RESEARCH HIGHLIGHTS

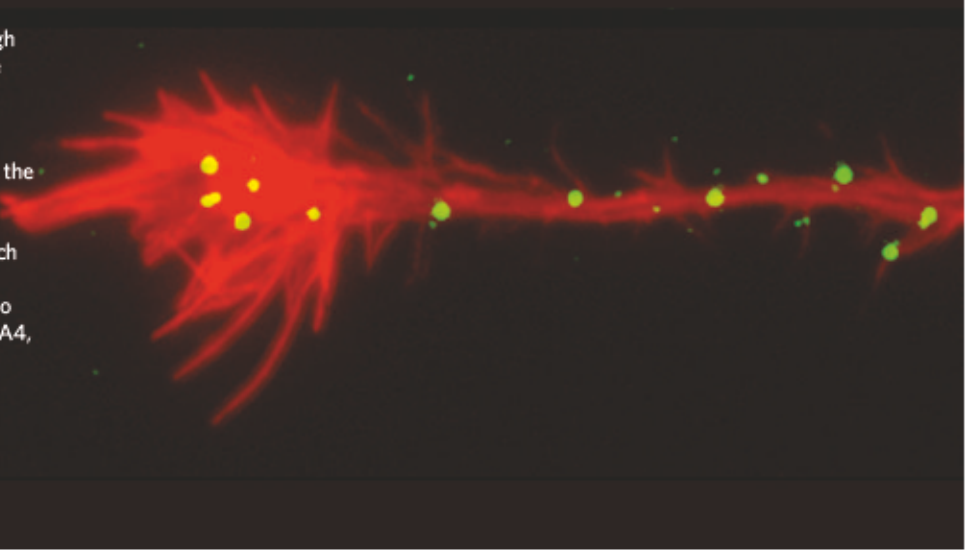
Second signal

Neuron 47, 515–528 (2005)

One way that cells communicate is through receptor proteins called receptor tyrosine kinases. Typically, such receptors relay signals when a kinase enzyme that forms part of their structure is activated.

However, a team led by Rüdiger Klein at the Max Planck Institute of Neurobiology in Martinsried, Germany, has shown that signalling by receptors called Ephs — which guide axon growth — is not that simple.

The team genetically engineered mice to carry an altered form of an Eph called EphA4, whose kinase is permanently active. Unexpectedly, some aspects of neural development were still normal. The team suggests that clustering of receptors (pictured in green on the red growth cone of an axon) triggers signalling through an additional mechanism.



J.EGEA/K.DEININGER/R.KLEIN

CANCER

Vessels take off

Genes Dev. doi:10.1101/gad.1308805 (2005)

The tumour suppressor gene *PTEN* governs the formation of blood vessels by influencing vascular growth factors, suggests a study in mice. Animals lacking one copy of the gene showed unregulated expansion of vessels around tumours and faster cancer growth than controls. This is probably because the vessels feed and sustain the developing cancer.

Akira Suzuki of Japan's Akita University School of Medicine and his fellow authors also note that people suffering from hereditary disorders such as Cowden disease — which make them susceptible to tumours — carry mutated copies of *PTEN*.

ASTRONOMY

Growing dwarf

Astrophys. J. **630**, L89–L91 (2005).

Brown dwarfs often seem like the runts of the astronomical litter, being too small to fuse hydrogen. But observations now confirm that they grow like proper stars.

Astronomers from the University of Delaware in Newark have used the Hubble Space Telescope to collect the first ultraviolet spectrum of a brown dwarf. Their study of object 2M 1207 reveals a cold cloud of molecular hydrogen surrounding the dwarf star, and ions heated to 100,000 °C accreting on its surface. These characteristics are shared with bigger T Tauri stars, which are bright young things with less than twice the mass of the Sun.

J. DANIELS/ARDEA

ANIMAL BEHAVIOUR

Chicken little

Curr. Biol. 15, R620–R621 (2005)

Migrating birds are known to use the Earth's magnetic field to orient themselves, but researchers have struggled to condition birds to respond to fields in the lab. Now a team led by Rafael Freire from the University of New England in Armidale, Australia, has achieved this in an unlikely species: the domestic hen.

The researchers attribute their success to the use of a social stimulus, rather than the usual food, as a reward in their experiments. Young domestic chickens were allowed to develop an attachment to a red ball and were then sent to find it. The direction of a local magnetic field was shown to influence the direction in which a chick started its search over a series of trials. This finding also reveals that the chicken's magnetic compass has survived thousands of years of domestication.

MICROBIOLOGY

Ancient disease

PLoS Pathogens 1, 5 (2005)

Tuberculosis may have affected early hominids, according to a genetic analysis that extends the pathogen's family tree.

Cristina Gutierrez from the Pasteur Institute in Paris and her colleagues isolated rare strains of tubercle bacilli from patients in east Africa. Genetic comparison with *Mycobacterium tuberculosis*, the agent responsible for most tuberculosis cases today, revealed that a common ancestor existed an estimated 3 million years ago. The comparison also showed that genetic recombination had occurred between the diverging strains.

