RESEARCH HIGHLIGHTS

Volcanic paintings

Atmos. Chem. Phys. **7,** 4027–4042 (2007)

The ash from large volcanic eruptions can cool Earth's climate and cause vivid red sunsets. But the historical effects of volcanic activity on climate are difficult to quantify owing to a lack of direct atmospheric observation.

Christos Zerefos at the Academy of Athens in Greece and his colleagues have come up with a novel way to estimate the volcanic particle content in middle latitudes of the Northern Hemisphere during the period 1500–1900. They analysed sunsets captured in paintings by artists such as John Mallord William Turner, Edgar Degas and Gustav Klimt. (Pictured is one of their subjects, *The Stages of Life* (1835) by Caspar David Friedrich.)

The researchers calculated red/green colour ratios from digital photos of hundreds of paintings. They found that artists used more red after major volcanic eruptions such as those of Krakatau in 1680 and 1883. The team then used the red/green ratios to reconstruct how much light was intercepted by volcanic ash in the air. The resulting time series correlates well with and could complement existing historical reconstructions of atmospheric composition.

BRIDGEMAN ART LIBRARY

ASTRONOMY

Bright start

Astrophys. J. Lett. **667,** L37 (2007)

Not all supernovae are created equal, according to an analysis of 169 stellar explosions.

Andrew Howell and his colleagues at the University of Toronto in Canada analysed the peak brightness of one type of supernova at different times during the Universe's history. Type 1a are thought to be of almost uniform brightness, and have thus been used to probe the distances between objects in space and the strength over time of dark energy — the force pushing the Universe apart.

However, Howell found that, on average, Type 1a supernovae from the young Universe were brighter for longer than their counterparts in the current era. Correcting for this does not significantly change current measurements of dark energy, but the effect may limit supernovae's usefulness as a gauge of dark energy in the past, the authors report.

GENOMICS

Weak to strong

Genome Res. doi:10.1101/gr.6395807 (2007)

It seems that evolution may indeed favour the strong over the weak, according to Katherine Pollard at the University of California, Davis, David Haussler at the University of California, Santa Cruz, and their colleagues.

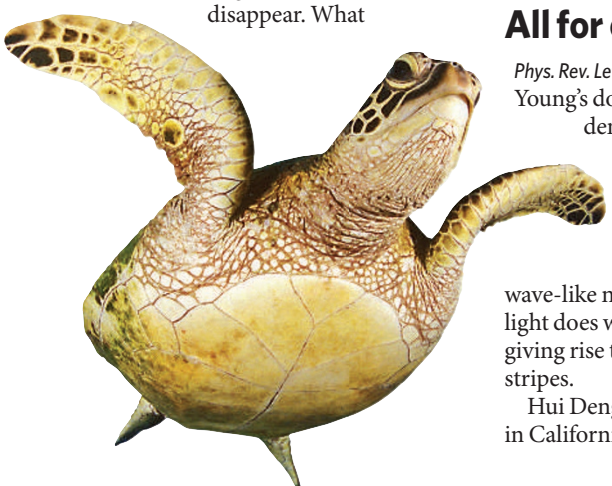
Last year, the team reported that the 200 or so most rapidly evolving spots in the human genome had more single-base changes from A and T to G and C bases — known as 'weak-to-strong' substitutions. Genome wide, mutations happen at approximately equal rates in both directions. Now, Pollard and Haussler extend their analysis and find the weak-to-strong substitution bias exists in all the many thousands of regions of the human genome in which evolutionarily recent substitutions are densely clustered. The most biased clusters contain a disproportionately high number of genes. The authors also find an intriguing correlation with areas that have high recombination rates in males.

POPULATION ECOLOGY

Wayward youth

Biol. Lett. doi:10.1098/rsbl.2007.0394 (2007)

After emerging from their nests, green turtle hatchlings bolt for the sea and disappear. What they do in the 'lost years' that follow, before they reappear to feed on seagrasses and algae near the shore, has been revealed by analysis of scute, the fingernail-like coating on turtle shells.



