



# Infoteca's E-Journal



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**Why wartime wrecks are slicking time bombs**

- 01 September 2010 by **Mick Hamer**
- Magazine issue 2776.

Rusting time bombs

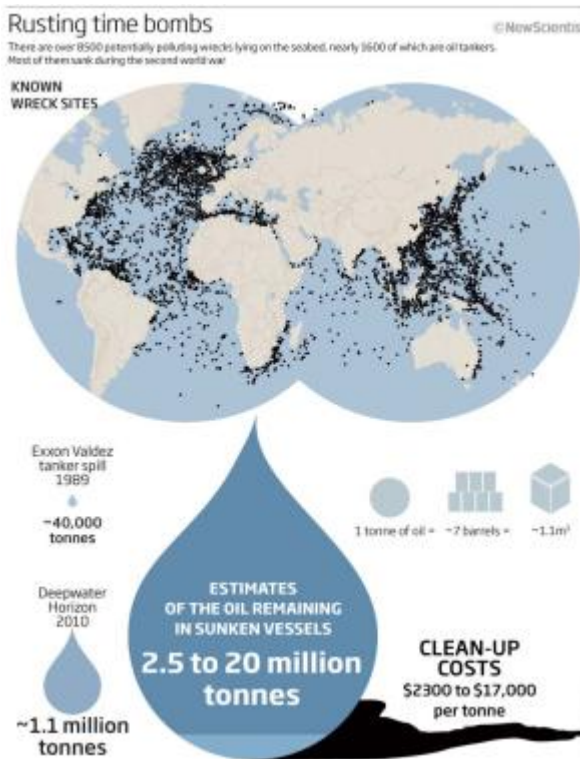
*Thousands of ships sunk in the second world war are seeping oil – and with their rusty tanks disintegrating, "peak leak" is only a few years away*

THE battle for Guadalcanal was one of the pivotal moments of the second world war. The Japanese occupied Guadalcanal, the largest of the Solomon Islands, in August 1942. When the Americans landed a few months later, the Japanese set out to reinforce their troops by sea. The struggle for naval supremacy that followed was confused and bloody, but by February 1943 the battle was over and the Japanese had evacuated their remaining troops.

The battle has a hidden legacy, however. Before the war, the stretch of water north of Guadalcanal was called Sealark Sound. Now it is known as Iron Bottom Sound, because of the number of wrecked ships there. One of these is the 6800-tonne Japanese freighter Hirokawa Maru, lying stranded off what would otherwise be an idyllic, palm-fringed Pacific island beach. Every now and then the ship leaks oil, threatening coral reefs, marine life and subsistence fishing.

Compared with the spill from BP's Deepwater Horizon field in the Gulf of Mexico, the oil from the Hirokawa Maru is a drop in the ocean. But this is not an isolated case of one ship blackening the shores of one Pacific island. The second world war saw the greatest-ever loss of shipping: more than three-quarters of the oil-containing wrecks around the globe date from the six years of this war. Sunken merchant ships are scattered around trade routes, the victims of attack by U-boats and other craft aiming to disrupt enemy nations' supply lines (see map). Then there are the naval ships sunk during great engagements such as the attack on Pearl Harbor and the battle of Chuuk Lagoon, the Japanese base in the Pacific where the US sank over 50 Japanese ships. In some locations these hulks are already leaking oil, threatening pristine shorelines, popular beaches and breeding grounds for fish. This year, for example, oil has begun to leak from the Darkdale, a British naval tanker that sank in 1941 near the island of St Helena in the south Atlantic Ocean. It was carrying more than 4000 tonnes of oil when it went down.

So how long have we got before there is a sharp increase in leakage from this lost fleet, and how big a problem could it be? What, if anything, can we do about it - and who will foot the bill?



## Mystery cargoes

Trevor Gilbert of the Australian Maritime Safety Authority, Dagmar Etkin of Environmental Research Consulting in New York state, and their colleagues have compiled the first global database of these polluting wrecks. In 2005 they told the International Oil Spill Conference in Miami that there are 8569 potentially polluting wrecks, 1583 of which were oil tankers. No one can know for sure how much oil is held in these ships. "Many wrecks may have lost oil when being sunk due to major structural damage," says Rean Gilbert of the Queensland-based consultancy Sea Australia, a leading authority on wrecks of the second world war. Regardless of whether they were carrying oil as cargo, these ships all contain "bunker fuel", a heavy oil that can devastate marine life and fisheries. How much bunker fuel they have depends partly on how far they had travelled since they last refuelled. But experience with modern wrecks, such as the oil tanker Prestige, which split in two off the coast of Spain in 2002, shows that most will have at least some oil on board.

There may be huge uncertainties about exactly how much oil is out there, but no one doubts that it dwarfs any single previous maritime spill. Etkin and Trevor Gilbert put the figure at somewhere between 2.5 million tonnes and 20 million tonnes. Even the lower estimate is more than double the amount of oil thought to have been spilled into the Gulf of Mexico by the Deepwater Horizon accident and more than 60 times that of the Exxon Valdez (see diagram).

After 70 years at the bottom of the ocean, these wrecks will soon start to leak. "There is ample evidence that there are a large number of wrecks in US coastal waters that are, in essence, spills waiting to happen," says Etkin. Doing nothing is fast ceasing to be an option. Ian MacLeod, based at the Western Australia Maritime Museum in Welshpool, is an authority on marine corrosion and has worked on the wrecks in Chuuk Lagoon. "It's not hopeless but it is getting desperate," he says. "I think we are going to see a sharp increase in the number of leaking ships in five to 10 years' time."

There is evidence that a large number of wrecks in US coastal waters are spills waiting to happen

In recent years there has been a steady trickle of leaks. In August 2001, a sunken US military oil tanker, the USS Mississinewa, began to leak into Ulithi Lagoon, in Yap state, part of the Federated States of Micronesia. The tanker had been carrying 20,000 tonnes of aviation fuel and fuel oil when it was sunk on 20 November 1944. And there it stayed for 57 years, a largely forgotten wreck lying in about 35 metres of water. Then in 2001 a typhoon struck and the islanders woke up to find thick fuel oil smeared over their beaches.

Quite when a wreck will leak oil depends largely on how fast its steel corrodes. "One millimetre a decade is the long-term average for corrosion," says MacLeod. "We've got a pretty good handle on this now." Marine engineers normally reckon that a ship would lose its structural integrity once its steel plate has lost between a quarter and a half its thickness. Most ships sunk during the second world war were made of plate between 19 and 25 millimetres thick.

However, the rate of corrosion depends hugely on the circumstances of individual wrecks. "It is vital to inspect and measure," says Rean Gilbert. "What may be true of one wreck is not necessarily the same for another." Most of the second world war wrecks were damaged when they were sunk, which is likely to have compromised their structural integrity. Any holes might also allow local currents to maintain a constant supply of oxygenated water, accelerating corrosion.

What's more, the use of different metals in ships can set up galvanic coupling, essentially creating a battery with the steel plate as the anode. This causes the steel plate to be eaten away, even if no other metals are in contact with it. "On one US wreck we found very high corrosion rates within 5 to 10 metres of the carpenters'

store. When we investigated we found the store had 5000 copper nails in it," MacLeod says. On the other hand, accretions of calcium carbonate and organisms such as barnacles can form a protective coating on the steel that retards the rate of corrosion - though violent storms can strip off this coating.

A lot depends on how a wreck is lying on the seabed. If it is not sitting upright, the rate of corrosion can be a lot higher due to the stresses placed on its structure. "Ships are designed to float, not to be wrecked," MacLeod says.

### **'Peak leak' soon**

The crucial question is just when a wreck has reached the point at which it will start to gush oil. "We don't have a lot of the answers," admits Lisa Symons, who heads a team at the US National Oceanic and Atmospheric Administration (NOAA) in Silver Spring, Maryland, responsible for potentially polluting wrecks. But the general picture is clearer. As steel plates corrode and lose their strength they reach the point where the next storm will trigger a catastrophic release of oil. MacLeod believes that in five to 10 years we will enter a period of "peak leak", which he expects to last for 50 years or so.

For most countries, these old wrecks are out of sight and out of mind, until they start to leak. In the early 1990s oil started to come ashore in NOAA's Gulf of the Farallones marine sanctuary, south of San Francisco. Initially blamed on pollution from passing ships, it continued to come ashore sporadically throughout the 1990s. In late 2001 there was another spill that went on for months. It killed about 50,000 seabirds and eight sea otters, and polluted 100,000 square kilometres of tidal marshes. Chemical tests showed that the oil was not from Alaska - the usual type carried by tankers passing the Californian coast - and that it matched previous mystery spills. So NOAA turned its attention to eight wrecks off the Californian coast. Divers and satellite imagery eventually pinpointed the source as the wreck of the Jacob Luckenbach.

For most countries, these old wrecks are out of sight and out of mind, until they start to leak

Although not a wartime wreck, the Jacob Luckenbach is of a similar vintage, having sunk after a collision in 1953. Fifty years later, researchers found that the ship rocked from side to side on the seabed every time there was a heavy storm, releasing oil. NOAA and the US coastguards decided it would be best to remove the oil, so in 2003 salvors bored holes in the ship's tanks and heated the oil with steam lances to lower its viscosity, then pumped it out. This technology for removing oil, known as hot tapping, is well established but it can be expensive, depending on the state of the wreck. Emptying the Jacob Luckenbach cost \$19 million.

It is important to NOAA to understand the potential impact of leaks on fisheries and marine sanctuaries, and their timescale, says Symons. Partly as a result of the Jacob Luckenbach incident, NOAA set up its Resources and Undersea Threats (RUST) database. This is a catalogue of the wrecks around the US coast that could cause oil spills, together with what is known about their oil load, location and state of corrosion. It lists some 1700 of these wrecks, their oil carried either as cargo or as bunker fuel. Taken together, they could potentially leak more than 15 times the amount of oil spilled by the Exxon Valdez. The wrecks are not evenly distributed around the coast: there are hotspots such as the Gulf of Mexico, where German U-boats were particularly active in the months after the US joined the war.

The US is one of the few countries to have started planning for peak leak. "NOAA is working to narrow down our list of RUST sites to determine those which are of greatest potential threat to economic and environmental resources," says Symons.





In 2009, the American Salvage Association (ASA) helped to set up the Wreck Oil Removal Program to identify high-risk wrecks that could threaten the US coastline, either damaging the marine environment or threatening economic interests such as fisheries and tourism. Etkin, the ASA and the not-for-profit North American Marine Environmental Protection Association successfully persuaded Congress to give \$1 million to WORP in 2010. "The first phase of the project is to do a risk assessment - the probability of leakage multiplied by the consequences of leakage," says Etkin. As part of this work, NOAA is organising a workshop of the world's leading corrosion experts at Newport News, Virginia, in October. The aim is to develop standard tests for deciding what to do about any given wreck. Ultimately, though, it is the US coastguard that will decide whether to remove oil from a wreck.

Close to the top of WORP's list of priorities is likely to be the Coimbra, a British tanker that was torpedoed by a U-boat in 1942 and sank off the coast of Long Island, New York, in 55 metres of water. Carrying a cargo of 11,000 tonnes of lubricating oil, the tanker broke into three parts and has been a chronic source of oil pollution over many years.

Away from the US, in the Pacific about 85 per cent of the wrecks are Japanese and the rest are mostly American. In the Mediterranean, Atlantic and Indian Oceans about half the wrecks are British and 16 per cent American, says Rean Gilbert. In general, most wrecks are the responsibility of the owners, but outside the armed forces not many of these owners still exist. And flag states are reticent about accepting liability. The British government, for example, failed to reply to *New Scientist's* questions about the Coimbra.

The cost of dealing with these wrecks is daunting. It cost about \$5 million to pump 6000 tonnes of oil from the USS Mississinewa, for example. The cost of cleaning up the oil once it has leaked is also dismaying. In 1999 Etkin put it at between \$2300 and \$17,000 per tonne of oil, depending on a wreck's depth and location. "As the situation in the Gulf of Mexico has made abundantly clear, once the oil spills it is a very expensive exercise to clean it up," says Rean Gilbert. Poorer countries face exceptional difficulties here. The Federated States of Micronesia and the Solomon Islands are among the world's most impoverished countries, with little leverage when it comes to persuading richer countries to take responsibility for their wrecks.

While the cost of pumping the oil out of all of the world's rusting hulks would be enormous, it is possible to spread the cost as well as carry out surveys to identify those most at risk of creating a serious spill, says MacLeod. But the first step should be to put so-called sacrificial anodes on bunker-fuel tanks. A sacrificial anode is a piece of metal that alters the local electrochemistry and then slowly dissolves. This not only halts the corrosion of the steel it is attached to but also raises the local pH of the seawater, encouraging protective marine deposits to grow. "It will gain you some breathing space," says MacLeod. "What we need is time."

