RESEARCH HIGHLIGHTS

STEM CELLS

Insulin from scratch

Nature Biotechnol. doi:10.1038/nbt1393 (2008)

Researchers have used human embryonic stem cells to generate insulin-producing pancreatic cells that respond to glucose and protect against a diabetes-like condition in mice. The approach may one day be useful for treating diabetics.

Previous attempts had yielded pancreatic cells that did not respond to glucose. But Emmanuel Baetge and his co-workers at Novocell in San Diego, California, adjusted their protocol to select cells at an earlier stage of differentiation. When those pancreatic cells were grafted into mice, the cells began producing insulin within 30 days of the transplant.

Both fasting and glucose intake triggered insulin production by the transplanted cells. The cells also protected mice from diabetes caused by a toxin that selectively kills mouse insulin-producing cells.

ENTOMOLOGY

Metal mouth

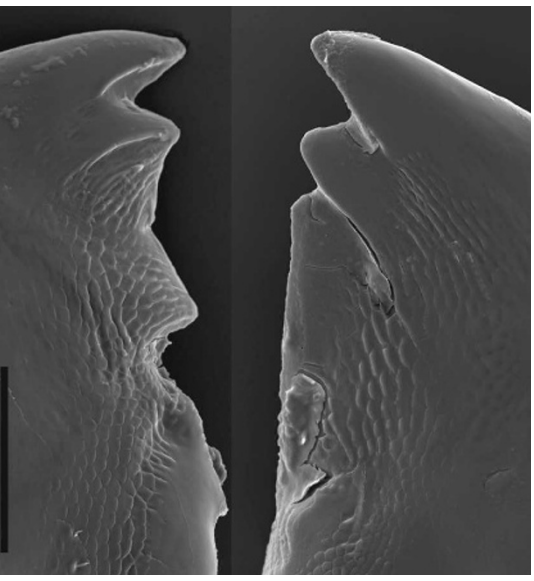
Naturwissenschaften doi:10.1007/s00114-008-0346-3 (2008)

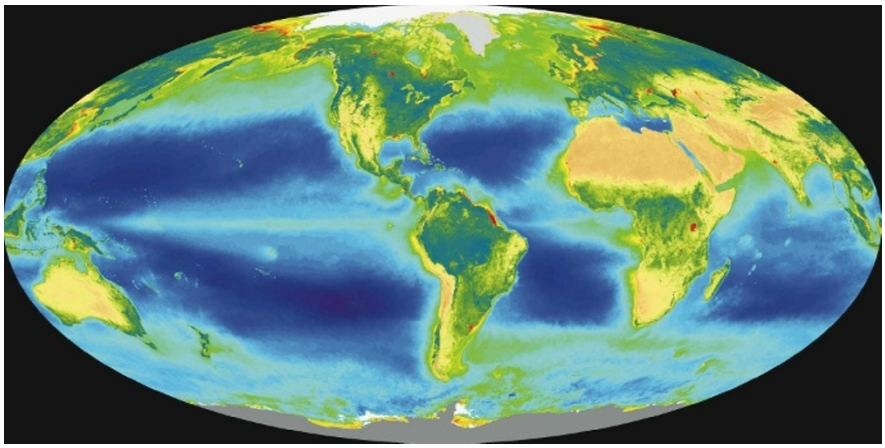
The termites of the subfamily Kalotermitidae have mandibles that are harder than those found among any of their kin, according to Bronwen Cribb at the University of Queensland in Brisbane, Australia, and her colleagues.

The secret to their hardness seems to be the substantial amount of zinc in the wood that termites eat, which the Kalotermitidae alone concentrate along the edges of their mandibles (pictured below). The researchers analysed the elemental composition of different termite species' mandibles and applied scratch tests along the mandible edges to determine just how hard they were. Previous work found that zinc reinforcement made mandibles up to 20% harder.

Most termites eat damp or moistened wood, whereas the Kalotermitidae specialize in consuming dry wood, which is tougher to chew through and is probably what drove the evolution of their extra hard bite.

B. W. CRIBB





NASA

Hue and die

Geophys. Res. Lett. **35,** L03618 (2008)

The ocean's colour from space is determined by the density of its photosynthetic life, allowing researchers to track changes in sea life over time across extensive areas.

Jeffrey Polovina of the US National Oceanic and Atmospheric Administration's Pacific Islands Fisheries Science Center in Honolulu, Hawaii, and his co-workers looked at the colour of the least biologically productive reaches of the ocean, known as the subtropical gyres, from 1998 to 2006. They found that the most desert-like areas (darkest blue in this false-colour map) are expanding — hand in hand with rising sea surface temperature due to global climate change. Warmer waters see less vertical mixing and therefore reduced movement of nutrients from the depths to the sunlit surface.

The work provides an update on analyses done with the same data set but over fewer years, and startles with its dire conclusions: waters containing 0.07 milligrams or less of chlorophyll per cubic metre have expanded by 6.6 million square kilometres, that is, by about 15%, in nine years. This is a much faster rate than expected from climate models.

SEMICONDUCTORS

Under the wave

Phys. Rev. Lett. **100,** 073602 (2008)

In the semiconductor business, the smaller the circuit that can be etched onto a microchip, the more profit a company is likely to see. The wavelength of light used to etch the chips is one of the main constraints on miniaturization.

Muhammad Suhail Zubairy at Texas A&M University's campus in Doha, Qatar, and his colleagues have found a way — in theory at least — to make smaller features.

The team's calculations show that multiple lasers can be beamed onto a surface in a way that creates quantum interference. This interference could, in turn, be used to create sub-wavelength patterns on a chip.

