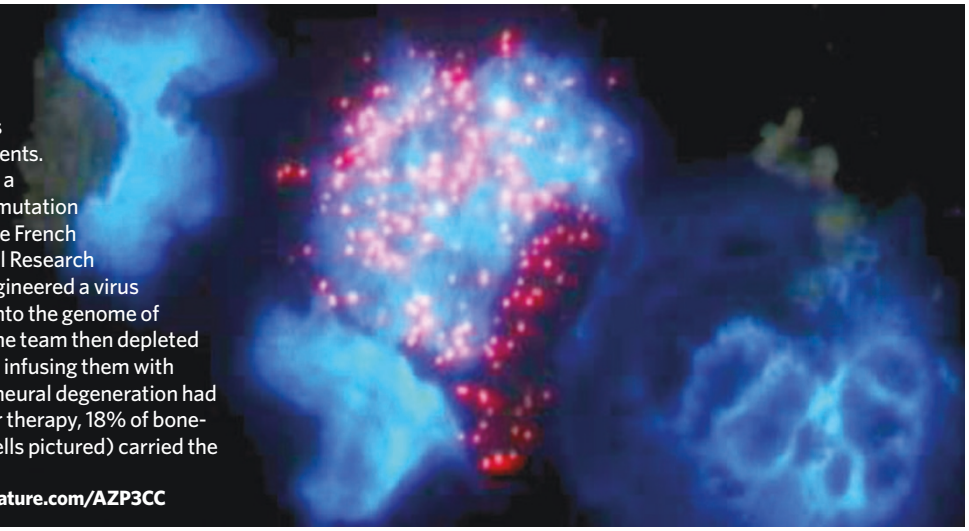
RESEARCH HIGHLIGHTS

Nerve repair

Science **326,** 818–823 (2009)

Researchers have slowed a fatal brain disease by inserting a gene into stem cells and then transplanting them into two patients. X-linked adrenoleukodystrophy (ALD) is a neurodegenerative disease caused by a mutation in the *ABCD1* gene. Patrick Aubourg of the French National Institute for Health and Medical Research (INSERM) in Paris and his colleagues engineered a virus to insert a functioning copy of the gene into the genome of the patients' bone-marrow stem cells. The team then depleted the patients of their bone marrow before infusing them with the repaired cells. Sixteen months later, neural degeneration had stopped in both patients. Two years after therapy, 18% of bone-marrow stem cells in one patient (four cells pictured) carried the working gene (cell with red dots).

For a longer story on this research, see go.nature.com/AZP3CC



P. AUBOURG

CLIMATE SCIENCE

Volcano chills

Geophys. Res. Lett. 10.1029/2009GL040882 (2009)

Analyses of ice cores from Greenland and Antarctica have revealed a previously unknown tropical volcanic eruption that spewed huge amounts of ash and gas in 1809. The event resulted in a decade, starting in 1810, of the coldest temperatures recorded in the past 500 years.

Jihong Cole-Dai of South Dakota State University in Brookings and his colleagues identified unique isotopic signatures of volcanic sulphate in the core layers from 1810 and 1811 that point towards the eruption. Its exact location remains unknown. The researchers report that the release of sulphur gases, which form Sun-blocking aerosols, by this volcano and the famed 1815 Tambora eruption in Indonesia was sufficient to bring about the cold decade, which included the 'year without a summer' in 1816.

LONGEVITY

Sweet food, short life

Cell Metab. **10,** 379–391 (2009)

Nematode worms fed on a diet spiked with glucose die about 20% earlier than those consuming just the bacterium *Escherichia coli*.

Cynthia Kenyon and her colleagues at the University of California, San Francisco, found that dietary glucose inhibits the DAF-16 and HSF-1 proteins, which are known to lengthen nematode lifespan. This in turn lowers the activity of the gene *aqp-1*, which codes for a glycerol channel, suggesting that glucose shortens lifespan by affecting glycerol metabolism.

Worms consuming glycerol also died earlier. The authors think that the worms metabolize glucose into glycerol, which then initiates life-shortening processes.