M. USHIODA/IMAGEQUESTMARINE.COM

Kimberly Reich and her colleagues at the Archie Carr Center for Sea Turtle Research, University of Florida, Gainesville, measured isotopes in layers of scute laid down as turtles' shells grow. High levels of nitrogen-15 in the oldest scute suggest that the turtles spend their first three to five years as carnivores, because this isotope accumulates towards the top of the food chain. Older scute also contains low levels of carbon-13, indicating that the turtles had lived in open ocean habitats. Shallow water is relatively rich in carbon-13, because the rate of photosynthesis, which preferentially snaps up carbon-12, is high.

QUANTUM PHYSICS

All for one and one for all

Phys. Rev. Lett. **99,** 126403 (2007)

Young's double-slit experiment — a classic demonstration of the wave nature of light — has been repeated for a 'polariton condensate' to test claims about such condensates' quantum nature.

Objects that have a quantum wave-like nature are expected to behave as light does when it passes through two slits, giving rise to a pattern of dark and bright stripes.

Hui Deng, then at Stanford University in California, and her colleagues looked

for this effect in polaritons, which each comprise a photon and a bound pair of charges, in a semiconductor device at low temperature. They confirmed that widely spaced polaritons share an almost pure quantum state. Atoms in the ever-intriguing Bose–Einstein condensates share one pure quantum state, but debate is likely to continue over whether polariton condensates deserve the Bose–Einstein label, says Deng.

NEUROBIOLOGY

Sensory deprivation

Nature Neurosci. doi:10.1038/nn1978 (2007)

Visual deprivation during the first five months of life may permanently damage interactions between the body's audio and visual systems.

Lisa Putzar of the University of Hamburg in Germany and her colleagues examined people born with dense cataracts who had no pattern vision for at least five months, but then gained good vision. Compared with controls, those born with cataracts were less likely to be distracted by a burst of noise interrupting a test containing visual cues — a sign that interference between the audio and visual systems is reduced. Those who had cataracts at birth also showed poorer audio–visual integration: they were less able than controls to recognize the words of speakers in videos with degraded audio tracks despite having similar lip-reading skills.

ARCHAEOLOGY

Keep paddling

Science **317,** 1907–1911 (2007)

The first inhabitants of Hawaii are thought to have originiated from Polynesia. The discovery of an adze — an axe-like tool — made from Hawaiian basalt on a Tuamotu atoll in East Polynesia provides the first material evidence that ancient voyagers made a round trip of more than 8,000 kilometres from the South Pacific to Hawaii and back again. Scientists long thought that journeys between remote Pacific islands must have been accidental or one-time events, although oral histories and recent research hinted otherwise.

Kenneth Collerson and Marshall Weisler at the University of Queensland in Australia examined trace elements and isotope ratios in stone adzes found on the Tuamotus islands. The adzes were from a number of Pacific islands, with one bearing the chemical fingerprint of Hawaii. Collerson suggests that pieces of rock may have been taken from island to island as a memento by travellers commemorating their long and arduous journeys.

CLIMATE MONITORING

Melt maps

Geophys. Res. Lett. **34,** L18504 (2007)

Microwave radiation emitted by snow and ice can indicate whether the surface is dry or wet. Wet surfaces imply melting. In an analysis of satellite data collected in Antarctica between 1987 and 2006, researchers confirm previous reports of extensive inland melting in early 2005 and document complex patterns of coastal and inland melting over the years. A team led by Marco Tedesco, of the University of Maryland in Baltimore, looked only at periods of 'persistent melting', defined as a period of one consecutive day and night or three days in a row. The reseachers used a new method that takes advantage of a particular microwave frequency. Tedesco says he used the same method to determine that high-altitude melting in Greenland set a record in 2007.