*Mick Hamer is a journalist based in Brighton, UK*

<http://www.newscientist.com/article/mg20727761.600-why-wartime-wrecks-are-slicking-time-bombs.html?DCMP=NLC-nletter&nsref=mg20727761.600>

### Window on cosmic maternity wards

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The interstellar medium of the Antennae galaxies radiates only in infrared - it appears dark at the wavelengths of light that our eyes can see (Image: NASA/ESA/HHT/STSCI/AURA)

*Infrared was the first invisible radiation discovered – it has revealed asteroids, comets, interstellar dust and the birth of planets, stars and galaxies*

As we look into a clear night sky, we see just a fraction of what the universe contains: mainly stars in our galaxy radiating in the narrow visible wavelength band between 390 and 750 nanometres.

Optical telescopes extend that vision to far-off galaxies, but it is only in the past century or so, as we have begun to observe the broad sweep of invisible electromagnetic wavelengths, that the full drama of the cosmos has been unveiled.

The first invisible radiation to be detected was in the infrared range, at wavelengths from 750 nanometres up to a millimetre. It was discovered in 1800 when the British astronomer William Herschel used a prism to split sunlight and saw the mercury of a thermometer placed beyond the red end of the spectrum begin to rise.

Infrared astronomy took off in the 1960s. It studies objects in the universe at temperatures between 10 and 1000 kelvin: asteroids, comets, interstellar dust and newly forming stars and galaxies.

### **Dust to dust**

The most significant source of the infrared light that reaches Earth is the interstellar medium. This mixture of gas and dust pervades the space between stars in galaxies and has a temperature of 10 to 50 kelvin. It radiates only in the infrared, and dims the visible light from distant stars, reddening their colour.

The first direct image of the interstellar dust came in 1983 courtesy of the Infrared Astronomical Satellite (IRAS), a space telescope funded by the US, the Netherlands and the UK. It was a signal moment in astronomy. Observing interstellar dust allows us to glimpse the full cycle of stellar life and death, including the formation of new stars and planetary systems from the dust - sometimes in violent bouts as distant galaxies collide - long before these stars become visible to optical telescopes. A striking example lies in the pair of merging galaxies known as the Antennae, around 45 million light years from us: their brightest infrared regions (image left) are dark at visible wavelengths (image right).

Infrared observations also reveal dying stars blowing off clouds of dust and gas, replenishing the interstellar medium. The dust is mainly silicates and amorphous carbon - sand and soot. The production of this dust is crucial to our existence: every carbon atom in our bodies was created in the core of a star, was ejected as that star died, and drifted around in the interstellar medium before being sucked into our solar system.

### **Other worlds**

The first dedicated infrared space telescope, IRAS, found discs of dust and other debris around some bright stars, pointing the way to searches for planetary systems. Infrared surveys have since detected many debris discs and planets in the process of forming.

Most fully-formed extrasolar planets are discovered by optical telescopes looking either at small changes in the star's velocity as the planet orbits it, or tiny drops in brightness as the planet crosses the surface of the star. Infrared instruments, such as NASA's Spitzer Space Telescope (left), have an important complementary role to play. They look for "hot Jupiters", close-orbiting massive planets, as they pass in front of their star.

An infrared instrument on the European Southern Observatory's Very Large Telescope was the first to provide a direct image of an extrasolar planet. This body, in orbit around a brown dwarf star, is five times the mass of Jupiter.

### **Galactic origins**

Because infrared observations spy out stars as they form and die, we can use them to look back in time, tracing how stars and galaxies formed throughout cosmic history almost as far back as the big bang.

When NASA's Cosmic Background Explorer (COBE) space mission, launched in 1999, measured the total background radiation at millimetre and sub-millimetre wavelengths, it found a strong contribution from



distant galaxies. It turns out that more than half of the energy emitted by far-off stars at optical and ultraviolet wavelengths is absorbed by dust and re-emitted in the infrared before it reaches us, making infrared essential for our understanding of the universe.

The infrared is also important for finding out how galaxies first arose. The universe is expanding, which means most galaxies are receding from us and the radiation they emit undergoes a Doppler shift to longer wavelengths. This "red shift" means visible light from the most distant galaxies known, emitted in the first billion years after the big bang, is stretched to infrared wavelengths by the time it reaches us.

### **Star instrument: Herschel**

Most infrared wavelengths are absorbed by water and carbon dioxide in the atmosphere, with only a few narrow spectral "windows" of infrared reaching the ground. Infrared telescopes must therefore be situated at the top of mountains or, better still, in space.

The current top dog in the infrared pack is the European Space Agency's Herschel telescope, which started operating in 2009. It is the largest telescope ever launched into orbit, and carries a spectrometer and two cameras that cover wavelengths between 70 and 500 micrometres. All this equipment has to be cooled to temperatures close to absolute zero to prevent the telescope's own infrared emissions affecting the measurements.

As interpretation of Herschel data gets under way, the telescope is already delivering some spectacular images of filamentary interstellar dust clouds in which stars may be forming, as well as galaxies with unexpectedly large amounts of very cold dust missed by earlier studies.

<http://www.newscientist.com/article/mg20727762.700-unseen-universe-window-on-cosmic-maternity-wards.html>

### Tuning into the deep space channel

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The 64-metre movable Parkes radio telescope in Australia is the second largest movable dish in the southern hemisphere (Image: Roger Ressemeyer/Corbis)

*Radio and microwave telescopes expose the cold and quirky cosmos – from the chilled-out radiation of the big bang to extreme pulsars and quasars*

Radio and microwave telescopes study the longest electromagnetic wavelengths - anything longer than about a millimetre. Some of these emissions are produced by the coldest objects in the cosmos, such as the 2.7-kelvin background radiation from the big bang.

Most, however, are generated as "synchrotron radiation", given off when electrons spiral through magnetic fields at close to the speed of light. Identifying the sources of this radiation has revealed some of the universe's most extreme objects, such as pulsars and quasars.

Identifying the sources of radio waves reveals some of the universe's most extreme objects

## Quasars

The first isolated celestial source of radio waves, Cyg A in the constellation Cygnus, was identified as a distant galaxy in 1954. By 1962 astronomers at the University of Cambridge had listed over 300 radio sources in the northern sky.

A few of these were remnants of supernovae in our galaxy, including an object - now known to be a pulsar - at the heart of the Crab nebula, the remains of a supernova explosion seen by Chinese astronomers in AD 1054. Most, however, were within distant galaxies. Some were associated with objects that looked like stars, and became known as quasi-stellar radio sources, or quasars. What these luminous, compact objects were was long controversial. Today we believe them to be supermassive black holes at the centre of distant galaxies, with masses ranging from a million to a billion times that of the sun.

We now suspect that most galaxies, including our own, have a black hole at their heart, and that in radio galaxies and quasars this black hole is swallowing up the surrounding gas. As the gas spirals in towards the hole, magnetic field lines in the gas get wound up too, accelerating electrons and producing radio waves. More than 200,000 quasars are now known.

## Galactic interactions

Regular galaxies are suffused with hydrogen gas. As hydrogen atoms emit radio waves with a wavelength of 21 centimetres, radio telescopes can map this gas. Often it extends far beyond a galaxy's visible boundary and can even link objects that appear separate. An example is the M81 group of galaxies around 12 million light years away (pictured below). In an optical telescope these galaxies seem distinct, but radio observations show a web of hydrogen connects them, through which they tug at each other gravitationally.

We can get a wealth of information on the internal dynamics of galaxies by looking at other spectral lines from interstellar gas molecules, for example in the microwave band, which lies between the radio and the infrared. Such observations reveal that dense molecular clouds have a rich chemistry, much of it based on carbon: more than 140 molecules have been identified, with carbon monoxide the most abundant after hydrogen.

## Pulsars

In 1967, Jocelyn Bell and Antony Hewish (above) were studying emissions from quasars with a new radio antenna on the edge of Cambridge, UK, when Bell noted a pulsing radio signal repeating every second or so. It was the first of a new class of radio sources known as pulsars. These rapidly rotating neutron stars, the remnants of massive supernovas, have stupendous magnetic fields which can reach 10 gigateslas; Earth's field, by comparison, is a puny 50 microteslas. As they spin, pulsars emit synchrotron radiation in jets that sweep through space like a lighthouse beam, resulting in the pulsing signal seen by our telescopes.

Radio telescopes have found thousands of pulsars with periods ranging from a millisecond to several seconds. In 1974, the orbit of a pulsar in a binary system with an ordinary, non-pulsing neutron star was seen to be slowing down exactly as it would if it were emitting gravitational waves - the only indirect evidence we have so far of this key prediction of Einstein's general theory of relativity (see Instant Expert 1, "General relativity", *New Scientist*, 3 July).

## Cosmic microwave background

In 1965, while trying to make the first microwave observations of the Milky Way, Arno Penzias and Bob Wilson of Bell Labs in Holmdel, New Jersey, (below) found their instruments plagued by unexplained noise coming from all directions in the sky. This turned out to be one of the most important astronomical discoveries of the 20th century: the radiation left over from the big bang, known as the cosmic microwave background or CMB.

This radiation has a spectrum exactly like that of a body with a temperature of 2.73 kelvin, a spectacular confirmation of what the big bang theory predicts. Its strength is virtually identical no matter where you look: disregarding a systematic 1 in 1000 variation caused by our galaxy's motion through the cosmos, its intensity varies by no more than 1 part in 100,000.

These tiny fluctuations are nonetheless important, as they provide a wealth of information about the abundance of different types of mass and energy in the universe. Measurements of the CMB by the Wilkinson Microwave Anisotropy Probe (WMAP) suggest just 4 per cent of the universe is ordinary matter, while 23 per cent is unseen dark matter, presumed to be made of unknown particles, and 73 per cent is the even more perplexing dark energy, whose nature remains a mystery.

The European Space Agency's Planck Surveyor mission, launched in 2009 on the same rocket as the Herschel infrared telescope, will map the CMB in still more exquisite detail than WMAP, perhaps even detecting the fingerprint of gravitational waves left over from the early stages of the big bang.

## Star instrument: The Very Large Array

The classic image of the radio telescope is of an overblown television satellite dish. Famous examples include the steerable telescopes at Jodrell Bank in the UK, the Parkes Observatory in New South Wales, Australia, and the National Radio Astronomy Observatory at Green Bank, West Virginia. The largest single dish of them all is the fixed 305-metre-diameter dish at Arecibo in Puerto Rico, which famously featured in the James Bond film *GoldenEye*.

Even such a monster cannot pinpoint a radio source in the sky to the desired accuracy, however. To make high-resolution observations, you need a dish hundreds of thousands of times bigger than the radio wavelengths you are observing. This is done by combining the signals from many scattered dishes using a technique called aperture synthesis. The prime example of such an instrument is the Very Large Array in New Mexico, which consists of 27 dishes spread along three arms of a "Y", each 10 kilometres long. It can locate a radio source in the sky to an accuracy of around a 1/10,000th of a degree.

<http://www.newscientist.com/article/mg20727762.800-unseen-universe-tuning-into-the-deep-space-channel.html>

## Hot, violent, high-energy happenings

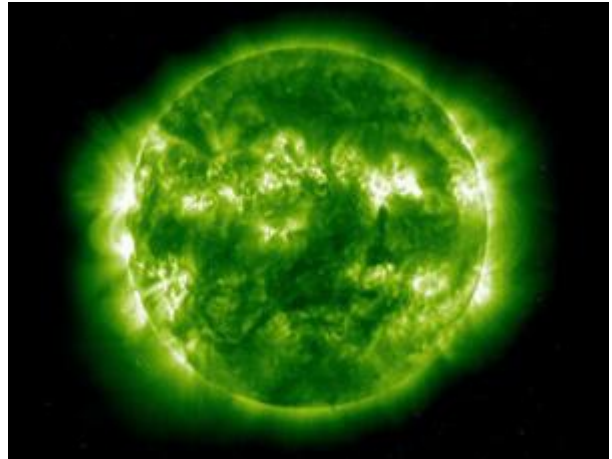
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X-ray images of the sun allow us to see the full spectacular effect of solar activity caused by magnetic forces (Image: SOHO/NASA/ESA)

*X-rays and gamma rays show the universe at its hottest and most violent, the realm of gamma-ray bursts, white dwarfs, neutron stars and black holes*

X-rays and gamma rays are the most energetic electromagnetic waves, with wavelengths of a fraction of a nanometre or less.

Observations at these wavelengths show the universe at its hottest and most violent. This is a realm of gamma-ray bursts, of gas at temperatures of hundreds of millions of degrees swirling around the remnants of dead stars, and of fascinating objects such as white dwarfs, neutron stars and black holes.



## Burst astronomy

Gamma rays have wavelengths shorter than 0.01 nanometres and are emitted during radioactive decay, or by particles travelling near the speed of light. The first gamma-ray burst was detected in 1967 by satellites monitoring atmospheric nuclear weapons testing.

