RESEARCH HIGHLIGHTS

I. KATO/REUTERS

Runner gene

Nature Genet. doi:10.1038/ng2122 (2007)

A mutation commonly found in endurance athletes may have been favoured by evolution because it aids efficient muscle function, say researchers in Australia. More than a billion humans worldwide are predicted to have the mutation, causing them to lack a 'fast' muscle-fibre protein known as α-actinin-3. Absence of this protein seems to boost stamina, as metabolic resources are diverted onto a slower but more efficient metabolic pathway.

Researchers led by Kathryn North of the Children's Hospital at Westmead in Sydney found that mice lacking α-actinin-3 ran on average 33% farther on a treadmill than normal mice before reaching exhaustion. They also show that the human version of the mutation is surrounded by well-conserved DNA sequence, suggesting that it has been favoured by natural selection.

NEUROSCIENCE

A glimpse of the impossible

Nature Neurosci. doi:10.1038/nn1951 (2007)

Researchers have proposed an explanation for why our brain can detect a visual phenomenon that doesn't naturally occur.

The brain processes images from each eye to establish a single picture. It registers differences between the relative positions of objects in each eye to glean depth information. But the visual cortex also has neurons that register an improbable effect known as 'phase disparity' — differences in the patterns of light and dark.

Jenny Read of Newcastle University, UK, and Bruce Cumming of the National Eye Institute in Bethesda, Maryland, hypothesized that the ability to detect phase disparity allows the brain to recognize when it has incorrectly aligned the eyes' two images. They applied a computer model of how the brain may do this to a stereogram of the Pentagon, headquarters of the US Department of Defense. The model yielded reasonably accurate images (pictured right), outperforming models that lack checks on phase disparity.

PHYSICS

Iced neutrons

Phys. Rev. Lett. **99,** 104801 (2007)

Good news for physicists who like their neutrons chilled: Oliver Zimmer of the Technical University of Munich in Germany and his co-workers have demonstrated the viability of one long-standing proposal for making 'ultra-cold neutrons'.

Such neutrons, which move at no more than human running speed, can probe fundamental aspects of physics, for example, the decay lifetime of the neutron itself. But the best nuclear-reactor sources offer only a few dozen ultracold neutrons in each thimbleful of space — too few for easy study.

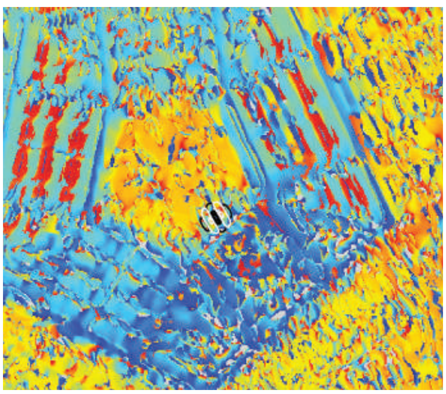
Zimmer and his colleagues cooled neutrons from a research reactor source by passing them through superfluid helium. Such cooling has been achieved before, but the researchers have now also shown how to accumulate the ultracold neutrons before extracting them to attain higher neutron densities.

EARTH SCIENCE

No oxygen required

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0704912104 (2007)

It is widely accepted that there was not a persistent, significant amount of oxygen in Earth's atmosphere more than 2.45 billion years ago. But in 1999, hydrocarbon molecules called 2-methylhopanes, thought to be biomarkers distinctive of oxygen-producing cyanobacteria, were found in sediments that are 2.7 billion years old. This has led to much discussion of how an oxygen-producing biosphere could persist for hundreds of millions of years before any of its oxygen accumulated in the atmosphere.



Sky Rashby of the California Institute of Technology in Pasadena and his colleagues argue that 2-methylhopanes may not be de facto evidence for oxygenic photosynthesis. They found that the purple non-sulphur bacterium *Rhodopseudomonas palustris* produces 2-methylhopanes. Although this bacterium, like cyanobacteria, is photosynthetic, it does not produce oxygen, and it needs no oxygen in order to make the biomarkers.

BIOCHEMISTRY

Radical weapons

Cell **130,** 797–810 (2007)

Antibiotics that target different cellular pathways have been found to have a common mode of killing. The lethal weapons, identified by James Collins and his colleagues at Boston University in Massachusetts, are hydroxyl free radicals — highly reactive molecules that damage DNA and proteins.

Using a hydroxyl-sensitive fluorescent dye, the researchers showed that antibiotics that target bacterial cell-wall, protein or DNA synthesis pathways trigger the production of hydroxyl radicals. They also found that blocking production of these radicals decreases the potency of antibiotics, whereas blocking the DNA-repair pathway that bacteria use to fight free-radical damage increases cell death. The team says that the findings point to routes to enhancing the potency of antibiotics.