G. CHAPELLE/AFP/GETTY

MASS SPECTROMETRY

Hands off

Angew. Chem. Int. Edn doi:10.1002/anie.200702200 (2007)

A new technique allows the chemical make-up of human skin, plant tissue, frozen meat and other living materials to be determined quickly without harming the biological surface under scrutiny or having to treat it before analysis.

Renato Zenobi and Huanwen Chen at ETH Zurich in Switzerland and their colleagues blow a stream of nitrogen, a neutral gas, across a surface and collect a sample of what is dislodged. The sample is then transported to an extractive electrospray ionization mass spectrometer, where it can be directly analysed for its chemical composition. Using the technique, it is possible to quickly detect, from a human hand, the difference in caffeine levels before and after a person drinks a cup of coffee.

JOURNAL CLUB

Manyuan Long
University of Chigaco, Illinois, USA

An evolutionary geneticist is surprised by genes of unknown origin.

I once thought that, like us, every gene must have a mother. But recent work has identified some genes that seem to have no genetic ancestry. These 'motherless' genes pose a new challenge to understanding the molecular mechanisms and evolutionary forces that shape our DNA. This isn't the first time we've had to revise our ideas about gene evolution.

About 40 years ago, geneticist Susumu Ohno proposed that new genes originate when an existing gene duplicates, then one of the copies evolves a new function. Working with Chuck Langley in the early 1990s, I had the luck to discover a gene in flies that added another strand to Ohno's story. The gene, named *Jingwei*, is a chimaera that formed through the combination of two existing genes.

Since then, researchers have identified many other 'new' genes assembled from unrelated genes and mobile DNA elements. Often the sequences' origins can be identified. When they can't, researchers have simply assumed that subsequent evolution has masked the relationship of the gene to its ancestral sequences.

But this is unlikely to be the case for *hydra*, a gene found recently in *Drosophila melanogaster* and closely related species (S.-T. Chen *et al. PLoS Genet.* **3,** e107; 2007). No homologous sequences are found in a species that diverged from those carrying *hydra* only 13 million years ago — too recently for mutations to have obscured any related sequences. This implies that *hydra* arose *de novo*.

Another group has found a further 16 *de novo* genes in flies, which they propose evolved from non-coding DNA (D. J. Begun *et al. Genetics* **176,** 1131–1137; 2007 and M. T. Levine *et al. Proc. Natl Acad. Sci. USA* **103,** 9935–9939; 2006). These genes beg further study: what initiated their formation?

Discuss these papers at **http://blogs.nature.com/nature/journalclub**

habitat is probably present.

Buford Price and Robert Rohde, at the University of California, Berkeley, may have identified this missing habitat. They calculated that enough molecules such as carbon dioxide, oxygen, nitrogen and methane can diffuse through ice to sustain life.

By scanning ice cores with laser fluorimeters they detected protein spikes, some of which were indicative of single isolated cells, in just such habitats.

ASTROCHEMISTRY

Salty stars

Astrophys. J. **668,** L131–L134 (2007)

Researchers in the United States have found a dash of the unexpected in oxygen-rich stars. Lucy Ziurys and her colleagues at the University of Arizona in Tucson used the Submillimeter Telescope on Mount Graham and the 12 Meter Telescope on Kitt Peak, both operated by the Arizona Radio Observatory, to observe two red-giant stars that have shells dominated by oxygen. By analysing the recorded spectra, the team determined that the shells contain NaCl, which has previously been observed only in carbon-rich red giants.

The findings suggest that oxygen-rich stars, like their carbon-rich cousins, may be home to the complex types of chemistry that create molecular precursors to life.

BIOCHEMISTRY

Keeping the 'code'

Cell **131,** 58–69 (2007)

Certain chemical changes, or marks, made to the histone proteins around which DNA wraps seem to tell the cell whether or not that DNA should be transcribed.