Most bursts probably occur when a massive, fast-spinning star collapses to form a black hole, sending out a narrow beam of intense radiation, while shorter bursts may be emitted when two neutron stars merge. Bursts typically last a few seconds, with a longer-lived X-ray and optical afterglow, but can release as much energy as our sun will radiate in a 10-billion-year lifetime. They are visible even from the edge of the visible universe: recently, rays were seen from a galaxy 13 billion light years away, meaning they were emitted just 600 million years after the big bang.

As with X-rays, gamma rays are absorbed by the Earth's atmosphere. A dedicated space mission, NASA's [SWIFT](#) telescope, has studied over 500 bursts since it was launched in 2004, while ground-based instruments such as [HESS](#) in Namibia, [MAGIC](#) in the Canary Islands and [VERITAS](#) in Arizona keep an eye out for light from showers of short-lived subatomic particles created when energetic gamma rays collide with atoms in the Earth's atmosphere.

## X-ray suns

Ordinary stars emit huge amounts of X-rays, as the American T. R. Burnight discovered in 1948 when he launched a captured German V2 rocket containing a roll of photographic film towards the sun. These come mainly from our star's corona, the outer envelope of hot plasma that is most easily seen during a total eclipse, and also from particularly active regions of the sun's disc.

Solar X-ray missions such as NASA's Solar and Heliospheric Observatory (SOHO), launched in 1995, and Yokohoh, a joint mission by Japan, the UK and the US launched in 1991, have been able to observe solar flares as they develop. The most powerful of these flares can result in coronal mass ejections where a huge bubble of highly energetic particles and magnetic field lines bursts away from the sun. These can potentially disrupt communications when they hit Earth, and also present a radiation hazard to astronauts on any future crewed interplanetary missions.

### Death stars

Cosmic X-rays are absorbed by oxygen and nitrogen in Earth's atmosphere, so X-ray telescopes must be put into orbit. The first compact X-ray source, Sco X-1 in the constellation of Scorpio, was found during rocket observations of the moon in 1962. In 1970, the first dedicated X-ray satellite, NASA's Uhuru, was launched.

Many X-ray sources are binary star systems in which gas being shed by a dying star spirals into its companion - a dead, compact remnant of what was once a star. As it does so, it heats up and emits X-rays.

In Sco X-1 the companion object is a neutron star, the remnant of a star 10 times the mass of our sun. Other systems have larger, white-dwarf companions. But measurements in 1971 of the unseen companion's orbital wobble in one X-ray source, Cyg X-1 in the constellation Cygnus (pictured below), showed it was too heavy for a white dwarf or neutron star. It had to be a black hole - the first observational evidence of the existence of such a body.

X-rays are also emitted from the hot inner edges of discs of material accreting around supermassive black holes in active galactic centres and quasars (see p iv). Surveys by NASA's Chandra X-ray observatory and the European Space Agency's XMM-Newton satellite, both launched in 1999, have pinpointed thousands of such sources. One X-ray spectral line from highly ionised iron has been particularly informative: in some cases, it provides evidence of distortion due to the effects of general relativity.

### Star instrument: Fermi

The international Fermi gamma-ray space telescope was launched in 2008. It will carry out a survey of the whole sky as well as studying gamma-ray bursts (see below), pinpointing their locations to within 1/60th of a degree.

Most of the gamma-ray sources will probably be supermassive black holes at the centre of galaxies, but Fermi will also study pulsars, supernova remnants and the general background of gamma rays that emanates from all corners of the cosmos and whose origin is not fully understood.

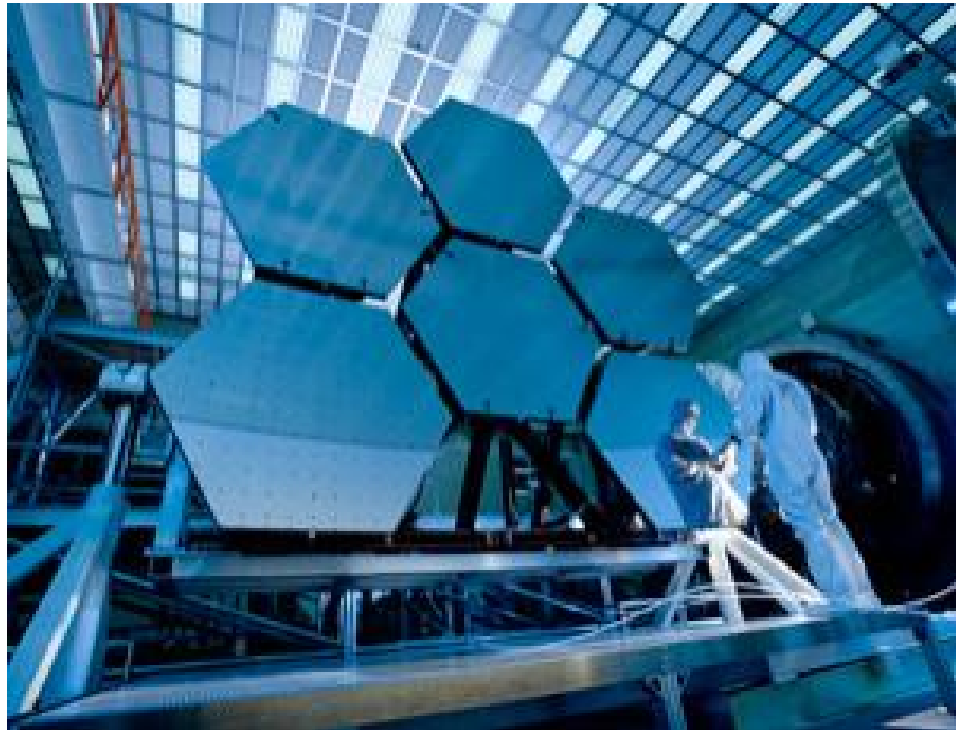
Fermi might also detect interactions between the postulated dark-matter particles known as WIMPs, if they exist. It will also perform other tests of fundamental physics that can be carried out at these ultra-high energies, such as measuring whether the speed of light is the same at all wavelengths.

<http://www.newscientist.com/article/mg20727762.900-unseen-universe-hot-violent-highenergy-happenings.html>



### What bigger, better vision will see

- 01 September 2010
- Magazine issue 2776.



The James Webb Space Telescope should be ready to replace Hubble in 2014 (Image: NASA/MSFC/David Higginbotham/Emmett Given)

*New space observatories, huge earthbound telescopes and a continent-sized radio array will probe the origins of stars, elements and the universe itself*

The coming years will see more of the invisible universe revealed by existing instruments and new probes spanning all wavelengths.

The workhorse of current space astronomy, the Hubble space telescope, will cease to operate after 2014, at which time its successor, the James Webb Space Telescope, should be ready for launch. The JWST will operate mainly in the infrared, covering wavelengths from 500 nanometres to 24 micrometres. Its main aim will be to obtain images of Earth-sized planets and to detect the very first galaxies at the edge of the observable universe. Towards 2020, SPICA, a joint Japanese-European infrared space telescope, should also be well advanced, together with a slew of giant ground-based optical and near-infrared telescopes - the European Extremely Large Telescope, the Thirty-Metre Telescope and the Giant Magellan Telescope.

The Atacama Large Millimeter Array (ALMA) will span wavelengths from 0.4 to 3 millimetres and should come on stream in Chile in 2012. It will probe star-forming regions in our galaxy and others with exacting angular resolution and sensitivity.

Even ALMA will be surpassed in scale, though, by an international radio telescope known as the Square Kilometre Array (SKA). To be sited in South Africa or Australia, it will connect a dense central square kilometre of radio antennas with receiving stations up to 3000 kilometres away. Ambitions for SKA are mind-blowing: it will study cosmic evolution and the nature of dark matter and dark energy through observations of hydrogen gas in a billion galaxies, and perform fundamental measurements to test our understanding of gravity and detect gravitational waves.

At the X-ray end of the spectrum, NASA and the European and Japanese space agencies are investigating the feasibility of an International X-ray Observatory. If it goes ahead, IXO will peer through dust and obscuring clouds of gas to discover and map supermassive black holes back at times when galaxies were first forming, and uncover the history and evolution of matter and energy, both visible and dark. It will also investigate when and how the elements were created and how they became dispersed in the intergalactic medium.

### **Michael Rowan-Robinson**

Michael Rowan-Robinson is professor of astrophysics at Imperial College London. He works principally on infrared and sub-millimetre astronomy, and cosmology. He contributed to the IRAS, ISO and Spitzer infrared space missions, and is currently involved with both the Herschel and Planck projects. He has been writing for *New Scientist* for over 40 years.

### **Recommended reading**

*Night Vision* by Michael Rowan-Robinson (Princeton University Press, to be published late 2010)

*Finding the Big Bang* by P. J. E. Peebles, L. A. Page Jr and R. B. Partridge (Cambridge University Press)

### **Websites**

Infrared astronomy (Infrared Processing and Analysis Centre, California Institute of Technology: [bit.ly/bhfGlb](http://bit.ly/bhfGlb))

Radio astronomy (US National Radio Astronomy Observatory: [bit.ly/A5gA4](http://bit.ly/A5gA4))

An introduction to X-ray astronomy (University of Cambridge Institute of Astronomy X-ray group: [bit.ly/70yrUF](http://bit.ly/70yrUF))

<http://www.newscientist.com/article/mg20727763.000-unseen-universe-what-bigger-better-vision-will-see.html>

## Void that is truly empty solves dark energy puzzle

- 01 September 2010 by [Rachel Courtland](#)

Magazine issue [2776](#).



A space-time continuum of calm (Image: Ralf Hiemisch/Getty)

EMPTY space may really be empty. Though quantum theory suggests that a vacuum should be fizzing with particle activity, it turns out that this paradoxical picture of nothingness may not be needed. A calmer view of the vacuum would also help resolve a nagging inconsistency with [dark energy](#), the elusive force thought to be speeding up the expansion of the universe.

Quantum field theory tells us that short-lived pairs of particles and their antiparticles are constantly being created and destroyed in apparently empty space. A branch of the theory, called quantum chromodynamics (QCD) - which explains how gluons and quarks, the particles that make up protons and neutrons, behave - predicts that a vacuum should be awash with an interacting sea or "condensate" of quarks and gluons. This picture helps to explain how particles made of quarks get most of their mass.

This condensate carries energy, so it might be thought to be a candidate for the mysterious source of dark energy, which can be described by a parameter called the cosmological constant. The trouble is that when physicists use QCD to estimate the condensate's energy density, their calculations suggest it would pack a punch that is  $10^{45}$  times the cosmological constant that we measure from observations of the universe's expansion.

Now [Stanley Brodsky](#) of the SLAC National Accelerator Laboratory in Menlo Park, California, and colleagues have found a way to get rid of the discrepancy. "People have just been taking it on faith that this quark condensate is present throughout the vacuum," says Brodsky. Instead, his team have assumed that the condensate exists only inside protons, neutrons, pions and all other quark-containing particles, collectively known as hadrons (*Physical Review C*, DOI: [10.1103/PhysRevC.82.022201](#)).

"In our picture, quarks and gluons can't flutter in and out of existence unless they are inside hadrons," says team member [Craig Roberts](#) of the Argonne National Laboratory in Illinois. As a result, the vacuum is much calmer and, crucially, the problem it poses for the cosmological constant is reduced.

In our picture, quarks and gluons can't flutter in and out of existence unless they're inside hadrons

In 1974, Aharon Casher of Tel Aviv University in Israel and Leonard Susskind, now at Stanford University in California, suggested that a condensate present only inside hadrons could give these particles mass. Brodsky and colleagues are the first to show that this idea also helps resolve the dark energy discrepancy.

Daniel Phillips of Ohio University in Athens is excited by the result, but says more work must be done to show that the condensate can't leak out of hadrons and into the vacuum. He points out that the result doesn't rule out the existence of a vacuum condensate. "It just shows you don't have to assume one."

Another issue is that the quark and gluon condensates predicted by QCD are not the only entities to jar with the observed cosmological constant. Other theories predict vacuum energies that also vastly exceed it (see "The worst prediction physics ever made"). "To solve the cosmological constant problem you would have to eliminate all these contributions," says Dejan Stojkovic of the University at Buffalo in New York.

### **The worst prediction physics ever made**

"One down, three to go" would be an appropriate mantra for anyone trying to explain the universe's accelerating expansion in terms of the energy of quantum processes in empty space.

The problem is that all potential sources of this vacuum energy give values that far exceed the cosmological constant, an estimate of the universe's energy density based on its observed expansion rate. A new study may have got rid of one source of excess energy (see main story), but there are other, even more problematic ones. The Higgs boson, thought to be partially responsible for giving other particles mass, has an associated field whose vacuum energy is  $10^{56}$  times the observed cosmological constant. Meanwhile, the vacuum energy associated with grand unified theories that aim to unify electromagnetism and the nuclear forces gives a value  $10^{110}$  times too big.