The spread of a complex of strains resembling *M. tuberculosis* may have coincided with waves of human migration out of Africa, the researchers speculate.

NANOTECHNOLOGY

Drop by drop

Nature Mater. doi: 10.1038/1455 (2005)

Demonstrating exceptional chemical wizardry, a team of European researchers has harnessed light-powered molecular motion to drive a droplet of liquid up a sloping surface. The technique could be used in lab-on-a-chip devices.

The researchers coated the slope's surface with rotaxanes. These molecules consist of a chain threaded through a ring that shuttles up and down the structure. The team

designed the rotaxanes so that ultraviolet light would push the shuttle group to one end, hiding a fluoroalkane segment of the chain in the process. This makes the rotaxane layer more wettable where the light is shining. So, illuminating the front edge of a droplet drags it forward.

W. WHITEHURST/CORBIS

MATERIALS

Diamond geezers

Appl. Phys. Lett. **87**, 083106 (2005)

A diamond material that has been assembled from spherical carbon molecules (C_{60}) is denser and harder than the real thing (pictured), report Natalia Dubrovinskaia from the University of Bayreuth in Germany and her colleagues.

The researchers squashed the fullerene molecules together at 2,200 °C using 20 gigapascals of pressure, which is equivalent to the weight of the Titanic pressing down on an area the size of a CD.

This left them with a translucent cylinder made from a jumble of diamond nanorods, each of which was less than 20 nanometres across. The material is 0.2–0.4% more dense than natural diamond, and tests suggest it could form longer-lasting coatings for precision drill bits.

ECOLOGY

Richer soil

Science **309**, 1387-1390 (2005)

The average gram of unpolluted soil contains a million different bacterial species, according to a reanalysis of existing data. Previous estimates put the figure at 10,000.

The number of species is estimated by jumbling DNA from a sample and seeing how quickly matching sequences group together. Past calculations assumed that all species were equally common. To reach the higher figure, the team from Los Alamos National Laboratory in New Mexico allowed for variation. It also calculates that pollution with toxic metals wipes out 99.9% of bacterial species, despite an unchanged cell count.

EVOLUTION

Margin for error

Nature Genet. doi:10.1038/ng1621 (2005)

A classic problem in biology, concerning the origin of life, may benefit from a relaxed view.

Eigen's paradox points out that long genomes need complex enzymes to replicate themselves reliably — and questions whether the code for such enzymes could fit within these genomes. Now Eörs Szathmáry of the Collegium Budapest in Hungary and his colleagues redefine what consitutes a 'reliable' copy by mapping the effect of mutations — or mistakes — in RNA molecules called ribozymes.

They show that a ribozyme's function, which is defined by its shape (or phenotype), can survive a relatively large number of mutations to its sequence (or genotype).

This suggests that long genomes could survive much higher error rates in copying than researchers had previously thought.

CELL BIOLOGY

Bubble wrap

Cell **122**, 605-617 (2005)

Within cells, many proteins are transported inside bubble-like lipid sacs called vesicles. These bud off the membrane layers of the endoplasmic reticulum, where such proteins are made. But how are the vesicles sculpted?

Researchers led by Randy Schekman at the University of California, Berkeley, have revealed that a protein called Sar1p initiates membrane curving by poking a helical arm into the membrane. If the arm is removed from the protein, budding never begins. Sar1p then interacts with other proteins that stabilize the budding vesicle and capture its cargo. And it seems that Sar1p is involved from start to finish, because buds formed in the presence of mutant Sar1p are unable to pinch off, remaining attached to the membrane layer.

JOURNAL CLUB

Craig Bina
Northwestern University, Evanston, Illinois

A geophysicist revises his heat-flow notes by the light of a deep blue crystal.

In September 1999, after a long day at a conference, I was sharing a bottle of wine with Joe Smyth on the shore of Lake Maggiore in northern Italy.

He was rhapsodizing about the translucent, blue crystals he had formed by squeezing olivine — a major constituent of Earth's mantle — to the pressures found deep beneath the surface.

A few weeks later I was back in the United States, teaching an undergraduate geophysics class. As I filled the blackboard with equations for heat transport in Earth's interior, I dutifully crossed out the radiative terms as negligible.

We have all known since the 1970s that rocks are opaque to radiation at the high pressures and temperatures of the mantle, so its contribution to heat flow is deemed unimportant.

There matters rested, until I picked up the July issue of the *American Mineralogist*, and was reminded of Joe and those crossed-out terms.

Joe had measured the absorption spectra of his beautiful blue crystal — a hydrous ringwoodite — as it was squeezed between two diamonds to the pressure found 645 km down (H. Keppler and J. R. Smyth *Am. Mineral.* 1209–1212; 2005).

The surprising result? The absorption of red and infrared wavelengths decreased as the pressure intensified. Thus, for realistic ringwoodite, radiative heat transfer is important.

This means that plates heat up more quickly than we thought as they subduct into the mantle, and it affects our modelling of mantle plumes such as those that produced the volcanic islands of Hawaii.

Not all the consequences are clear, but one thing is certain: I'm revising my lecture notes before classes begin.