Teams led by Matthias Mann at the Max Planck Institute for Biochemistry in Martinsried, Germany, and Marc Timmers at the University Medical Centre Utrecht in the Netherlands looked for proteins that bind to one chemical mark — trimethylation of lysine 4 on the histone H3. This mark is usually associated with transcriptional activity, and they found that a component of the transcription factor TFIID bound it tightly.

Dimethylation of a nearby arginine residue inhibited this binding, and other specific marks strengthened it, lending credence to the hypothesis that a combinatorial 'histone code' determines how cells read their DNA.

PLANT ECOLOGY

Grass attack

J. Ecol. doi:10.1111/j.1365-2745.2007.01307.x (2007)

Looking for signs of biological warfare past, Carolyn Malmstrom of Michigan State University in East Lansing and her colleagues delved into herbarium specimens at two University of California sites and extracted some of the oldest plant-virus RNA ever recovered.

Although ecological theory generally says that invasive species are successful outside their home ranges because they are freed from the pathogens that evolved to plague them, Malmstrom and colleagues suspect that a historical takeover of California grasslands by Eurasian grasses succeeded in part because the invaders brought viruses with them that affected the natives or changed the dynamics of an existing virus population.

They extracted barley yellow dwarf virus RNA from several specimens, including a 1917 invasive wild oat, proving that the virus was present at the time of invasion.

VISION

A scaffold in new light

EYE OF SCIENCE/SPL

Cell **131,** 80–92 (2007)

The fruitfly protein INAD had long been considered to be a scaffolding protein, organizing important visual signalling proteins that attach to it. But recent research suggests that INAD directly regulates visual perception.

Rama Ranganathan, of the University of Texas Southwestern Medical Center in Dallas, and colleagues show that, in response to light, one of five structural 'PDZ' domains of INAD transiently switches from a reduced to an oxidized state, distorting INAD's ability to bind to other molecules. This seems crucial to visually mediated reflex behaviours and for terminating visual responses.

Many scaffolding proteins contain PDZ domains, which could undergo similar conformational changes to that of INAD. Thus, rather than support components, these might serve as control centres for other signalling molecules.

Correction

The Research Highlight 'Volcanic paintings' (*Nature* **449,** 510; 2007) wrongly named Joseph Mallord William Turner as John Mallord William Turner.

JOURNAL CLUB

Andre Geim
University of Manchester, UK

Imploding atoms have softened this experimentalist's teasing views on theoretical physics.

As an experimentalist, I instinctively dislike theory papers. Too many of them seem to be written for the sole purpose of showing off an integral larger than a competitor's, or to present multiple theories just in case one idea proves right and so is hailed as visionary. I feel even less warmly towards theories that are nigh on impossible to check, such as the supposed precursor to a theory of everything, string theory.

But speaking seriously, even the most obscure predictions can turn out to be spectacularly relevant.

In our lab we have been studying graphene, a material that comprises a single layer of carbon atoms arranged similarly to chicken wire. Because electrons in this material mimic ultra-relativistic particles, it should be possible to observe in their behaviour century-long-predicted phenomena such as the Klein paradox (which concerns how highly energetic electrons tunnel through supposedly impenetrable barriers) and *zitterbewegung* (jittery movements of relativistic wave-packets).

Several recent theory papers on the physics preprint server arXiv predict another coup for graphene (see A. V. Shytov *et al.* arXiv:0708.0837; 2007).

According to relativistic quantum theory, atoms containing more than 170 protons cannot exist, because electrons around nuclei with such a large charge would fall into the centre. Nuclear physicists have not come close to creating atoms heavy enough to test this prediction. But the recent theory papers suggest that it should be relatively easy to observe the effect in graphene. This is because electrons in this material interact much more strongly than they do in atoms, so should fall down on charged impurities (standing in for nuclei) rather routinely.

This makes me wonder: could we design condensed-matter systems to test the supposedly non-testable predictions of string theory too?

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