The biggest disparity of all comes from attempts to unify quantum mechanics and general relativity. Under so-called quantum gravity, the energy density is  $10^{120}$  times too big. "This is actually called the worst prediction that physics ever made," says Dejan Stojkovic of the University at Buffalo in New York.

<http://www.newscientist.com/article/mg20727764.100-void-that-is-truly-empty-solves-dark-energy-puzzle.html>

## Space ribbon deployed to surf Earth's magnetic field

- 18:09 02 September 2010 by **David Shiga**



The T-Rex experiment unfurled a tether during a suborbital rocket flight (Image: JAXA)

A Japanese rocket unfurled a 300-metre-long ribbon in space on Monday, testing technology that could one day allow spacecraft to navigate by surfing Earth's magnetic field.

Conventional spacecraft have to burn fuel to manoeuvre in orbit. But the fuel adds weight and cost to the launch and eventually gets used up, limiting the probes' lifetime.

In principle, it is possible to propel an orbiting spacecraft without fuel by using a long piece of metal to interact with the magnetic field surrounding our planet. "You're essentially pushing against the Earth's magnetic field," says Les Johnson of NASA's Marshall Space Flight Center in Huntsville, Alabama.

On Monday, the Japan Aerospace Exploration Agency (JAXA) launched a spacecraft to test the idea.

### Live wire

Called T-Rex, short for Tether Technologies Rocket Experiment, the mission launched from the Uchinoura Space Center in Japan at 2000 GMT (5 am on Tuesday, local time) on a suborbital flight that lasted about 10 minutes and reached a maximum altitude of 309 kilometres.

While in space, the spacecraft unfurled the 300-metre-long "tether" – a 2.5-centimetre-wide metallic ribbon. It also successfully turned on its cathode, a device at one end of the tether designed to expel electrons into space.

The tether was meant to sweep up electrons floating in space and channel them along its length, creating an electric current. It would then expel them into space from the cathode.

In practice, the electric current would interact with Earth's magnetic field to drag the spacecraft to a lower orbit. Using power from solar panels, however, a spacecraft could also drive current in the opposite direction, which would raise its orbit.

### Impact hazard

It looks like the mission generated a current, which should have produced some thrust, says Johnson. He is a member of the mission team, which is led by Hironori Fujii of the Kanagawa Institute of Technology in Tokyo.

But there is no way to know for sure because the mission was not equipped to measure thrust, Johnson says. It was meant instead to return data on how efficiently the tether collected electrons, to help engineers design future tethers for propulsion. It is not yet clear what data the mission was able to return, Johnson says.

Some previous tether designs have used a thin wire, but these can be severed if hit by fast-moving bits of space debris or micrometeorites. The flat, ribbon-like tether used by T-Rex is less vulnerable to such impacts, which would merely punch a hole in the ribbon rather than break it, says Johnson.

### Short circuit

Johnson is part of a team planning a mission to demonstrate tether-based propulsion using NASA funds. This mission will have to compete for funding with other advanced technology demonstrations, such as solar sail propulsion, however. If selected, the tether demonstration could be ready to fly in 2013 or 2014, Johnson says.

Tethers have been launched into space before, but with mixed success. One was deployed from the space shuttle in 1996, but broke before it reached its full extent. An investigation determined that a short circuit burned through the tether, Johnson says.

More recently, in 2007, two attempted tether missions went awry. On one, called Multi-Application Survivable Tether (MAST), the tether failed to deploy. On the other, called Young Engineers Satellite 2 (YES2), the tether probably deployed fully but then snapped.

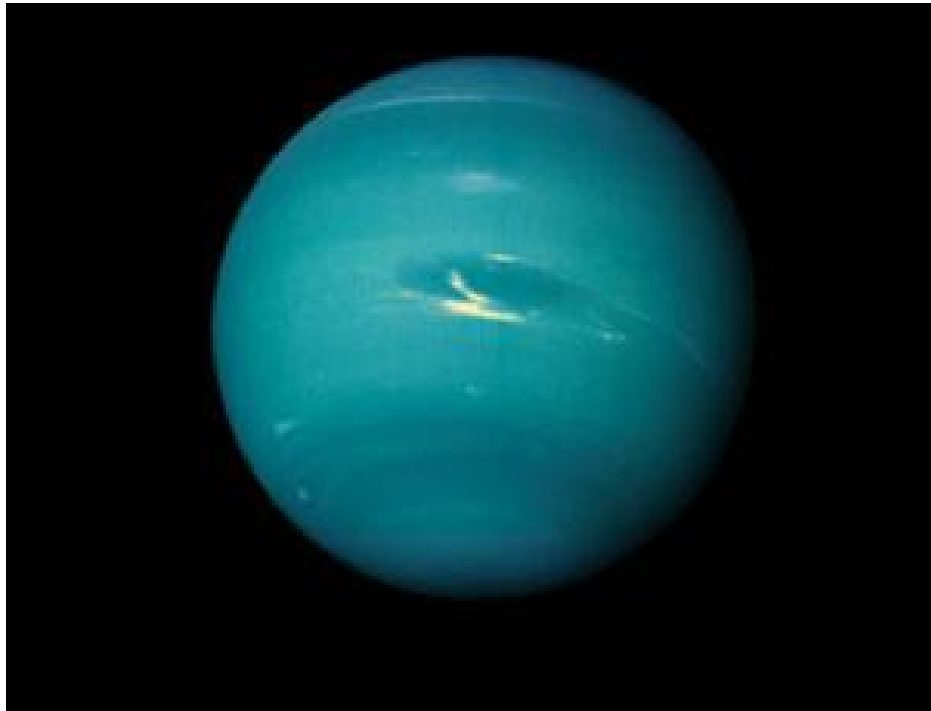
<http://www.newscientist.com/article/dn19393-space-ribbon-deployed-to-surf-earths-magnetic-field.html>



## Weird water lurking inside giant planets

- 02 September 2010 by **David Shiga**

Magazine issue 2776.



Don't bother with a compass (Image: JPL/NASA)

WHAT glows yellow and behaves like a liquid and a solid at the same time? Water - at least in the strange form it appears to take deep within Uranus and Neptune. This exotic stuff might help explain why both planets have bizarre magnetic fields.

Simulations in 1999 and an experiment in 2005 hinted that water might behave like both a solid and a liquid at very high pressures and temperatures. Under such conditions, the oxygen and hydrogen atoms in the water molecules would become ionised, with the oxygen ions forming a lattice-like crystal structure and the hydrogen ions able to flow through the lattice like a liquid. This "superionic" water, forming at temperatures above 2000 °C or so, should glow yellow.

The extreme conditions that exist deep within Uranus and Neptune could be ideal for superionic water to form. But whether it really occurs inside these planets, and in what quantities, has never been clear because of uncertainty over the exact pressures and temperatures needed to make it.

Now the most detailed computer models yet, created by a team led by Ronald Redmer of the University of Rostock in Germany, suggest both planets possess a thick layer of the stuff. The simulations assume the most extreme conditions possible inside both planets, with temperatures reaching up to 6000 °C and pressures 7 million times the atmospheric pressure on Earth. The results show that a layer of superionic water should



extend from the rocky core of each planet out to about halfway to the surface (*Icarus*, DOI: [10.1016/j.icarus.2010.08.008](https://doi.org/10.1016/j.icarus.2010.08.008)).

That tallies nicely with the results of a [2006 study](#) led by Sabine Stanley, now at the University of Toronto, Canada, and Jeremy Bloxham of Harvard University, attempting to explain both planets' curious magnetic fields. Whereas Earth's magnetic field resembles that of a bar magnet, on Uranus and Neptune nearby patches of the surface can have fields of opposite polarity.

On Uranus and Neptune, nearby patches of the surface can have magnetic fields of opposite polarity

Stanley and Bloxham's work suggested that the interiors of both planets contain a narrow layer of electrically conducting material that is constantly churning, which generates magnetic fields. This conducting layer would be made of ionic water, in which the molecules have broken down into oxygen and hydrogen ions. The study also indicated that the convecting zone cannot extend deeper than about halfway down to the planets' centres. If it were thicker, it would produce a more orderly field like that of a bar magnet.

The transition from convection to non-convection at the depth calculated by Stanley and Bloxham might seem irrelevant, since the superionic water takes over here. But superionic water also conducts electricity, via the flow of hydrogen ions. So something must be stopping the superionic water from churning and making the magnetic field more orderly.

One possibility is that superionic water is mostly transparent to infrared radiation, or heat. The electrons in superionic water can absorb infrared radiation, but simulations indicate they tend to stay near the oxygen atoms, making most of the space transparent to heat. That would make it easy for heat from the planets' cores to radiate through the superionic water rather than building up at its base, as would be needed for convection to occur.

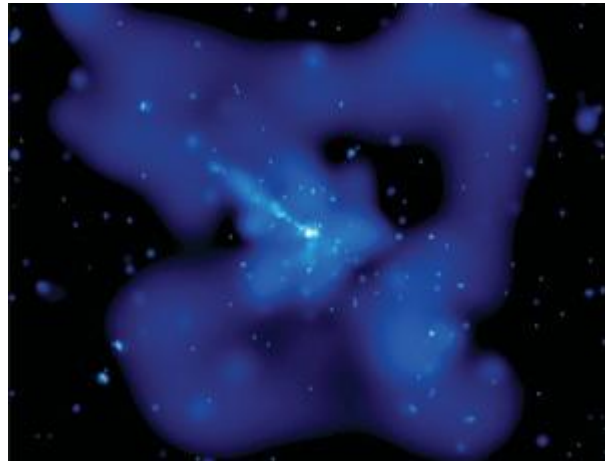
Laurence Fried of the Lawrence Livermore National Laboratory in California is impressed by the new work: "This is a new frontier that promises much insight into planetary structure."

<http://www.newscientist.com/article/mg20727764.500-weird-water-lurking-inside-giant-planets.html>

## Black holes + dark matter = light

- 27 August 2010 by [Kate McAlpine](#)

Magazine issue [2775](#).



Dark signs from Centaurus A (Image: NASA/CXC/SAO/M.Karovska *et al*)

TWO of the darkest things in the universe may be making light - or at least, radiation. When jets spat out by a [supermassive black hole](#) at the centre of a galaxy collide with dark matter, they could produce gamma rays detectable from Earth - possible evidence of the elusive dark stuff.

Jets of particles are propelled away from black holes at near the speed of light. Akin to a cosmic belch, they are thought to be connected with matter falling into the black hole. [Stefano Profumo](#) of the University of California, Santa Cruz, and his colleagues calculated how electrons in one of these jets would interact with any surrounding dark matter.

They looked specifically at the types of dark matter particles predicted by two major theories: one is supersymmetry, which proposes that each ordinary particle has a superpartner, and the other assumes that the universe is hiding a fourth spatial dimension.

They found that rather than simply ricocheting off one another, some of the electrons and dark matter particles could fuse together, transforming into a single, supersymmetric or extra-dimensional version of the electron. This particle would be heavy, and much of the electron's kinetic energy would be dumped into making the new particle. As a result, the particle would be almost standing still.

If the particle were then to decay into an electron and a ground-state dark matter particle, the electron would release gamma rays. Unlike a particle travelling fast, like those in the jets, the slow-moving particle would emit rays that could travel in any direction. This could potentially make them easier to distinguish from the flood of photons in the jet, says collaborator Mikhail Gorshteyn of Indiana University in Bloomington.

The idea that particles from a black hole could interact with dark matter to produce gamma rays has been proposed before, but a previous study suggested the rays would be too faint to see from Earth (*Physical Review D*, DOI: [10.1103/PhysRevD.57.1299](#)).



However, Profumo's team found that within a narrow range of electron energies, nearly all electrons colliding with dark matter will convert into the supersymmetric or extra-dimensional version. This "resonance" effect would produce gamma rays that could be seen in detectors near Earth, such as NASA's Fermi Space Telescope, says Gorshteyn.

Jets from a black hole could interact with dark matter to produce gamma rays detectable on Earth

The team calculate that the effect could account for the frequencies of gamma rays measured by Fermi coming from the black hole at the centre of the galaxy Centaurus A ([arxiv.org/abs/1008.2230](http://arxiv.org/abs/1008.2230)). However, the frequency spectrum of gamma rays from another galaxy, Messier 87, does not match their predictions.

"One has to regard the results as very premature," says Lars Bergstrom of Stockholm University in Sweden. However, he adds that differences in dark matter distribution in the two galaxies may explain the discrepancy.

