

NANOTECHNOLOGY

Swirls move tiny objects

Individual cells can be manipulated by tiny vortices generated in fluids, rather than by the potentially harmful lasers or electric fields typically used. The concept is the brainchild of Li Zhang and his colleagues at the Swiss Federal Institute of Technology in Zurich, who used the vortices to control the movement of microscopic objects.

The team placed a tank of water in a rotating magnetic field, which triggered nickel nanowires in the tank to rotate in turn, generating microvortices. The vortices trapped polystyrene microbeads in the water. By controlling the movement of the nanowires, the authors could tightly control the movement of the beads.

They also successfully manipulated *Escherichia coli* bacteria using a pair of microspheres in place of the nanowires.

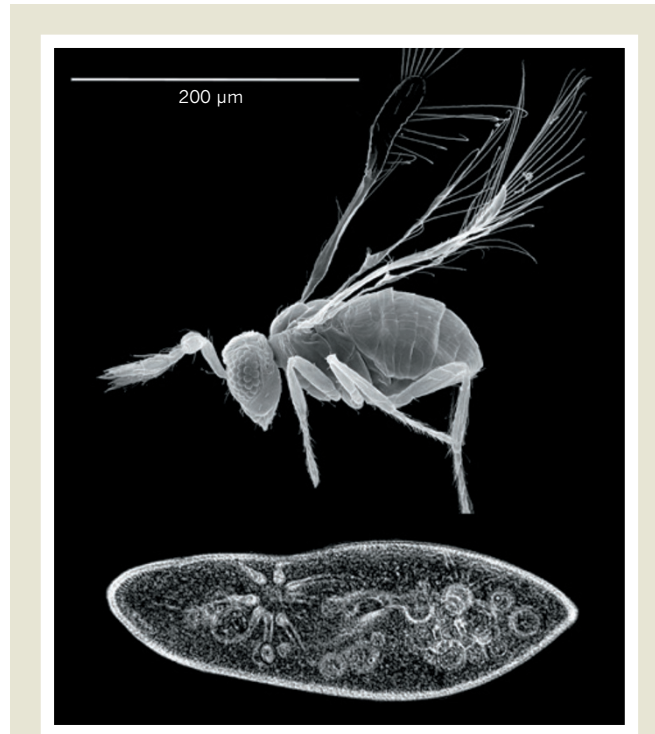
Nano Lett. <http://dx.doi.org/10.1021/nl2032487> (2011)

ANIMAL BEHAVIOUR

Rats rescue others in distress

Primates show signs of empathy, but can other mammals sense and respond to emotional distress in another individual? Yes, say Peggy Mason and her co-workers at the University of Chicago in Illinois, who report that rats will liberate a trapped individual even when they do not receive a reward for doing so.

In the experiments, one rat was trapped inside a container within a larger arena in which another rat roamed free. By day



NEURODEVELOPMENT

Wasp neurons lack nuclei

A tiny parasitic wasp that is smaller than some single-cell organisms (such as *Paramecium*, pictured bottom) has the fewest neurons of any insect studied so far. The bulk of the cells even lose their nuclei when the insects become adults.

Alexey Polilov of Lomonosov Moscow State University sectioned pupae and adults of the wasp (*Megaphragma mymaripenne*, pictured top) and examined their central nervous systems with light and electron microscopy. The wasp's brain contained around 4,600 neurons — orders of magnitude fewer than house flies (340,000 neurons), bees (850,000) or even closely related parasitic wasps (37,000).

During metamorphosis to an adult, more than 95% of *M. mymaripenne*'s neurons lost their nuclei and cell bodies — the bulbous part of the neuron that contains the nucleus. As a result, the creature's brain shrank by almost 50%. The neurons seem to function without nuclei, because the wasps were still able to fly, eat and find hosts for eggs.

Arthropod Struct. Dev. 41, 29–34 (2012)

six or seven, on average, the roaming rat learned to free the trapped one. When a container holding chocolate was added to the arena, the liberators took roughly the same amount of time to free a trapped rat as

to access the treat.

Distressed rats typically freeze in response to another distressed rat. The fact that the creatures can control such urges to help another shows that empathy can motivate

behaviour in animals other than primates, the authors suggest.

Science 334, 1427–1430 (2011)
For a longer story on this research, see go.nature.com/87bk8y

CLIMATE CHANGE

The growth of dying seas

Oxygen-deprived dead zones in coastal waters around the world have expanded exponentially since the 1960s and are likely to increase further in a warming climate.

Markus Meier of the Swedish Meteorological and Hydrological Institute in Norrköping and his colleagues used a group of physical–biogeochemical models, driven by data from regional climate models, to project the effects of climate change and changes in nutrient cycles on oxygen conditions in the Baltic Sea.

Most scenarios suggested that oxygen-depleted zones at the bottom of the sea would expand by the end of the century. Driving factors include rising nutrient input from river runoff; reduced oxygen flux from the atmosphere to the ocean; and increased oxygen consumption by surface-level organisms that are fed by the boost in nutrients. Similar changes can be expected for coastal oceans worldwide, the authors say.

