

RESEARCH HIGHLIGHTS

MOLECULAR NEUROBIOLOGY

Active resilience

Cell **131**, 391–404 (2007)

A molecule known as BDNF may provide a pivotal distinction between people who succumb to conditions such as depression or post-traumatic stress disorder and the majority who do not.

Eric Nestler of the University of Texas Southwestern Medical Center in Dallas and his colleagues had previously identified mice that avoided social contact with cage-mates after repeated 'social defeat' — brought about by forced encounters with more aggressive mice.

The researchers found that resilience to stress in this social-defeat model is an active process in which stress-induced firing in part of the brain's neuronal circuitry associated with reward and drug addiction is suppressed. This lowers levels of brain-derived neurotrophic factor (BDNF), and mice with a natural variation in their BDNF gene were resilient to stress. The researchers also found high levels of BDNF in a region associated with reward in post-mortem brains of people with a history of depression.

ECOLOGY

Smelly fish

Proc. R. Soc. B doi:10.1098/rspb.2007.1283 (2007)

Fish that have been exposed to even very low levels of a common pollutant are shunned by their conspecifics, according to research by Ashley Ward at the University of Sydney and his co-workers. The effect may put the tainted fish at increased risk of predation.

The research looks at the effect of low levels of 4-nonylphenol, a surfactant sometimes found in shampoos and soaps, on schooling in juvenile banded killifish (*Fundulus diaphanous*, pictured below). Unexposed fish were unwilling to school with fish that had been exposed for as little as an hour to levels commonly found in sewage outflows.

Extraordinary sound

Nature Phys. doi:10.1038/nphys774 (2007)

Light squeezed through a hole of smaller diameter than its wavelength can emerge in a collimated beam when the hole is set in a periodic array of indentations. This counter-intuitive phenomenon is known as "extraordinary optical transmission". Now researchers in Spain have shown that an analogous effect can be achieved with sound waves.

Using their understanding of the role of surface plasmons in the optical case, Francisco Garcia-Vidal at the Autonomous University of Madrid and his colleagues designed systems of holes and grooves in which acoustic surface waves have a similar effect, producing a beam of sound through cunningly contrived interference and reinforcement. The authors think this effect might be applied in non-destructive materials testing and medical ultrasound.



MICROBIOLOGY

A time to die

Science **318**, 652–655 (2007); *Proc. Natl Acad. Sci. USA* doi:10.1073/pnas.0704256104 (2007)

Bacteria communicate with each other to a greater extent, and in more ways, than was once thought. Hanna Engelberg-Kulka of the Hebrew University in Jerusalem and her colleagues report that *Escherichia coli* can send out messages that encourage their neighbours to kill themselves. The 'extracellular death factor' involved turns out to be a chain of five amino acids that seems to be produced by the degradation of a metabolic enzyme, glucose-6-phosphate dehydrogenase.

The authors suggest that the ability to coordinate cell death may allow bacteria to release nutrients from a proportion of individuals when the population is under stress, or to defeat phage attacks by means similar to a 'scorched-earth' policy.

Meanwhile, Frances Arnold at the California

Institute of Technology in Pasadena, Ron Weiss at Princeton University, New Jersey, and their colleagues report engineering a system into populations of *E. coli* that allows a specific pattern of gene expression only when both populations are present in sufficient numbers. They suggest that such systems could be used to engineer specific responses in artificial biofilms.

Intriguingly, three years ago these labs engineered a 'neighbour killing' system into bacteria quite similar to that now being reported (L. You *et al.* *Nature* **428**, 868–871; 2004). This may be the first example of synthetic biology anticipating a function only later revealed in nature.

RELATIVISTIC PHYSICS

Hot at any speed

Phys. Rev. Lett. **99**, 170601 (2007)

According to the theory of special relativity, measurements of length and time differ depending on the relative velocity of the observer and the thing being measured. Einstein and other prominent physicists believed that the measured temperature of a gas would also depend on the speed of the observer.



Work by Peter Hänggi of the University of Augsburg in Germany and his collaborators contradicts those early calculations. The group's one-dimensional models of particles in a gas show that the same temperature will be observed regardless of the observer's speed. The team admits, however, that this may not be true of two- or three-dimensional gases, and believes that further study is needed.