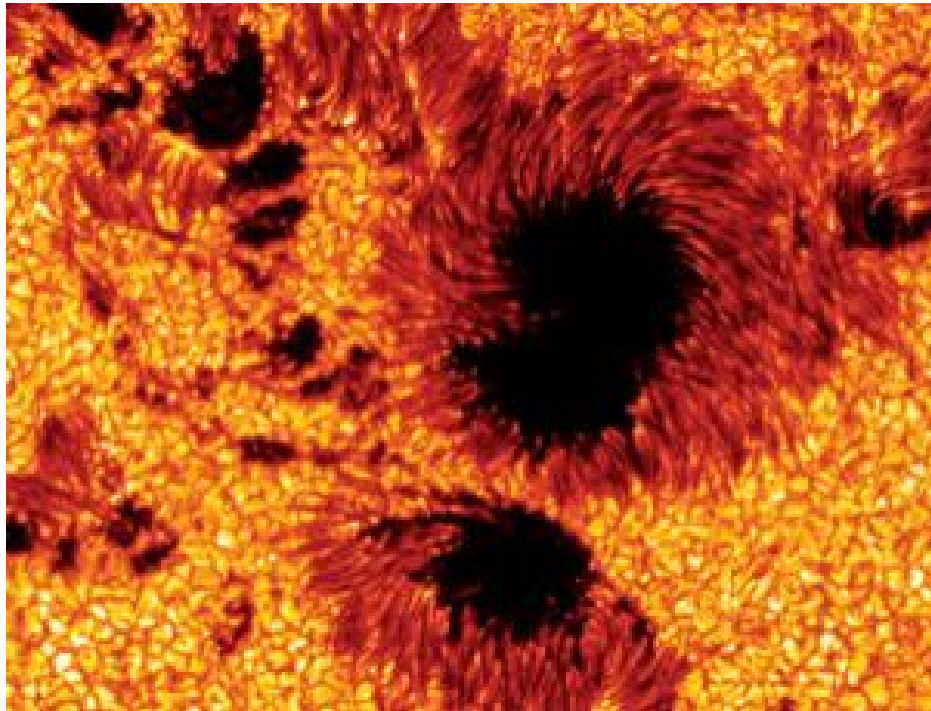
"The exciting thing is that we have some hints from the Fermi data," says Profumo, "but of course you need confirmation - you need other pieces of the puzzle to come together."

<http://www.newscientist.com/article/mg20727753.800-black-holes--dark-matter--light.html>

## Sunspots squeeze and stretch the day

- 27 August 2010 by **David Shiga**

Magazine issue 2775.



Influential beasts (Image: Scharmer et al/Royal Swedish Academy of Sciences/SPL)

MOST of us don't notice it, but not all days are the same length. Now it seems that sunspots - dark regions that emerge on the sun's surface - may be partly responsible for the millisecond fluctuations in the time it takes Earth to rotate once on its own axis. The finding could help to steer spacecraft more accurately.

There are already explanations for why the exact length of a day varies. Changes in winds and ocean currents cause the Earth's spin to slow slightly or speed up to compensate, preserving the planet's total angular momentum. Meanwhile, shifts in how matter is distributed around the planet due to climate change may also affect the speed of Earth's spin.

The latest association, between sunspots, whose abundance rises and falls on an 11-year "solar cycle", and the Earth's spin rate, is perhaps the most bizarre yet.

Researchers have long observed that the spin rate fluctuates with the seasons, in response to shifting wind patterns. Now, a team led by Jean-Louis Le Mouél at the Paris Institute of Geophysics in France has found that this seasonal effect also grows and shrinks in an 11-year cycle, rather like sunspots. Seasons have a bigger effect on spin rate when sunspots are scarce, and a smaller effect when spots are abundant, according to an analysis of data from 1962 to 2009 (*Geophysical Research Letters*, vol 37, L15307).



The team suspects that this link between sunspot abundance and spin rate is due to sunspots somehow altering wind patterns on Earth. One way this might occur is through sunspot-mediated changes in the ultraviolet brightness of the sun. Since UV light heats the stratosphere, sunspots could plausibly alter wind patterns, says Steven Marcus of NASA's Jet Propulsion Laboratory in Pasadena, California, who was not involved in the study.

He says researchers need to better pin down where and when wind changes occur and determine if they tie in with these UV fluctuations. "This is an intriguing result, but some major pieces of the puzzle are still missing," Marcus says.

Filling in those pieces could pay dividends by improving predictions of when and how the rotation rate will change. These are important when using Earth-based radio dishes to track spacecraft. A 1-millisecond error in the rotation period can skew calculations of spacecraft locations by thousands of kilometres at the distance of Mars, Marcus says, "an important difference when trying to land on or even orbit the planet".

<http://www.newscientist.com/article/mg20727754.000-sunspots-squeeze-and-stretch-the-day.html>



## Synchronised planets could help weigh alien Earths

- 00:10 27 August 2010 by Rachel Courtland



Two Saturn-sized planets travel in synchronised orbits around the star Kepler-9 (Image: NASA/Ames/JPL-Caltech)

NASA's Kepler space telescope normally cannot "weigh" the extrasolar planets it finds, instead measuring their physical size. But the discovery of its first multiple planet system shows the telescope can weigh planets that are gravitationally linked with their neighbours.

Kepler hunts for periodic dips in a star's brightness, a signal that a planet may be crossing between the star and Earth in an event called a transit. The technique measures a planet's width, since large planets block out more of their stars' light. But it does not reveal how much mass is packed into a planet of a given size. Without that information, it may be hard to tell the difference between a water world and a planet that has been stripped down to its iron core.

Instead, Kepler astronomers must rely on other telescopes to measure how much the planets tug on their host stars, causing them to wobble forwards and backwards.

Now, the telescope has found a planetary system that demonstrates it can weigh planets for itself.



## Keeping time

Using data collected over seven months, researchers led by Matthew Holman at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, have uncovered two Saturn-size planets orbiting a star called Kepler-9, which lies more than 2000 light years from Earth. A planet about 1.5 times as wide as Earth may also be part of the system.

The Saturn-sized planets travel in orbits that "keep time" with each other – the outer planet takes 38 days to orbit, twice as long as its sibling. But this "resonance" isn't exact – sometimes the ratio of the planets' periods is more than 2-to-1, and sometimes it is less. The discrepancy comes from the planets' tugs on each other, providing an estimate of their relative masses.

This is a new capability for Kepler, and it could prove useful in measuring the masses of Earth-sized objects, Holman noted in a press conference.

That's because Earth-sized planets that orbit far enough away from their stars to be able to support life as we know it will tug relatively weakly on their stars. That will make it difficult for other telescopes to weigh the planets by searching for how they make their host stars wobble.

"With Kepler, in all likelihood, you're going to have these tantalising Earth-sized planets, but you're going to have a very difficult time measuring their masses," says Greg Laughlin at the University of California, Santa Cruz.

## Subtle effect

But if an Earth-sized planet is in a resonance with larger planets, measuring variations in the times between their transits could give Kepler a way of determining whether it has really found Earth's twin.

The subtle effect may require many transits – and therefore years – before the variations can be detected, though, Laughlin points out.

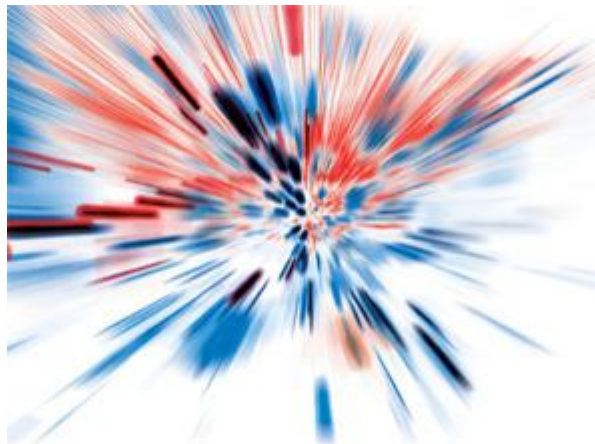
Exoplanets also made news earlier this week. On Tuesday, the European Southern Observatory announced the discovery of a sun-like star about 130 light years away that boasts as many as seven planets. Wobbles in the star's position suggest that one planet candidate may be just 1.4 times as massive as Earth. If confirmed, the planet would tie the record for the smallest exoplanet found so far (a record that doesn't include one tiny body found orbiting a dead neutron star).

Journal reference: *Science*, DOI: 10.1126/science.1195778

<http://www.newscientist.com/article/dn19372-synchronised-planets-could-help-weigh-alien-earths.html>

## Wonder conductors will spin up cooler computers

- 01 September 2010 by **Catherine Zandonella**
- Magazine issue 2775.



Spin superhighway (Image: Tim Graham/Getty)

*Newly discovered materials could clear the way for blisteringly fast laptops and smartphones that don't warm our laps or singe our ears*

As I write this, an uncomfortable warmth is starting to overcome me. But this is no mystery fever to send me running to the medicine cupboard. The source is all too obvious: the laptop cradled in my lap. Time to fetch not a cold compress, but a pillow to place beneath my computer.

Today's microelectronic devices pump out a lot of heat. If only they wouldn't, processors would be zippier, batteries would last longer, laptops could be used on laps and smartphones wouldn't singe our ears. But there is little we can do. Heat is a natural by-product of what goes on in a computer chip, released when electrons careering around the processor pathways smash into each other and the surrounding furniture, and through that become deflected from their intended course.

Help might be at hand. In the past five years, physicists have uncovered a new kind of material that can keep electrons on the straight and narrow, eliminating collisions and slashing the amount of heat produced. Called topological insulators, these materials conduct electricity by harnessing a quantum-mechanical property of electrons called spin. Unlike superconductors, those other low-heat-loss marvel materials, they can perform this feat at room temperature. Forget silicon: it could soon be time to fasten your seat belt for a drive on the spin superhighway.

Unlike superconductors, these low-heat marvel materials perform their feats at room temperature

"Topological insulator" is an odd name for a wonder conductor. After all, insulators are the very opposite of conductors: their electrons are tightly bound to atoms and the material resists the flow of electrical current. That is indeed the case in the heart of a topological insulator. On its surface, however, a rather different picture emerges - of skittish electrons only too ready to roam and be marshalled into a current.

The first hints of such odd behaviour at the surfaces and boundaries of solids came in 1980, when the German physicist Klaus von Klitzing took a thin slice of a silicon-based semiconducting structure and cooled it to within a few degrees of absolute zero. When he bombarded his sample from above with a strong magnetic field, electrons flowing through the slab began to skitter towards one edge, deflected by the magnetic field. This sudden flight created positively charged "holes" at the opposite edge of the material, which the electrons ran around the edge to fill.

The result was a flow of electrons around the edge of the material, like skaters circling the perimeter of an ice rink. The newly established conductivity depended on the number of paths the electrons found to skate along, and increased stepwise, in discrete quantum jumps, as the magnetic field increased (*Physical Review Letters*, vol 45, p 494).

The discovery of this "quantum Hall effect", which had been predicted some years earlier, earned von Klitzing the Nobel prize in physics in 1985. While it was an important fundamental discovery, it was not one that had an immediate practical application. The effect required temperatures that were too low and magnetic fields that were too high to be used in everyday devices.

### Orderly queue

In 2005, Charles Kane and Eugene Mele of the University of Pennsylvania in Philadelphia did away with half of that objection. Some materials, they showed, would naturally create their own magnetic fields that marshal electrons into orderly lanes along their edges.

To envisage how this works, imagine taking a ride on an electron that is travelling through a solid material. As we pass an atomic nucleus, to us on the electron it appears as a large charged body moving in the opposite direction. Moving charges create magnetic fields, so our electron experiences a magnetic field from the passing nucleus.

That is not the only field in play: our electron has its own mini-field as a result of its quantum-mechanical spin. Spin is akin to the rotation of a spherical particle around its axis one way or the other, and it creates a magnetic field either from its north to its south pole (which can be denoted spin "down") or from its south to its north pole (spin "up").

The degree of interaction between the magnetic field caused by an electron's spin and that caused by its motion, or "orbit", depends on the material it is moving through. In materials where the spin-orbit interaction is strong, a spin-up electron will be deflected in one direction on encountering a nuclear magnetic field, while a spin-down nucleus will be deflected in the opposite direction - an effect dubbed the quantum spin Hall effect.

### On the edge

In a slice of the right material one atom thick, Kane and Mele showed, this would have an odd consequence. In the bulk of the material, there would be no conduction, as electrons deflected in opposite ways around adjacent nuclei would cancel each other out. At the edge of the material, however, with no adjacent nucleus available on one side, the net result would be a flow of spin-up electrons in one direction around the edge, and a flow of spin-down electrons in the opposite direction (*Physical Review Letters*, vol 95, p 146802).

A full quantum-mechanical description of how this comes about requires a detailed examination of the topology of the electrons' probabilistic wave functions, and so the materials in question acquired the name

"topological insulator". The effect has an important upside: because the electrons' spin is locked into their direction of motion, they cannot change direction without flipping their spin, something that quantum mechanics forbids. So the scattering of electrons, whether off themselves or imperfections in the crystal, is suppressed, and heat loss consequently eliminated. "These surface states have a very special property that prevents the scattering process from occurring," says Kane. "It is like a one-way street with no U-turns."