Geophys. Res. Lett. <http://dx.doi.org/10.1029/2011GL049929> (2011)

ASTRONOMY

A filter for the night sky

Infrared signals from distant stars that formed soon after the Universe itself could one day be discerned from Earth, thanks to a specially

designed filter. Such signals are normally drowned out by a blaze of infrared emissions of wavelength 1,000–1,800 nanometres coming from hydroxyl chemicals in Earth's upper atmosphere.

The filter, developed by Joss Bland-Hawthorn at the University of Sydney, Australia, and his colleagues, combines two technologies: Bragg gratings, which are fibre-optic cables with unevenly spaced notches that suppress and reflect up to 400 hydroxyl spectral lines; and a converter that funnels the light from the sky into the grating as a single ray.

Tests at an observatory over three evenings showed that the filter blocked out most of the brightest emissions with wavelengths between 1,440 and 1,630 nanometres. Although a still a prototype, the device could be used with 8-metre and future 30-metre telescopes, the authors say. *Nature Commun.* 2, 581 (2011)

BIOELECTRONICS

Recharge through the skin

Replacing the batteries of implanted medical devices such as pacemakers usually requires surgery. An invention (pictured) by Eijiro Miyako at the National Institute of Advanced Industrial Science and Technology in Ikeda, Japan, and his colleagues could, in theory, provide a noninvasive way to recharge such devices. The authors have built an implantable converter that generates electric current when hit with laser light that is beamed through the skin.



1 cm

The device consists of carbon nanotubes — which heat up when exposed to laser light — wrapped in a polymer and dispersed in silicone. The heat warms one side of the converter more than the other, and the flow of heat to the cooler side generates an electric voltage.

The researchers show that, when irradiated with laser light, their device can electrically stimulate a zebrafish heart, and can generate a voltage while implanted in a rat.

Angew. Chem. Int. Edn
<http://dx.doi.org/10.1002/anie.201106136> (2011)

EVOLUTION AND DEVELOPMENT

How the brain became human

Humans' evolution of big brains and unique cognitive abilities may be down to key regulators that control gene expression during development.

Philipp Khaitovich and Svante Pääbo at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, and their colleagues compared gene-expression patterns in the brains of dozens of humans, chimpanzees and rhesus macaques of different ages. Relative to those of chimps and macaques, human brains showed many more differences in gene-expression patterns as newborns developed into adults, particularly in a region involved in cognition called the prefrontal cortex (PFC). Genes that encode microRNAs, which regulate the activity of many other genes, were among those whose developmental expression patterns varied most between the PFCs of humans and other primates.

The authors suggest that a small number of microRNAs and proteins controlling brain development could have driven the evolution of the human brain.

PLoS Biol. 9, e1001214 (2011)

COMMUNITY CHOICE

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NEUROSCIENCE

The brain's nutrient sensor

HIGHLY READ
on www.cell.com
in November

Certain brain cells can respond not only to changing glucose levels, but also to mixtures of amino acids — the building blocks of proteins. This suggests that the brain can sense the body's nutrient status in addition to its energy needs.

Denis Burdakov at the University of Cambridge, UK, and his colleagues looked at cells in the brain's hypothalamus called orexin/hypocretin neurons, which regulate energy balance and feeding. Working with mice, they found that these cells were activated both *in vitro* and *in vivo* when exposed to nutritionally relevant amino-acid mixtures.

Glucose normally suppresses the activity of these neurons, but when the researchers exposed the cells to both glucose and amino acids, the amino acids excited the neurons and blocked the effect of glucose. The authors suggest that this boosts the signal from amino acids, which are typically at lower concentrations in the brain than glucose.

Neuron 72, 616–629 (2011)



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ENERGY

Sugar-cane biofuel fouls air

Brazil has rapidly become the world's biggest producer of ethanol — an alternative to petroleum-based fuel — from sugar cane. The greenhouse-gas emissions created during sugar-cane ethanol production are lower than those associated with the creation of other biofuels, but a study shows that the process generates up to seven times more air pollutants than previously estimated from remote-sensing data.

Elliott Campbell at the University of California, Merced, and his colleagues used agricultural survey data from Brazil to calculate emissions of various air pollutants, such as sulphur dioxide and black carbon, from the entire production cycle of

sugar-cane ethanol in 2000–08. A major source of emissions is the burning of sugar-cane fields before harvest (pictured). The authors' estimates of emissions from just this burning phase were 1.5–7.3 times higher than those from satellite-based methods. Altogether, the production of sugar-cane ethanol generated more pollutants than petrol or diesel production.

The authors say that even in regions where burning has been scaled back, pollutant emissions continue to grow because of the increase in sugar-cane production in Brazil.

Nature Climate Change
<http://dx.doi.org/10.1038/nclimate1325> (2011)

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