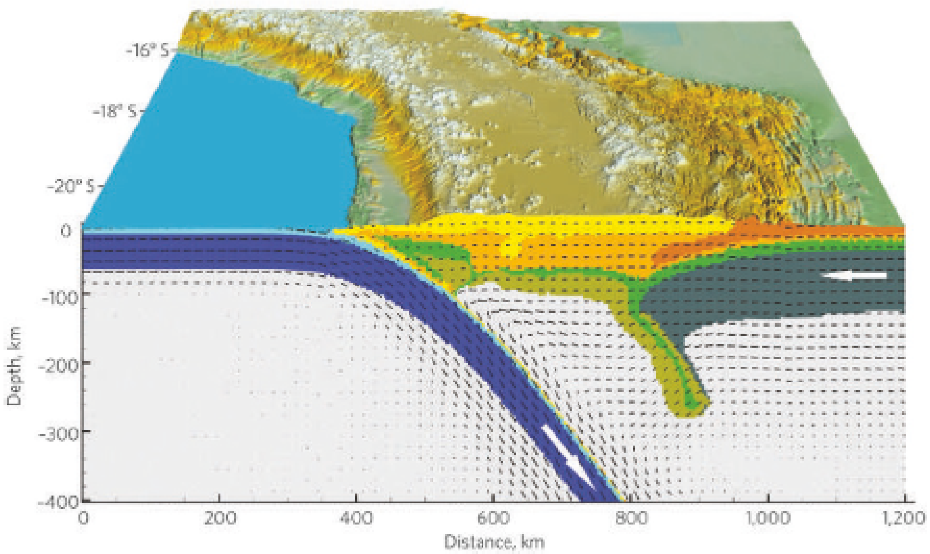
RESEARCH HIGHLIGHTS

GEOPHYSICS

Up the Andes

Geology **33,** 617–620 and 621–624 (2005)
For more than 200 million years, the South American plate slid westwards over the Nazca plate without buckling. Then, in the past 30 million years, the spectacular plateau of the central Andes was pushed up. What changed? Using a computer model, Stephan Sobolev and Andrey Babeyko, both at Germany's National Research Centre for Geosciences in Potsdam, have shown that the most important factor was accelerated drift of the South American plate. The model reproduces features of the plates' interaction, including the rolling back of the subducting Nazca plate, and the forcing down of portions of the continental plate under the plateau.



S. SOBOLEV

NEUROSCIENCE

A life of regret

Nature Neurosci. doi:10.1038/nn1514 (2005)
Regret springs from a region of the brain called the medial orbitofrontal cortex, according to a study that used functional magnetic resonance imaging to analyse peoples' response to a gamble.

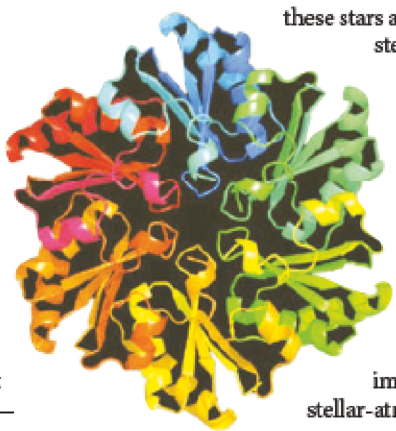
A team led by Raymond Dolan of the Wellcome Department of Imaging Neuroscience in London and Angela Sirigu of the Institute for Cognitive Science in Lyon offered 15 subjects the choice of two gambles, one riskier — but for higher stakes — than the other. When those who took the safe option were told they would have won the riskier bet, their medial orbitofrontal cortex became active. This area then fired before the regretful gambler's later choices, suggesting it is also involved in anticipating regret.

CELL BIOLOGY

Tiny organs

Science **309,** 936–938 (2005)
Scientists in California have revealed the molecular shape of a bacterial organelle. Its structure is uncannily similar to that of certain viruses.

Organelles are usually found in more complex eukaryotic cells — the plant chloroplast is one example — where they provide controlled environments for key biochemical reactions. But some bacteria contain protein shells that do a similar job. A team led by Todd Yeates at the University of California, Los Angeles, determined the structure of one such organelle, a carboxysome, which is involved in processing carbon. Its building blocks form hexagonal plates (pictured below) that are assembled into a polyhedral shell, similar to the protein coats of some viruses. The shell also has an electrically charged hole that may control what enters and leaves the structure.



E. YEATES

ASTRONOMY

Not so cool

Astrophys. J. **628,** 973–985 (2005)
Red supergiants begin life as stars at least 15 times more massive than our Sun, and then swell to hundreds of times the Sun's radius.

But observations have suggested that these stars are cooler than theories of stellar evolution can explain. A team of astronomers has now gone some way to raising these stars' temperatures and reconciling the two lines of evidence. By fitting new spectral measurements of the light from 74 supergiant stars to improved versions of stellar-atmosphere models called MARCS, they find that the stars are up to 400 K hotter than previously calculated, with temperatures typically around 3,000–4,000 K.

CELL BIOLOGY

Gas binding

Cell **122,** 195–207 (2005)
Nuclear receptors are a family of proteins that can switch some genes on and off, but the ligands they normally bind are known in only a few cases.

Henry Krause from the Charles H. Best Institute in Toronto and his colleagues have now identified the simple gases nitric oxide and carbon monoxide — short-lived signalling molecules important in many physiological functions — as natural ligands of the *Drosophila* nuclear receptor E75.

They show that the receptor includes an iron-containing haem molecule within its ligand-binding pocket. The state of oxidation of the haem affects the ability of the E75 receptor to bind the gases.