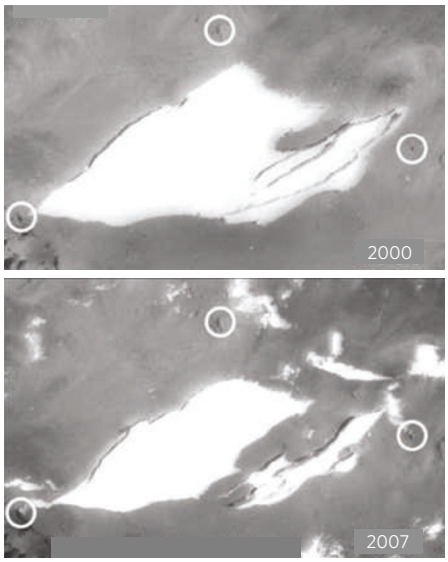
CLIMATE CHANGE

Kilimanjaro's loss

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0906029106 (2009)

Between 2000 and 2007, the area covered by the iconic glaciers of Mount Kilimanjaro shrank by 26%. In addition, the ice thinned rapidly, according to an analysis of aerial photographs and ground measurements by Lonnie Thompson of Ohio State University in Columbus and his colleagues.

One of the ice fields, the Furtwängler (pictured below), halved in thickness — by nearly five metres — between 2000 and 2009 at one drill site. The glaciers now cover just 15% of the area they covered in 1912. The researchers predict that, probably owing to global warming, Africa's highest peak will be ice-free by 2033.



L. THOMPSON *ET AL./PROC. NATL ACAD. SCI. USA*

For a longer story on this research, see go.nature.com/IWMvvU

NEUROSCIENCE

Early stress marks genes

Nature Neurosci. doi:10.1038/nn.2436 (2009)

Changes in gene expression caused by factors other than variation in the DNA code — 'epigenetic' changes — are partly responsible for the mental and physical health problems often associated with stress in early life.

Dietmar Spengler and his colleagues at the Max Planck Institute of Psychiatry in Munich, Germany, stressed newborn mice by separating them from their mothers. As adults, the mice secreted abnormally high levels of the stress hormone corticosterone, were less able to cope with stressful situations and had memory impairments. They also had fewer methyl groups attached to the regulatory region for the gene that encodes the hormone vasopressin, a key player in the biochemical pathway that leads to corticosterone release. The reduced methylation resulted in a rise in vasopressin expression.

ASTRONOMY

Galaxies far, far away

Astron. Astrophys. doi:10.1051/0004-6361/200912299 (2009)

Astronomers have identified the most distant cluster of galaxies yet. The object, called JKCS 041, is 3.1 billion parsecs away, and existed when the Universe was just a quarter of its current age, say Stefano Andreon of the Brera Astronomical Observatory in Milan,

Italy, and his colleagues.

The team detected 16 of the brightest galaxies in the cluster, which consists of a gravitationally caged set of hundreds to thousands of galaxies. It is an extremely early example of the effect of gravity competing — and winning — against the dispersive effect of the Big Bang.

The researchers used both ground- and space-based telescopes, but required X-ray observations of hot gas between the individual galaxies to show that they are bound together in a cluster.

BIOPHYSICS

DNA stop and go

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0907404106 (2009)

DNA polymerase enzymes that are responsible for DNA replication can work faster than previously thought.

Using a type of fluorescence spectroscopy, Jerrod Schwartz and Stephen Quake at Stanford University in California studied single polymerase molecules from the bacterium *Escherichia coli* in real time.

The enzyme pauses periodically as it travels along a strand of DNA synthesizing a partner strand, and the researchers measured its speed during periods of movement. They showed that the DNA polymerase Pol I(KF) has an intrinsic speed limit of 14–17 nucleotides per second, depending on the conditions — about ten times greater than estimates based on averages of all of its movements, including pauses. Another polymerase they looked at had a highly variable synthesis rate, ranging from 1 to about 50 nucleotides per second.

ATMOSPHERIC SCIENCE

Industrial UV shield

Atmos. Chem. Phys. **9,** 7737–7751 (2009)

Earth's natural sunscreen — the stratospheric ozone layer — has thinned during the past few decades because of the rise in atmospheric pollutants such as chlorofluorocarbons. This has allowed more ultraviolet (UV) radiation to reach many parts of the planet's surface since the 1970s. However, other forms of pollution have helped to shield Earth from UV rays.