The surface states have a special property that prevents scattering from occurring. It's like a one-way street with no U-turns

It only remained to find a material that fitted the description of a topological insulator in reality. Kane and Mele originally had single-atom layers of carbon, aka graphene, down as a candidate, but it turns out that carbon is subject to thermal fluctuations that overwhelm the delicate spin-orbit coupling. Then Shoucheng Zhang and Andrei Bernevig of Stanford University, California, showed that the nether regions of the periodic table might be the place to look. Heavy elements have nuclei with large positive charges, which makes it more likely that they have strong spin-orbit coupling. The duo predicted that the effect would be particularly strong in one alloy, mercury telluride (*Science*, vol 314, p 1757).

It took little more than a year for Laurens Molenkamp and his colleagues at the University of Würzburg in Germany to confirm that prediction, demonstrating in 2007 that electrons could flow without losing heat in a sandwich of mercury telluride and cadmium telluride. This was the first experimental evidence of the quantum spin Hall effect in a one-atom-thick topological insulator (*Science*, vol 318, p 766).

It was a significant advance but not yet a breakthrough. Not only were frigid temperatures close to absolute zero needed for the effect to kick in, but the ingredients for the sandwich were hard to make. Topological insulators seemed destined at that point to remain a laboratory curiosity. But then Kane and his student Liang Fu came out with another prediction: that a similar behaviour should exist in chunks of bismuth and antimony alloys (*Physical Review B*, vol 76, p 45302). Unlike atom-thick slices, where the electrons travel around the edge, in this case layers of electrons should circle a non-conducting interior like a ribbon encircling a birthday present.

Bismuth-based materials are easy to make or buy. If you are a wine connoisseur, you might even have some already: crystals of bismuth telluride are used as "thermoelectric" cooling materials in some wine chillers. Word spread quickly, and physicist Zahid Hasan and his student David Hsieh at Princeton University started to look for topological behaviour in bismuth alloys prepared by their colleague Robert Cava. By blasting a bismuth antimonide crystal with ultraviolet light, and measuring the spin and momentum of the electrons that were ejected, they showed that the electrons flowed on the surface in "lanes" of corresponding spin and direction (*Nature*, vol 452, p 970).

### Hotting up

A clinching result? Not quite. Although this was the first convincing demonstration of topological insulator behaviour in a three-dimensional crystal, the effect only happened at temperatures of around 15 kelvin, so it was still of little practical use.

The temperature hurdle was finally overcome last year, when Hasan and Hsieh uncovered another compound, bismuth selenide, that retains its topological properties at room temperature (*Nature*, vol 460, p 1101). In July this year, Ali Yazdani of Princeton University and his colleagues completed the final part of the puzzle, confirming the lack of electron scattering and heat dissipation (*Nature*, vol 466, p 343). "In these new

materials, the electrons don't get stuck," says Yazdani. "They are able to flow through even the imperfections."

Now that the zippy electrons are ready to roll, when can we expect the spin superhighway to make it to the chips in our laptops? Exploiting this technology for consumer devices is still several years off, but when it happens, less heat loss won't be the only benefit. Electronic circuits based on the manipulation of spin, rather than charge currents, are a goal in their own right. This "spintronic" approach promises smaller, faster, more powerful and cooler electronic devices, as it takes a lot less time and energy to flip an electron between spin states than it does to move charge through transistors on a chip.

Controlling spin is easier said than done. Applying a magnetic field is one way to do it, but directing a strong magnetic field onto a microprocessor chip is no easy feat. An art we have already mastered, on the other hand, is applying an electric field to manipulate charge on a chip - but until now we had no way of using this to control spin. Topological insulators square that circle. In these materials, applying an electric field to the electrons creates their initial motion, and through the resulting spin-orbit interaction controls where electrons of opposite spins flow.

For physicists, the interest in topological insulators does not end with their spintronic promise. Besides revolutionising the behaviour of electrons in our smartphones and laptops, the materials may be a breeding ground for a whole menagerie of exotic physical beasts - something that could make them the next big hope in the quest to build a computer that fully harnesses the awesome power of quantum mechanics ([see "Topological breeds"](#)).

Besides revolutionising smartphones and laptops, these materials could help to harness the power of quantum computing

While such curiosities are sure to keep physicists busy, work is already under way to move topological insulators from the wine cooler to the laptop. That requires some further thought, though. For one thing, although electrons on a topological superhighway can't perform U-turns, they can seek the exit in other ways, by diving down into the crystal when they encounter an impurity, for example.

Such problems can be solved by making the crystals as pure as possible, something that Cava and others are working on. Meanwhile, other materials are in the frame: the possibility of topological insulators based on lead and germanium is also being explored ([arxiv.org/abs/1007.4838](http://arxiv.org/abs/1007.4838)), and a consortium of chip-makers and other technology companies are funding research to apply the technology in consumer devices. The spin superhighway could soon be open for traffic.

### Topological breeds

There has certainly been no shortage of predictions of exotic species lurking within the newly discovered topological insulator materials. For instance, Xiao-Liang Qi and colleagues at [Station Q](#), a Microsoft-sponsored research group working on topological quantum computing at the University of California, Santa Barbara, have proposed that we might find magnetic monopoles at their surface - equivalent to finding a magnetic north pole without its accompanying south pole ([Science](#), vol 323, p 1184).

Together with Shou-Cheng Zhang at Stanford University in California, Qi has also speculated that [we can use topological insulators to characterise hypothetical elementary particles called axions](#), which some believe make up dark matter. The equations that describe axions at the grand scale of the cosmos are exactly the same kind of equations that describe excitations within a topological insulator. "These materials are like a little



baby universe," says Zhang. "We can study lots of effects that have been predicted but have been hard to access experimentally."

But the most exotic beast of all - and potentially most useful - is the Majorana fermion. If theorists are right, putting a slab of topological insulator next to a slab of conventional superconductor may create a perfect nursery for them.

Majorana fermions are truly odd characters - as mysterious as the Italian physicist Ettore Majorana after whom they are named, who disappeared in unexplained circumstances in the 1930s at the height of his career. These particle-like objects only ever appear in pairs, and they are their own antiparticles. Because of that, they are potentially an ideal memory resource for a future quantum computer.

Such computers, though powerful, are vulnerable to their information being destroyed by the surrounding environment. Majorana fermions could make them resilient: imprint any information on the quantum state of one of these particles, and you imprint the same information on its partner. That remains the case even if the two particles are subsequently separated, meaning the information cannot be lost without destroying the state of both particles. That is like hiding a second key to your safe deposit box - and could be a vital step forward for quantum computing.

*Catherine Zandonella is a freelance writer based in Princeton, New Jersey*

<http://www.newscientist.com/article/mg20727751.400-wonder-conductors-will-spin-up-cooler-computers.html>

## Scalpels and skulls point to Bronze Age brain surgery

- 31 August 2010 by **Jo Marchant**

Magazine issue 2775.



Sophisticated skull surgery (Image: Istanbul University)

*Önder Bilgi* talks about his discovery of a razor-sharp 4000-year-old scalpel and what it was originally used for

### Where are you digging?

At an early Bronze Age settlement called Ikiztepe, in the Black Sea province of Samsun in Turkey. The village was home to about 300 people at its peak, around 3200 to 2100 BC. They lived in rectangular, single-storey houses made of logs, which each had a courtyard and oven in the front.

### You have found what appear to be scalpels.

That's right. We have just found two cutting blades made of obsidian, a volcanic glass that forms a sharp edge when it fractures. The obsidian must have been imported from another region as there is no natural source of it in the area. We found the blades next to a circular clay platform that may have been used for religious ceremonies. The blades are double-sided, about 4 centimetres long, and very, very sharp. They would still cut you today.

### What makes you think they were used for surgery?

We have found traces of cuts on skulls in a nearby graveyard. Out of around 700 skulls, 14 have these marks. They could only have been cut with a very sharp tool. At this time, 4000 years ago or more, it could only have been an obsidian blade. The cut marks show that a blade was used to make a rectangular opening all the way through the skull. We know that patients lived at least two to three years after the surgery, because the skull has tried to close the wound.

### Have you uncovered any clues to why this surgery was performed?

There seem to be three main reasons. The first is to relieve the pressure of a brain haemorrhage; we found traces of blood on the inside of some of the skulls. The second is to treat patients with brain cancer, as we can see pressure traces from the cancer inside some of the skulls. And the final reason was to treat head injuries, which seem to have been quite common. The people of Ikiztepe got their copper from mines in the local mountains, and we think they had to fight other local people for access to it.

**Are there any other examples of such early skull surgery?**

A few skulls with cut marks have been found at other Bronze Age sites in this region, but other than these I have not found any parallel. There is a Neolithic skull found at a site in central Anatolia with a hole drilled into it. But the surgeons at Ikiztepe were cutting a rectangular opening. It is a much more sophisticated technique.

**What kind of items have you unearthed?**

As well as the houses we have found mainly metal objects, such as weapons, tools, jewellery and religious symbols. The inhabitants were skilled at metallurgy, unusually so for the period.

**You have been digging at the site for 37 years. Why has it taken so long?**

Wooden architecture is much more difficult to excavate than stone architecture. It is difficult to locate it in the soil. We have to use very small tools, like brushes and spatulas. But we will continue to dig here until we reach virgin soil.

**Profile**

Önder Bilgi is director of excavations at Ikiztepe, Turkey. Previously he was director of protohistory at Istanbul University

<http://www.newscientist.com/article/mg20727750.200-scalpels-and-skulls-point-to-bronze-age-brain-surgery.html>

## Slavoj Žižek: Wake up and smell the apocalypse

- 30 August 2010 by **Liz Else**

Magazine issue 2775.



Coping with threats (Image: Channel4/Everett/Rex Features)

*Is touchy-feely environmentalism a new opiate of the people? Why are we paying rent to Bill Gates? Is reality incomplete? Marxist cultural commentator **Slavoj Žižek**, the man they call the most dangerous philosopher in the west, unravels it all for **Liz Else***

**Your new book, *Living in the End Times*, is about the demise of global capitalism. What is science's place in all this?**

Science is completely entangled with capital and capitalism. It is simultaneously the source of some threats (such as the ecological consequences of our industries or the uncontrolled use of genetic engineering), and our best hope of understanding those threats and finding a way to cope with them.

**Given the book's title, it's no surprise that it also features the four horsemen of the apocalypse, which you identify with four major threats you say we face.**

For me, remember, apocalypse means revelation, not catastrophe. Take the threat to our ecology. Until recently, the main reaction to ominous news such as Arctic sea ice melting faster than predicted was, "We are approaching an unthinkable catastrophe, the time to act is running out." Lately, we're hearing more voices telling us to be positive about global warming. True, they say, climate change increases competition for resources, flooding, the stresses on animals and indigenous cultures, ethnic violence and civil disorder. But we must bear in mind that thanks to climate change the Arctic's treasures could be uncovered, resources become more accessible, land fit for habitation and so on.

**So it's business as usual?**

Yes. But whatever the truth of the predictions about how much oil and gas are locked up in the Arctic, for me an extraordinary social and psychological change is taking place in front of our eyes: the impossible is

becoming possible. We *know* the ecological catastrophe is possible, probable even, yet we do not *believe* it will really happen. Once the catastrophe occurs, it will be perceived as part of the normal run of things, as always having been possible.

**Does that mean the way that we think about such threats is wrong?**

Yes. One reason is to do with how certain environmentalists delight in proving that every catastrophe - even natural ones - is man-made, that we are all guilty, we exploited too much, we weren't feminine enough. All this bullshit. Why? Because it makes the situation "safer". If it is us who are the bad guys, all we have to do is change our behaviour. But in fact Mother Nature is not good - it's a crazy bitch.

**So what should we do instead?**

The fear is that this bad ecology will become a new opiate of the people. And I'm against the ecologists' anti-technology stance, the one that says, "we are alienated by manipulating nature, we should rediscover ourselves as natural beings". I think we should alienate ourselves more from nature so we become aware of the utter contingency, the fragility of our natural being.

We should alienate ourselves more from nature to be aware of our fragility

**Another of your "horsemen" is research into biogenetics. What's your problem with that?**

Craig Venter may dream of creating the first "trillion-dollar organisms" - patented bugs excreting biofuels, generating clean energy or producing tailor-made food. There are, of course, more sinister possibilities: for example, synthesising new viruses or other pathogens.

But I think the problem runs deeper in many ways. For example, such extreme genetic engineering will create substantially different organisms: we'll find ourselves in a terrain full of unknowns. These dangers are made worse by the absence of public control, so profiteering industrialists can tinker with the building blocks of life without any democratic oversight.

**You were in China recently and got a glimpse of what's happening in biogenetics there.**

In the west, we have debates about whether we should intervene to prevent disease or use stem cells, while the Chinese just do it on a massive scale. When I was in China, some researchers showed me a document from their Academy of Sciences which says openly that the goal of their biogenetic research is to enable large-scale medical procedures which will "rectify" the physical and physiological weaknesses of the Chinese people.