CHEMISTRY

Supercentre

Org. Lett. doi:10.1021/ol701911u (2007)

Making 'stereogenic centres' in molecules — regions where the arrangements of atoms can take left- and right-handed forms — is one of the toughest problems for synthetic chemists. It is usually hard enough to make a single such centre with the desired handedness, but Jingqiang Wei and Jared Shaw of the Broad Institute of Harvard and Massachusetts Institute of Technology in Cambridge have achieved the feat of creating two or three of them at once. Even more impressively, they do it by combining four separate molecular building-blocks in a single step. The result is a compound called a γ-lactam, which has a ring of four carbon atoms and one nitrogen and is a useful potential 'backbone' molecule for making new drugs.

CELL BIOLOGY

Fresh packaging

Nature Cell Biol. doi:10.1038/ncb1636 (2007)

New observations may settle controversy about how the membrane that wraps a cell's nucleus regenerates after cell division.

A replicating cell must break apart this membrane, known as the nuclear envelope, to split its chromosomes between its daughter cells. Daniel Anderson and Martin Hetzer of the Salk Institute for Biological Studies in La Jolla, California, show that the membranes in the daughter cells derive not from fragments of the old membrane, as one theory held, but from an internal network of tubular membranes called the endoplasmic reticulum (ER).

Fluorescent labelling of the ER allowed the researchers to watch the tubules expand and flatten into membrane sheets around the nucleus. They also showed that antibodies against a protein required for ER tubule formation inhibited development of the nuclear envelope.

ASTRONOMY

Double trouble

Astrophys. J. **666,** L89–L92 (2007)

Observations of stars shooting away from the Milky Way's core could reveal whether there is more than one black hole lurking at the Galaxy's centre, scientists say.

Most researchers agree that at least one massive black hole sits at the centre of the Galaxy (pictured, below), but if the Milky Way assembled through the merger of smaller galaxies, it may have two or more central black holes. Calculations by Youjun Lu and his colleagues at the University of California, Santa Cruz show that, if a binary black hole system survives at the Milky Way's centre, it could be identified through its distinctive effect on binary stars, ejecting one pair every 200,000 years. Astronomers have already seen lone 'hypervelocity' stars thought to have been kicked out of the Galactic core; now the team suggests a search for binaries.

NASA/CXC/MIT/F. K. BAGANOFF *ET AL.*

ECOLOGY

Breaking the cycle

PLoS Biol. **5,** e239 (2007)

Lab experiments have unearthed an exception to a classic tenet of ecology. The experiments show that the size of a predator population doesn't always cycle in tandem with the size of the population of its prey — a finding that may force ecologists to rethink how they search for species interactions.

Nelson Hairston at Cornell University in Ithaca, New York, and his colleagues first noticed the odd behaviour among rotifers and their algal prey — the number of algae would sometimes stay steady while rotifer numbers waxed and waned. This happened when the single species of alga was represented by several genotypes, some better at resisting rotifers than others. The researchers also observed similar dynamics between a bacterium and a virus.

A mathematical model suggests that species interactions become 'hidden' when the prey can rapidly evolve defence mechanisms against the predator and the evolutionary cost of doing so is low.

JOURNAL CLUB

Julian Davies
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A microbiologist wonders where diversity comes from.

Recent estimates indicate that the total number of bacteria in the biosphere approaches or exceeds 10^{31}. A major goal of microbiology is to understand what creates their diversity and how it is maintained.

Having trained as an organic chemist, I came to appreciate microbial diversity through the extravagance of small molecules that microbes produce. This reflects a diversity in microbial metabolism, which one might expect to have evolved as a result of the (organic) richness of the organisms' environments. But a couple of recent publications present findings that do not sit easily with this view.

Our first inkling of the huge diversity of the microbial world came from the use of ribosomal-RNA typing in the late 1980s. In the 1990s, this morphed into the expanding field of metagenomics, which is now providing catalogues of microbial communities from diverse terrestrial and marine environments.

One comparison of such catalogues showed that the seemingly bare and boring Arctic tundra exceeds fertile forest soils in phylogenetic content (J. D. Neufeld and W. W. Mohn *Appl. Environ. Microbiol.* **71,** 5710–5718; 2005). A more recent study compared information from more than 100 different environments, finding that the microbial content of soils is generally less diverse than that of sediments and hypersaline environments (C. A. Lozupone and R. Knight *Proc. Natl Acad. Sci. USA* **104,** 11436–11440; 2007).

I am looking forward to seeing what happens when the Human Microbiome Project gets under way. What variety of microbes is there to find living within us? What are they all doing? In what way will the population depend on diet? Given that we don't yet seem to understand the relationship between diversity and ecology, I am making no predictions.

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