Using an atmospheric radiation model, Gunnar Myhre of the University of Oslo and his colleagues found that, since 1750, pollutants such as sulphate, soot particles, sulphur dioxide and nitrogen dioxide have reduced the amount of UV light reaching some industrialized regions by as much as 20%. By scattering or absorbing UV light, such pollution may be masking some of the effects of ozone depletion, the authors say.

NANOSCIENCE

Release the goods

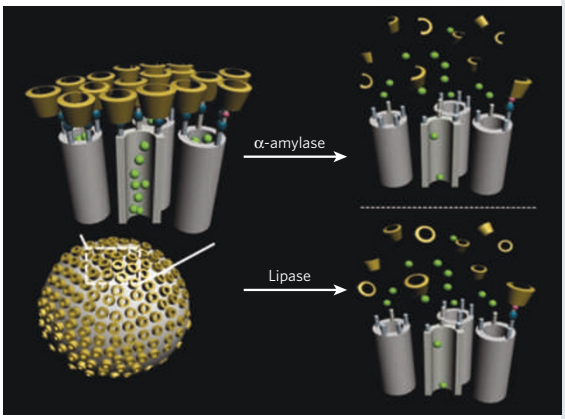
J. Am. Chem. Soc. doi:10.1021/ja9061085 (2009)

Silica nanoparticles can act as tiny containers to deliver drugs in response to enzymes, thanks to Chulhee Kim and his colleagues at Inha University in Incheon, South Korea.

The particles are pitted with pores that are capped with cyclodextrin molecules. The pores bear the cargo molecules — in the authors' experiments, fluorescent calcein dye.

The enzyme α-amylase, which increases in acute pancreatitis, was added to a buffer solution containing the particles. The enzyme degraded the cyclodextrin and calcein flooded out (schematic pictured below). The lipase enzyme had a similar effect, but when no enzyme was present, the pores remained closed and their contents locked away.

The system could have uses in drug delivery, diagnostics and imaging, the authors say.



AM. CHEM. SOC.

GENOMICS

Sequencing costs drop

Science doi:10.1126/science.1181498 (2009)

A team has sequenced three human genomes for US$4,400 each — at least ten times less than that achieved with other technologies.

Radoje Drmanac and Dennis Ballinger of Complete Genomics in Mountain View, California, and their collaborators developed a technique that chops DNA into fragments, makes many copies of these, rolls them up into 'nanoballs' and binds them to patterned silicon arrays. Nine-base-long probes of specific sequences — tagged with one of four different dyes, each corresponding to a 'letter' of the DNA code — are then added and bind to complementary DNA sequences with the help of synthetic 'adaptors'. Fluorescence imaging picks up the signal from the bound probes.

The technique keeps reagent use, and thus sequencing costs, low. It identified 94–98% of genetic variants when compared with established methods.

JOURNAL CLUB

Robert Blelloch
University of California, San Francisco

A computational biologist looks at how mRNA length changes during development.

I am always amazed by how we start as a fertilized egg and develop into a complex, multicellular organism. This feat occurs despite the fact that the DNA in every cell — even the most specialized ones — remains, for the most part, unchanged.

One method of regulating gene activity in differentiated, or specialized, cells is through the messenger RNA (mRNA), the code of which is translated to make proteins. For example, proteins and other RNAs can bind to the untranslated regions (UTRs) at the 5′ and 3′ ends of mRNAs to regulate mRNA stability and translation.

The constitution of the 3′ UTR itself can be regulated through alternative polyadenylation, whereby one of several possible UTR sites is cleaved, followed by the addition of adenosine-based molecules to its end. A broad shift in cleavage site choice — and thus 3′ UTR length — during mammalian development was recently described by Bin Tian and his team at the University of Medicine and Dentistry of New Jersey in Newark (Z. Ji *et al. Proc. Natl Acad. Sci. USA* **106,** 7028–7033; 2009).

By analysing genomic data, they show that 3′ UTRs generally get longer during development and cell differentiation. The authors further show that most of the genes in which 3′ UTRs are lengthened are also those that are increasingly suppressed during differentiation, such as the genes for DNA replication and cell division.

These findings bring to the forefront an underappreciated mechanism of genetic regulation that is likely to be important for normal cell differentiation. It is fascinating how many steps of the central dogma (DNA to RNA to protein) are controlled. This seems to be how evolution has managed to take a relatively simple cell and multiply it to form the complex body plan of the human.

Discuss this paper at **http://blogs.nature.com/nature/journalclub**