**Do these issues arise from problems about what humans are becoming, and the relationships between the public and the private?**

Yes. These are problems of the commons, the resources we collectively own or share. Nature is commons, biogenetics is genetic commons, intellectual property is commons. So how did Bill Gates become the richest man on earth? We are paying him rent. He privatised part of the "general intellect", the social network of communication - it's a new enclosure of the commons. This has given a new boost to capitalism, but in the long term it will not work. It's out of control.

Take a bottle of water: I produce it, you buy it. If I drink it, you cannot. Knowledge is exactly the opposite. If it freely circulates, it doesn't lose value; if anything, it gains value. The problem for companies is how to prevent the free circulation of knowledge. Sometimes they spend more money and time trying to prevent free copying than on developing products.

### **Despite your critique, you are positive about science?**

I have a very naive Enlightenment fascination with it. I have total admiration for science.

### **Should philosophers be helping scientists?**

Yes. For the last few decades, at least in the humanities, big ontological questions - What is reality? What is the nature of the universe? - were considered too naive. It was meaningless to ask for objective truth. This prohibition on asking the big questions partly accounts for the explosion of popular science books. You read Stephen Hawking's books as a way to ask these fundamental, metaphysical questions. I think that era of relativism, where science was just another product of knowledge, is ending. We philosophers should join scientists asking those big metaphysical questions about quantum physics, about reality.

### **And what is your take on reality?**

There is an old philosophical idea about God being stupid and crazy, not finishing his creation. The idea is that God (but the point is to think about this without invoking God), when he created the world, made a crucial mistake by saying, "Humans are too stupid to progress beyond the atom, so I will not specify both the position and the velocity of the atom." What if reality itself is rather like a computer game where what goes on inside houses has not been programmed because it was not needed in the game? What if it is, in some sense, incomplete?

### **All these complex ideas... how do we come up with them?**

I like Stephen Jay Gould here: intelligence, language and so on are exaptations, by-products of something which failed. Say I am using my cellphone - I become fully aware of it only when something goes wrong. We ask the big metaphysical questions even though we cannot solve them, and as a by-product we come up with wonderful, solid knowledge.

### **Profile**

Philosopher Slavoj Žižek is a senior researcher at the Institute of Sociology, University of Ljubljana, Slovenia, and international director of the Birkbeck Institute for the Humanities at Birkbeck, University of London

<http://www.newscientist.com/article/mg20727751.100-slavoj-zizek-wake-up-and-smell-the-apocalypse.html>



## Perfecting the plant way to power

- 10:03 01 September 2010 by **Helen Knight**



Catching up with nature's innovation (Image: Tom Uhlman/Getty)

Take sunlight, add water, and there you have it: free energy. Plants have been doing this for quite some time, splitting water's hydrogen apart from its oxygen, but our efforts to turn water into a source of free hydrogen fuel by mimicking them have borne no fruit. The problem is that splitting water takes more energy than conventional solar-cell technology can realistically deliver. But now we may be tantalisingly close to having economically viable sun-powered water splitters, and with it all the clean-burning fuel we want.

In 2008, Daniel Nocera at the Massachusetts Institute of Technology and his team unveiled a revolutionary approach to splitting water. They used a cheap cobalt-phosphate catalyst and titanium oxide electrodes that need far less electricity than conventional electrolysis to split water.

That raised the possibility of stealing plants' trick and using sunlight to power the reaction. However, the number of photovoltaic cells needed for such devices mean it cannot compete on price with fossil fuels, says Daniel Gamelin, a chemist at the University of Washington in Seattle.

But Gamelin and his team thought they could bring down the costs by incorporating some of that photovoltaic technology in Nocera's water-splitting device, creating a so-called photoelectrochemical (PEC) water splitter.

### **Rusty electrode**

Nocera's electrode was an indium-tin-oxide strip coated with cobalt and phosphate. Gamelin's team also used cobalt and phosphate, but they started with hot glass, onto which they sprayed an iron solution. The iron oxidises in the air, forming a crystalline rust. The rust crystals give the electrode a large surface area, and it also happens to have photovoltaic properties.

The team then immersed their rust electrode in a solution containing cobalt and phosphate, and applied a current to electrochemically deposit the compounds on the surface. This created a PEC electrode that can at once generate current and catalyse the water-splitting process.

So far, the electrode cannot generate enough power to do this on its own, but even so it could reduce the amount of solar cells needed, making the process far cheaper, says Gamelin (*Energy and Environmental Science*, DOI: [10.1039/c0ee00030b](https://doi.org/10.1039/c0ee00030b)).

### Synchronised splitting

Gamelin is also investigating the possibility of a so-called "tandem" device, which can generate enough energy from sunlight to power the water-splitting process on its own.

This device would have two cells housing electrodes, one on top of the other, with a rust electrode coated in cobalt and phosphate on top. Sunlight would strike the top electrode, which would absorb photons and catalyse the water-oxidation process. But not all the sunlight would be absorbed by this electrode: light with a wavelength longer than 600 nanometres isn't absorbed by the rust-coloured water in the top cell so would pass through to strike the lower electrode, powering the production of hydrogen.

Like Nocera's original device, Gamelin's technology is also only able to produce oxygen gas and hydrogen ions. Teams around the world are searching for suitable cathode materials which can efficiently turn those ions into hydrogen gas, says Gamelin.

### Efficiency targets

Meanwhile, other teams are working on alternative water-splitting devices. For example, a team led by [Licheng Sun](#) at KTH Royal Institute of Technology in Stockholm, Sweden, is working on a system that uses a photosensitised anode similar to those used in dye-sensitised solar cells (*Chemical Communications*, DOI: [10.1039/c0cc01828g](https://doi.org/10.1039/c0cc01828g)).

Unlike Gamelin's system, Sun's device is already producing both oxygen and hydrogen gas. However, the current version uses an expensive, and externally powered, platinum cathode. To produce a commercially viable device, Sun is exploring the use of carbon and cobalt-based cathodes, with which he hopes to ultimately reach a solar-to-hydrogen efficiency of around 10 per cent.

But almost all of the electrode materials studied to date are impractical, says [John Turner](#) at the National Renewable Energy Laboratory in Golden, Colorado. "The efficiency is abysmal," he says.

Instead of using titanium oxide or iron oxide, researchers need to explore advances in photovoltaic devices, where the best today achieve an efficiency of 27 per cent, he says.

### Space power

Turner and his team were inspired by the solar cells used on spacecraft, which use gallium-indium alloys.

His team has created a PEC water splitter that is 12 per cent efficient. The downside is that the electrodes are stable in water for only a few days. His team is now using computer models to identify other electrode alloys that have the right combination of efficiency and durability (*Physical Review B*, DOI: [10.1103/PhysRevB.82.045106](https://doi.org/10.1103/PhysRevB.82.045106)).

<http://www.newscientist.com/article/dn19383-green-machine-perfecting-the-plant-way-to-power.html>

## Laser-powered helicopter hovers for hours

- 12:58 02 September 2010 by **Jeff Hecht**

Lasers have recently shown they can down an uncrewed aerial vehicle (UAV) – but they can also keep the drones up in the air. LaserMotive, based in Seattle, Washington, has kept a 22-gram model helicopter hovering for hours at a time on a few watts of laser power.

LaserMotive won \$900,000 from NASA last year by beaming power to a robot that climbed a 900-metre cable dangling from a full-scale helicopter. The technology could help power space elevators to lift objects thousands of kilometres into orbit. But with space elevators still at the concept stage, LaserMotive is keen to find other ways to turn a profit from its technology, says company founder Jordin Kare.

Flying times of conventional UAVs are limited by the fuel or batteries they can carry. Solar power with battery backup for night flight allows flight times lasting several days – defence firm Qinetiq, based in the UK, has flown its ultralight Zephyr for more than 82 hours. But although Swiss company Solar Impulse has demonstrated that solar power can keep even a piloted craft in the air, the uncrewed vehicles typically flown by military agencies are heavier and more rugged, and so need more power to stay in the air than they can get from the sun.

LaserMotive says that ground-based lasers can deliver the required power. At last week's AUVSI Unmanned Systems Conference in Denver, Colorado, the firm focused light from an array of semiconductor-diode near-infrared lasers down to a 7-centimetre beam, which automatically tracked a modified radio-controlled helicopter. The aircraft carried photovoltaic cells optimised for the laser wavelength, which converted about half the laser power reaching them to generate a few watts of electricity – enough to power the rotors of the little copter.

The laser-powered helicopter can hover for 6 hours, company president Tom Nugent told *New Scientist* from the show. He thinks that limit is set only by the quality of the motor driving the rotors. "It's a little consumer-grade brush motor not meant to run this long," he says. Under laser power, the copter "flies for several hours until the motor burns out".

## Laser-powered future

"That little helicopter sounds like a nice demonstration," says Robert Van Burdine, a former engineer at NASA's Marshall Space Flight Center in Huntsville, Alabama, who demonstrated laser-powered flight of a fixed-wing craft in 2003. His group manually aimed the laser, but the 300-gram radio-controlled plane with 1.5-metre wingspan had enough momentum to glide if the beam drifted off target; the helicopter would fall if the beam missed it. Although many people expressed interest at the time, he knows of no follow-up work.

LaserMotive has bigger plans for extending flight duration of military craft, says Kare. "We expect we can scale to anything anybody is interested in," including helicopters and UAVs. A craft could hover for long periods over a laser base, or fly missions and return to recharge over the laser, or fly between a series of laser bases. In the longer term, he envisions lasers powering remote ground-based sensors, delivering power to forward military bases, or supplying emergency power during disasters.

<http://www.newscientist.com/article/dn19389-laserpowered-helicopter-hovers-for-hours.html>

## Shape-shifting robot compensates for damaged limb

- 16:51 01 September 2010 by Colin Barras



Roombots in one of a multitude of possible configurations

Think that shape-shifting robots, or ones that march on no matter how many limbs they lose, are just for *Terminator* films? Think again. A team of European roboticists have developed software that allows a modular robot to adapt when one part stops working.

David Johan Christensen at the University of Southern Denmark in Odense, working with Alexander Spröwitz and Auke Ijspeert at the Swiss Federal Institute of Technology in Lausanne, simulated a quadruped robot constructed from a dozen Roombots – identical rounded robots that have been developed in Lausanne and which can combine to form a variety of modular shapes (see picture).

In the simulation, each Roombot alters its pattern of movement randomly every few seconds and assesses how those changes affect the quadruped's overall velocity. After being given 10 minutes to find its feet, the quadruped had increased its speed from 5 centimetres per second to 31 cm/s.

When one Roombot was then made to malfunction – instantly slashing the walking speed to 15 cm/s – the quadruped learned to adapt its gait. After a further 20 minutes the hobbled robot had increased its walking speed to 21 cm/s.



## Damage control

The virtual quadruped is not the first robot to learn to adapt after damage. In 2006, Josh Bongard of the University of Vermont in Burlington worked with Viktor Zykov and Hod Lipson of Cornell University in Ithaca, New York, to design a multi-legged robot that uses knowledge of itself to work out how to adapt its gait if one leg malfunctions.

"The main difference is that our robot has no internal model of itself or the environment, and there is no centralised 'brain', but only a number of independently learning modules," says Christensen. "We have demonstrated that it is possible to achieve the same level of adaptation" without needing such a brain, he says.

Lipson thinks that Christensen's team's new work is both interesting and promising. "This method is especially suited for distributed systems such as modular robots," he says.

Bongard agrees, and adds that the two adaptive approaches could prove complementary. "A robot could adapt its pattern of locomotion while moving, yet at the same time use its self-model to mentally simulate new kinds of behaviours," he says. "This would be similar to the way a hiker might continuously adapt her way of walking on a rocky path while thinking about how to climb up an approaching steep ascent."

Christensen presented the work at the Simulation of Adaptive Behaviour conference in Paris, France, last week.

<http://www.newscientist.com/article/dn19388-shapeshifting-robot-compensates-for-damaged-limb.html>

## For self-healing concrete, just add bacteria and food

- 15:45 01 September 2010 by **Kate McAlpine**

Like living bone, concrete could soon be healing its own hairline fractures – with bacteria in the role of osteoblast cells. Worked into the concrete from the beginning, these water-activated bacteria would munch food provided in the mix to patch up cracks and small holes. Concrete reinforced with steel forms the skeleton of many buildings and bridges. But any cracks in its gritty exterior make it vulnerable: "Water is the culprit for concrete because it enters the cracks and it brings aggressive chemicals with it," says Henk Jonkers of Delft University of Technology in Delft, the Netherlands. These chemicals degrade both concrete and steel.

Locating and patching cracks in old concrete is a time-consuming business, but rebuilding concrete structures is expensive. Jonkers thinks the solution is to fight nature with nature: he suggests combating water degradation by packing the concrete with bacteria that use water and calcium lactate "food" to make calcite, a natural cement.