GENETICS

Smoking in black and white

Hum. Mol. Genet. doi:10.1093/hmg/ddn044 (2008)

Why is kicking the habit so hard for some? A protein involved in directing neuronal wiring looks increasingly like a culprit. Ming Li at the University of Virginia in Charlottesville and his colleagues analysed 21 points of frequent variation in the gene encoding neurexin 1 in smokers of varying levels of addiction.

Their findings confirm previous gene-association studies linking neurexin 1 to susceptibility to nicotine dependence. They further suggest that the same gene associates with dependence in Americans of both European and African descent, but in different ways. Different regions of the gene link to smoking for blacks and whites.

Neurexins are cell-adhesion molecules that may help form and maintain neuronal synapses. Another neurexin, neurexin 3, has previously been linked to alcohol addiction.

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NEUROLOGY

Diabetes lessens learning

Nature Neurosci. doi:10.1038/nn2055 (2008)

A stress-related steroid may damage regions of the brain responsible for memory in animals with diabetes.

Mark Mattson and his colleagues at the National Institute on Aging in Baltimore, Maryland, found that both rats modelling type 1 diabetes and mice modelling type 2 diabetes formed fewer new neurons in the hippocampus and experienced more difficulty learning than normal rodents.

Both rodent models also had higher levels of corticosterone. Humans with diabetes sometimes have higher levels of a related steroid called cortisol. Lowering corticosterone in diabetic rodents restored their capacity for learning, and later administration of high levels of corticosterone to these rodents reinstated the learning deficits. Taken together, the results suggest that corticosterone may cause cognitive impairment in diabetes.

MATERIALS

Gecko glue

Proc. Natl Acad. Sci. USA **105,** 2307–2312 (2008)

Inspired by geckos' feet, researchers have developed and tested *in vivo* a biodegradable tape that may one day be used as a replacement for sutures. The tape is made from a thin polymer film, etched with a forest of nanoscale, cone-shaped projections similar to the tiny bristles that cover the hairs on the pads of geckos' toes.

Geckos' feet bind to surfaces owing to simple intermolecular forces between the surface and these bristles. But the tape, developed by Robert Langer of the Massachusetts Institute of Technology in Boston, Jeffrey Karp of Harvard Medical School and a large team, depends on an extra layer of stickiness from a coating of sugar that assists with bonding.

Gecko-modelled adhesives have been developed in the past, but the researchers say this is the first to show compatibility in living tissue.

OPTICS

Hidden source

Phys. Rev. Lett. **100,** 063904 (2008)

If a spherical 'invisibility cloak' could hide physical objects, as recently proposed, it could also hide electromagnetic fields, according to Hongsheng Chen and his co-workers at Zhejiang University in Hangzhou, China.

The shield uses metamaterials, which interact with light in unusual ways, to divert electromagnetic waves around the inside of the shielded space. The principle has been demonstrated experimentally at microwave frequencies, but it wasn't clear whether it would work for cloaking 'active' devices such as electronic circuits, which produce electromagnetic fields that could leak out of the shield and undermine the invisibility.

Chen and colleagues calculate that such fields create electric and magnetic fields at the inner surface of a spherical shield, which, in turn, reflect any waves broadcast from an active object inside and prevent them from escaping.

K. PRUDIC

EVOLUTION

Back into hiding

Proc. R. Soc. B doi:10.1098/rspb.2007.1766 (2008)

Many species, especially insects, protect themselves from predators by mimicking the bright warning markings of other, better-defended creatures. A study of butterflies confirms one theory about this phenomenon — that when the noxious model species disappears the mimic does not necessarily vanish with it, but can revert to a less-conspicuous outfit.

Kathleen Prudic and Jeffrey Oliver at the University of Arizona in Tucson compiled an evolutionary family tree of North American admiral butterflies, a subspecies of which mimics the wing patterns of the toxic black pipevine swallowtail butterfly (mimic pictured above). One subspecies of *Limenitis arthemis* is descended from such mimics, but displays the camouflage patterns of its ancestors (pictured, inset), suggesting that it has re-evolved its disguise.

JOURNAL CLUB

Eric J. Nestler
University of Texas Southwestern Medical Center, Dallas

A psychiatrist talks about finding answers that add up across all levels.

Often when we study the brain and behaviour, we fail to tie molecular events to higher-order changes in composition, to shifts in the organ's circuitry, or all the way up to changes in actions or broad mental abilities. Many scientific fields suffer from this problem of scale, but the recent explosion in techniques available for molecular biology and quantitative behavioural analysis has given neurobiology the potential to bridge many conceptual gaps.

An excellent example is a study carried out by Roberto Malinow of Cold Spring Harbor Laboratory, New York, and his colleagues (H. Hu *et al. Cell* **131,** 160–173; 2007). They elucidated a molecular mechanism by which emotional stress and arousal promote long-term memory formation. In doing so, they brought together two well-characterized phenomena: that noradrenaline stimulates memory formation in the brain's hippocampus, and that the trafficking of a type of glutamate receptor is important for a form of plasticity in the same brain region.

Malinow's team shows that, by stimulating noradrenaline release in the hippocampus, emotional stress leads to phosphorylation of glutamate receptors. This boosts the incorporation of these receptors at the synapse — the junction between nerve cells — which, in turn, enhances synaptic function and improves memory formation. Crucially, mice with a mutation that prevents phosphorylation of the relevant part of the glutamate receptor do not show noradrenaline-mediated memory enhancement.

Impressively, this study begins with a clinically important phenomenon — memory enhancement by emotional stress — and establishes a detailed biological pathway that underlies a behavioural endpoint in an animal model. Studies such as this are what the field needs.

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