

normally occur in the environment. How it recognizes this compound was the subject of a recent study by Marta Perego and her colleagues at the Scripps Research Institute in La Jolla, California.

They searched the literature for other organisms that use bicarbonate, and found work on a photosynthetic bacterium, *Synechococcus elongatus*. This shuttles bicarbonate through its cell membrane by means of a multiprotein structure known as an ABC transporter. A scan of *B. anthracis*' genome for genes that encode similar proteins pinpointed a section named BAS2714-12. Deleting this region rendered the pathogen harmless to mice.

ECOLOGY

The alien within

Proc. Natl Acad. Sci. USA

doi:10.1073/pnas.0809423105 (2008)

South American fire ants (*Solenopsis invicta*) have been shown to invade Florida's extensive pine flatwoods only where human activities such as mowing or ploughing create a disturbance.

Joshua King and Walter Tschinkel of Florida State University in Tallahassee set up several types of plot: undisturbed, mowed and ploughed, and added fire ants to some of each plot type. Fire ants can't displace native ants on their own; instead, disturbance makes this possible by reducing native ant populations and creating habitats in which fire ants do particularly well.

NANOTECHNOLOGY

Scalable solution

Nature Nanotech. doi:10.1038/nnano.2008.365 (2008)

Sodium; ethanol; heat; sound waves: those easy-to-come-by, cheap ingredients are all that John Stride and his team at the University of New South Wales in Australia needed to make a couple of grams of pure carbon in the form of graphene.

Graphene is just one atom thick and looks like molecular chicken wire. First isolated in 2004, it is the strongest material known, and should make tomorrow's mix of power-hungry consumer gadgets lighter and more efficient. The problem has been that graphene is devilishly difficult to manufacture in large amounts.

Stride and his colleagues first reacted ethanol and sodium, then broke down a solid intermediate of the reaction by heating. This generated a fused pack of graphene sheets that they then broke apart with gentle sonication.

ANIMAL BEHAVIOUR

Love bite

J. Evol. Biol. doi:10.1111/j.1420-9101.2008.01636.x (2008)

Female sagebrush crickets (*Cyphoderris strepitans*) munch off males' wingtips during mating (pictured), stimulating an immune reaction that saps males' energy and makes it harder for them to woo other females.

Scott Sakaluk and his students at Illinois State University in the town of Normal arrived at this conclusion after measuring the cost of the immune response to male sexual vigour. They injected some wild-caught virgin males with lipopolysaccharides that trigger their immune systems, and others with a substance that has no such effect.

Lipopolysaccharides drastically reduced the courtship behaviour and mate procurement of male sagebrush crickets. Females seem to gain nothing more than a good meal from this act of aggression.



D. FUNK

IMMUNOLOGY

T cells get tired

Nature Immunol. doi:10.1038/ni.1679 (2008)

During chronic infection, immune systems' T cells often lose their ability to fight pathogens. Research now shows that this T-cell exhaustion is caused by complex negative-feedback pathways that depend on the types of inhibitory receptor the cells express on their surfaces.

By examining gene expression in mice with a chronic infection, John Wherry of the Wistar Institute in Philadelphia, Pennsylvania, and his colleagues found that up to seven inhibitory receptors, which are not made in fully functional T cells, are expressed in exhausted T cells. The more severe the infection, the more members and amounts of this septet the T cells produced.

Simultaneously blocking the function of two such receptors — PD-1 and LAG-3 — incompletely restored exhausted T cells' activity, indicating that multiple pathways are involved in T-cell exhaustion.

JOURNAL CLUB

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A neuroscientist marvels at our ability to learn unnatural tasks.

I find driving mind-boggling. As a neuroscientist studying motor control, I am amazed that nervous systems can adapt to the unnatural demands of operating a car. After all, humans did not evolve in habitats with steering wheels or accelerator pedals. What makes our ability to drive so curious is that it requires the modification of reflexes — twisting the steering wheel, for instance, rather than jumping aside, when an obstacle approaches.

Mark Wagner and Maurice Smith have shed some light on this curiosity. They show that the brain generalizes unnatural physical regimes, such as driving, to produce an appropriate corrective response to an unexpected change, even when that change has not been met before (M. J. Wagner and M. A. Smith *J. Neurosci.* **28**, 10663-10673; 2008).

The duo trained undergraduates to reach quickly for a target with one hand while holding on to a motorized arm with the other. The faster the students reached, the stronger the motorized arm pushed them off course.

Initially, the students made large errors, but they soon compensated for the lateral forces. Were their brains learning the dynamics of the new force, though, or were they reassigning the activation of muscles in the spinal cord from those for reaching towards those that normally help to generate sideways pushes?

Surprising the students with a sudden pulse of force in the reaching direction provided an answer. They compensated with almost ideal corrective forces, which spinal reflexes alone could not have achieved. The slight delay in the students' responses also indicates that their brains were working from an internal model of the new force regime. How the brain develops such a model is unknown, but this paper should drive that research.

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