomeningitis virus that cause chronic infection.

Both groups found that IFN-I produces an initial burst of antiviral activity, but then depresses the immune system over the long term, allowing the virus to persist.

Chronic activation of the immune system can damage tissue, and the authors speculate that IFN-I signalling dampens the immune-system response to limit this damage. Inhibiting IFN-I signalling may help to control chronic viral infections, they say.
Science 340, **202–207; 207–211 (2013)**

COMMUNITY CHOICE

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PHOTOVOLTAICS

Cheap, colourful solar cells

HIGHLY READ on pubs.acs.org 21 Mar–18 April

A light-harvesting crystal can make efficient, colourful and low-cost devices that convert sunlight into electricity.

Researchers led by Sang Il Seok at the Korea Research Institute of Chemical Technology in Daejeon, South Korea, created metal–organic hybrid materials that were composed of lead; methylammonium; and iodine or bromine, or both. Semiconductors used in solar cells can be coated in these materials, which absorb light and displace electrons that the semiconductor transfers to an external circuit. By varying ratios of bromine and iodine, the researchers tuned the material's stability and light-absorption properties to produce solar cells with a variety of translucent colours, from dark brown to yellow. On average, the cells could convert 10% of sunlight energy into electricity, with a maximum of 12.3% — a performance that matches competing low-cost options.
***Nano Lett.* http://dx.doi.org/10.1021/nl400349b (2013)**

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