BIOGEOGRAPHY

Gluttony and sloths

Proc Natl Acad. Sci. USA doi: 10.1073/pnas.0502777102 (2005)
The Americas were once home to at least 19 genera of sloth species, some weighing as much as an Asian elephant. It has been unclear whether climate change or human hunters caused their demise, as the two hit much of the Western Hemisphere at roughly the same time. To resolve the issue, David

Steadman at the Florida Museum of Natural History in Gainsville and his colleagues focused on the Caribbean, where the climate changed 7,000 years before humans arrived. Carbon dating of bones showed that the sloths disappeared only after humans reached the islands. The finding adds weight to the idea that hungry humans wiped out the New World's large mammals.

MATERIALS

Natural spirals

Science **309,** 909–911 (2005)

Spiral patterns similar to those seen in flower heads decorate the nanoparticles made by Zexian Cao's team at the Chinese Academy of Sciences in Beijing (pictured top right). Like the floral spirals, the microscopic swirls are described by Fibonacci number patterns.

The particles, measuring about 10 micrometres across, have a silver core with a silica coating. They are formed at 1270 K, slightly above the melting point of silver but well below that of silica. As the particles cool and shrink, stresses in the outer layer raise dimples on the shell. The patterns depend on the size of the particle, the thickness of its shell and the rate of cooling.

BIOTECHNOLOGY

A clean break

Nature Methods doi:10.1038/nmeth787 (2005)

Separating a genetically engineered protein from the bacterial cell that made it has got easier, thanks to a trick developed by David Wood and his colleagues at Princeton University.

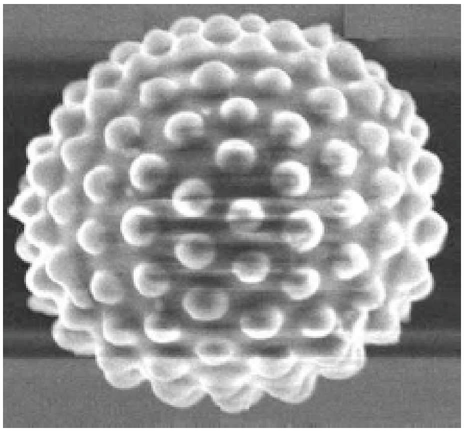
They fuse the gene encoding the target protein with genes encoding a sticky tail. The tail consists of a molecule called intein, which connects to the target protein, and a stretchy polypeptide similar to elastin. When the cell extract is heated, the tails get entangled, and the protein precipitates out of the mix. The intein links disintegrate in 4–10 hours, severing the protein's unwanted tail.

GENETICS

Noisy expression

Nature Genet. doi:10.1038/ng1616 (2005)

Fluctuating protein levels inside cells can arise from seemingly random variation in the rate that genes are expressed. To study the source of such noise, Alexander van Oudenaarden of the Massachusetts Institute of Technology and his colleagues looked at weakly active genes in the yeast *Saccharomyces cerevisiae*. Fluctuations in the activity of these genes became synchronized



SCIENCE

when they were engineered to be close together on the chromosome. This positional effect suggests that extrinsic factors, such as spatial variation within the cell's nucleus in the concentration of molecules that control gene activity, may cause the noise.

CLIMATE CHANGE

Greenland gets warmer

Geophys. Res. Lett. **32,** L14705 (2005)

Researchers have teased apart two factors affecting Greenland's climate, collecting data in agreement with climate-model predictions that global warming is having a disproportionately large effect on the island.

Temperature trends in Greenland are dominated by local climate patterns such as the North Atlantic Oscillation (NAO), which is thought to have cooled Greenland since the 1930s. To detect the change underlying the oscillation's effect, Petr Chylek of Los Alamos National Laboratory in New Mexico and Ulrike Lohmann of the Swiss Federal Institute of Technology in Zurich found a weather station on Greenland's northeast coast where temperatures for the past 30 years seem unaffected by the NAO. Temperatures at this station are rising 2.2 times faster than the global average.

JOURNAL CLUB

Peter Seeberger
Swiss Federal Institute of Technology Zurich, Switzerland

A new twist to an old reaction should break down barriers between chemists, argues one who has worked in two fields.

Every day, people in my laboratory are performing glycosylation reactions. This is the basic reaction that connects two sugars, and it is key to the study and exploitation of carbohydrate molecules. We need carefully synthesized structures to probe the biological role of carbohydrates and explore their therapeutic potential.

The problem is that the glycosylation reaction, despite being described in 1901, is one of the least predictable transformations in organic synthesis. The sugars link through a carbon and an oxygen atom. These can bond in two mirror-image configurations, producing two stereoisomers with different biological activity. Controlling the stereochemistry of some linkages is easy, but for some it is very hard. This was a problem when my group synthesized a carbohydrate vaccine for malaria, for example.

Recent work by Geert-Jan Boons and his colleagues at the University of Georgia (*Angew. Chem.* **44,** 947–949; 2005) describes a nice trick that will offer control over some reactions. A group needed to shield a reactive site in the first sugar is chosen so that it is also a chiral auxiliary — a chemical add-on that allows only one stereoisomer to form. The auxiliary forces the molecule into a ring-shaped intermediate that the incoming sugar can attack from only one side.

This shows that even in a seemingly mature field there is room for innovation. Organic chemistry routinely uses chiral auxiliaries, but carbohydrate chemistry has been seen as a separate discipline. Having worked in both fields, I am trying to break down the boundaries.