CLIMATE CHANGE

Irreducible sensitivity

Science **318**, 629–632; 582–583 (2007)

Decades of intensive work on climate change have done little to narrow the range of uncertainty over Earth's climate sensitivity — the amount of global warming to be expected under carbon dioxide levels twice those of the pre-industrial world, which the Intergovernmental Panel on Climate Change puts at between 2 °C and 4.5 °C. Nor can a substantially better estimate be expected in the future, according to Gerard Roe and Marcia Baker of the University of Washington in Seattle.

Their mathematical analysis stresses that normally distributed uncertainties in the feedbacks associated with climate processes make ruling out a long tail of high sensitivities unrealistic. In an accompanying Perspective, Myles Allen and David Frame at the University of Oxford, UK, argue that this is not a problem for setting policy, because the concentrations of carbon dioxide associated with specific warmings can be much better constrained.

CHEMISTRY

Clicking without copper

Proc. Natl Acad. Sci. USA **104**, 16793–16797 (2007)

Proteins can be quite easily labelled for studies in living cells, but other types of molecule are trickier to track. One possibility is to use a two-step technique: first get the cell's own machinery to add a chemical 'socket' to the molecule of interest, then add a trackable reagent that fits easily into that socket. 'Click' chemistry — so named for the ease of assembly — might be helpful for this second step, but normally depends on toxic copper compounds.

Now Carolyn Bertozzi and her colleagues at the University of California, Berkeley, report using a cyclooctyne onto which fluorine atoms have been added to carry out the same sort of click reaction without the need of copper. Their system can be used to track sugar molecules in and on living cells for minutes or for days.

PLANETARY SCIENCE

Identical twins

Astrophys J. **669**, L89–L92 (2007)

Astronomers have identified a star that is in many ways indistinguishable from the Sun.

Peruvian astronomers Jorge Meléndez of the Australian National University, and Iván Ramírez at the McDonald Observatory of the University of Texas in Austin report that the parameters of HIP 56948, one of four 'solar twins' they have been studying, are exactly the same as the Sun's, within the constraints of observational accuracy. Unlike previous solar twins, this star — which resides 200



light years away in the constellation of Draco — shares the Sun's low lithium content. In addition, HIP 56948, like the Sun, has no accompanying 'hot Jupiter' in close orbit.

Such solar twins are useful for various calibrations, the authors say; they are also of potential interest to researchers involved in the search for extraterrestrial intelligence.

CHEMICAL PHYSICS

Nano steams ahead

Phys. Rev. Lett. doi:10.1103/PhysRevLett.99.178103 (2007)

Nanoparticles may exhibit chemotaxis — directed motion along a gradient of chemical concentration previously seen at the microscale only for living cells.

Ayusman Sen, Darrell Velegol and their colleagues at Pennsylvania State University have shown previously that nanorods made with platinum at one end and gold at the other move through a solution of hydrogen peroxide, owing to the catalytic production of oxygen gas. Now they report that in a peroxide gradient the rods — 370 nm wide and 2 μm long — move 'uphill' towards the fuel source, because the increase in speed at higher peroxide concentrations biases their movement. This offers a simple way to power and guide nanoscale objects.

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JOURNAL CLUB

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A systems biologist encourages modelling by the millions.

In a typical modelling study, we write down equations, solve them, and see whether they account for known data. If they do, we claim to understand some bit of biology. One huge caveat is that many other models might have matched the data just as well.

Researchers from Peking University in Beijing and the University of California, San Francisco, have devised a satisfying way of dealing with this problem (W. Ma *et al. Mol. Syst. Biol.* **2**, 70; 2006).

Their starting point was epithelial patterning in the fruitfly *Drosophila*. During embryogenesis, a system known as the 'segment polarity network' generates repeating stripes of gene expression. The stripes are initially fuzzy and later become sharp. Ma *et al.* set out to see what simple gene circuits were best suited to this sharpening process.

They formulated differential-equation models for about 14 million ways of connecting two or three segmentation genes, then randomly chose 100 sets of parameters that defined the strength of the interactions for each gene. They then carried out computations for each combination to determine which of them converted fuzzy stripes into sharp ones.

Many topologies worked for at least one parameter set. But only a fraction worked for more than one or two. Interestingly, the most robust topologies were all variations on the same design — each had three sub-circuits, one 'stripe generator' motif and two bistable 'response sharpeners'. These findings give hope that complex networks may be decomposed into modular sub-circuits with understandable functions.

Comprehensively examining millions of models is a lot of work, but is not impossible. And, as Ma *et al.* show, it can yield important insight that could not have been derived from studies of one or two.

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