### Surviving soda

Unfortunately, most organisms keel over in a pH above 10, which is typical of concrete. To find bacteria that are happy in such an alkaline environment, Jonkers and his colleagues looked to soda lakes in Russia and Egypt where the pH of the water is naturally high – and found that some strains of *Bacillus* thrived there. Moreover, the bacteria can take on a dormant spore state for long periods – up to 50 years, according to Jonkers – without food or water. He compares them to seeds waiting for water to germinate. To keep the spores from activating in the wet concrete mix, and to keep them and their calcium lactate food from affecting the quality of the concrete, Jonkers and his colleagues first set both into ceramic pellets 2 to 4 millimetres wide and then added them to the concrete.

Only when tiny cracks form in the concrete – opening up the pellets – and water seeps inside will the bacteria activate and begin to consume the food that has also been freed. As they feed, they combine the calcium with oxygen and carbon dioxide to form calcite – essentially pure limestone.

### Surface seal

Brajadulal Chattopadhyay of Jadavpur University in Kolkata, India, says the work is "very interesting" and will "help to find a path for the development of real self-healing concrete in the near future". But he doesn't know how the bacteria can produce calcite deep in concrete, where they would be starved of the oxygen they need to metabolise the calcium lactate. Jonkers argues that it is not necessary to form calcite at such depths: simply sealing off the crack with calcite near the surface is enough to prevent water invading deep enough into the concrete to weaken the structure. "If there's no water, there's not really a fear of damage," he says.

There's also no fear of these bacteria turning into a health threat or ecological problem, he says – they die in the relatively pH neutral environments preferred by humans. Jonkers's team now aims to reduce the material's cost and make sure its strength remains comparable to concrete currently on the market.

Jonkers presented his work at the EU-US Frontiers of Engineering symposium in Cambridge, UK, today.

<http://www.newscientist.com/article/dn19386-for-selfhealing-concrete-just-add-bacteria-and-food.html>

## Medical nanotech could find unconventional oil

- 30 August 2010 by [Sujata Gupta](#)

Magazine issue [2775](#).



Nanoparticles will get more out (Image: Vladimir Weiss/Bloomberg News/Getty)

THE oil industry, operating on a gigantic scale, might seem at first sight to have little to learn from the intricacies of medical diagnosis and therapies. Yet nanotechnology developed for medical applications could form a model for ways of exploiting oil reserves that conventional methods cannot reach.

Oilfields deemed exhausted when all the free-flowing oil has been extracted still harbour plenty of the stuff, perhaps twice as much as what has been pumped conventionally, says [Iraj Ershaghi](#), a petroleum engineer at the University of Southern California in Los Angeles. A conservative estimate suggests that the remaining oil in old US fields amounts to "at least 360 billion barrels", he says.

That oil is clinging to the grains in the sedimentary rock, like the greasy residue on a frying pan, or confined to small porous structures in the rock away from the main oil trap. That makes pinpointing it challenging and extracting it tricky, according to Sean Murphy, manager of the [Advanced Energy Consortium](#) (AEC) at the University of Texas at Austin, backed by 10 oil and gas companies.

Current techniques to locate oil include drilling core samples, which provide a detailed map of the bedrock within a very small area, and using seismic imaging to make a general map of the whole field. The results are reminiscent of the kind of information doctors get when probing the body using biopsies and X-ray scans, respectively.

In medical imaging, nanoparticles coated with antibodies can [latch onto tumour cells](#), offering a new way to highlight their presence. Murphy says nanotechnology could also help to locate oil pockets within oilfields and improve the efficiency of oil recovery. Since 2008, the AEC has invested \$30 million into researching these applications.

The first step towards fully exploiting old oilfields is to establish precisely where the remaining oil is, so that extraction can focus on those locations. Oil companies already flush water through old oilfields to try to



recover some of the stubborn residues, and James Tour at Rice University in Houston, Texas, thinks sprinkling the water with nanoparticles could help identify exactly where the oil lies. He has devised nanoparticles with a layer of water-soluble polymers to prevent the nanoparticles clumping together, ensuring they do not become too large to get inside pores in the rock as the water carrying them is pumped through. The nanoparticles are also coated with hydrocarbon-loving compounds that can be stripped away by oil if the nanoparticles encounter significant deposits. "If you get the nanoparticle back and it has none of these chemicals, then you'll know it has seen a lot of oil below," he says.

Tour's nanoparticles are carried along by the flow of water, but Ayusman Sen at Pennsylvania State University in University Park is trying to develop nanoparticles that don't need to be pumped under pressure. Instead they spread through the naturally occurring brine in an oilfield and into the porous rock to locate oil. Previous studies have shown that something as simple as an acid-doped oil droplet floating on an alkaline solution can move if the solution becomes more alkaline in a certain direction. This gradient causes the edges of the droplet to leach acid into the solution at slightly different rates, effectively driving it on. Sen's nanoparticles will move by exploiting the saline gradient between the fresh water in which they are pumped and the brine in the oilfield. They will also be coated with a chemical that is attracted to hydrocarbons, meaning they "will actively move around and 'look' for oil", he says.

Nanoparticles could power themselves through the oilfield brine and into the oil-bearing porous rock

Nanoparticles attached to a tumour in the body can signal their presence by changing the wavelength of the light reflected when an infrared laser is shone at the affected tissue, but that's not possible from deep within an oilfield. Once Sen's nanoparticles have powered themselves away from the fresh water in which they arrived, they are essentially impossible to recover. They cannot report back on their findings.

Tour's nanoparticles stay close to areas from where they can be pumped out, but all they can tell us is whether they encountered oil. What is needed is a way to backtrack and figure out where the nanoparticles were in the reservoir when they saw the oil, says Murphy - and that is not yet possible.

While much remains to be done to refine these techniques, if the location of the oil is already known, then nanotechnology could make its extraction more efficient. Oil companies already add detergent to the water flushed into old wells. Inside the rock pores, the detergent frees oil from the surface of individual grains and forms an emulsion, which can be recovered and broken down to extract the oil. The process is of limited effectiveness, however, if little of the detergent makes it into the oil-filled pores.

Once again, the answer might lie in borrowing ideas from medical nanotech. The pharmaceutical industry is experimenting with the delivery of anti-cancer drugs using nanocapsules that only release their contents on contact with a cancerous cell. This avoids flooding healthy tissue with drugs that are both potent and expensive. Jenn-Tai Liang, a petroleum engineer at the University of Kansas in Lawrence, is pursuing a similar idea using nanocapsules filled with detergent. He says they have two advantages: they are small enough to penetrate the tiny pores, and they only release their detergent in the presence of oil.

Although still in the early stages of development, nanotechnology could yet have a big future in oil exploration.

<http://www.newscientist.com/article/mg20727755.500-medical-nanotech-could-find-unconventional-oil.html>

## Road to cut off Serengeti migration route

- 01 September 2010



Where to now? (Image: Anup Shah/naturepl.com)

LOOK out wildebeest, here come the cars. Tanzania's government plans to build a commercial road in the north of Serengeti National Park, cutting through the migratory route of 2 million wildebeest and zebra.

The road would cut the animals off from their dry-season watering holes, causing the wildebeest population to dwindle to just a quarter of current levels, says the Frankfurt Zoological Society in Germany. It could also be a collision zone for humans and animals, leading to casualties on both sides, and there is a risk that transported livestock would spread disease, the society adds.

The International Union for the Conservation of Nature has written to Tanzanian president Jakaya Kikwete to voice its concerns. While praising Tanzania's commitment to conservation, noting that 38 per cent of its land is already protected, the IUCN recommends carrying out a full assessment of the road's environmental impact.

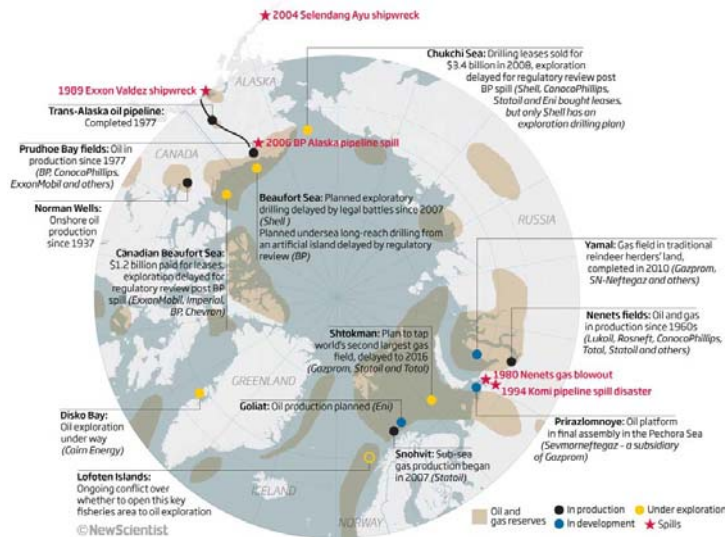
Meanwhile, the African Wildlife Foundation is campaigning for the road's path to be altered so that it passes south of the park, avoiding the migration route.

Despite the ongoing campaign, the road is set to go ahead, with construction kicking off in 2012. In a recent speech, Kikwete said the best he could do was to leave the part of the road that crossed the migratory route unpaved.

<http://www.newscientist.com/article/mg20727763.800-road-to-cut-off-serengeti-migration-route.html>

## Arctic oil and gas drilling ready to take off

- 01 September 2010 by [Alun Anderson](#)



Mapping the world's oil

DRILLING for oil kicked off in Greenland's Arctic waters last week - just weeks after the [Deepwater Horizon leak](#) was finally plugged - angering environmental groups. Cairn Energy, based in Edinburgh, UK, is the first company to explore Greenland's waters for oil. It won't be the last.

Interest in the Arctic - which holds 13 per cent of the world's remaining oil and 30 per cent of its gas - is booming, driven by the rising price of oil and a shortage of other places for multinational companies to drill.

The Deepwater Horizon spill has halted activities in American, Canadian and Norwegian waters, as new regulations are drafted. But exploration and exploitation in Russia and Greenland carry on - and even North American and Norwegian delays will only be temporary.

Drilling in the Arctic Ocean presents greater challenges than elsewhere, whether at sea or on land. Explorers face shifting pack ice, icebergs, storms, frigid temperatures and perpetual night in winter. This has led oil companies to set their sights on the accessible bits of the Arctic ([see map](#)). First in line are the relatively sheltered waters close to shore, and shallower regions further out where artificial islands can be built and linked to the coast, transforming the expedition into one that is effectively land-based.

In deeper water, giant steel structures that can be grounded on the seabed are the best bet. Russia's Prirazlomnoye platform, now almost complete, will weigh 100,000 tonnes and sit in 20 metres of water. Its sheer bulk will protect it from being crushed by the shifting ice that covers the area for eight months of the year.

To drill in even deeper water, ice-resistant production ships, linked to oil wells beneath them, will have to be constantly protected by ice breakers. The first of these is planned for Russia's Shtokman gas field, which is



650 kilometres offshore, lies 300 metres beneath the surface, and is plagued by icebergs. Production is planned to begin in 2016.

All this activity has environmental groups up in arms. Oil companies insist that they can take on the Arctic safely, yet there is no proven way to deal with a spill. The biggest threat is not from the wells - which will be few and tightly controlled - but from oil tankers. Pack ice, storms and icebergs mean that shipping accidents are almost inevitable, and spilt oil takes decades to break down in the cold Arctic waters.

Nothing much can be done to cope with a spill in the winter beyond tracking the ice, waiting for the oil to surface in the summer melt, then setting it alight. Yet calls for an Arctic-wide moratorium on oil exploration until safety measures are in place have gone unheeded. Over the last three years, big oil companies have teamed up with Norway's independent research organisation SINTEF, based in Trondheim, to test ways of fighting spills, such as mechanical skimmers, dispersants and performing controlled burns on deliberately spilled oil. Results show they are still far from knowing how to cope.

<http://www.newscientist.com/article/mg20727764.300-arctic-oil-and-gas-drilling-ready-to-take-off.html>



## Conservation and compassion: First do no harm

- 01 September 2010 by **Marc Bekoff**

Could a compassionate approach have worked just as well? (Image: Sumio Harada/Getty)

*In putting conservation into practice, we often cause great suffering to animals. **Marc Bekoff** argues that we need a new ethical perspective*

BLACK-footed ferrets were once widespread across the Great Plains and the inter-mountain west of North America. Then decades of habitat loss and disease pushed them to the brink of extinction. In the mid-1980s, with only 18 individuals left in the wild, the entire population was taken into captivity to establish a captive breeding programme. Reintroductions into the wild began in 1991, and the population is now around 750.



Some consider the [black-footed ferret recovery programme](#) to be a conservation success story. But that success has come at a heavy price. Captive-bred ferrets need to be taught to hunt before they can be released into the wild. This is done by feeding them golden hamsters and black-tailed prairie dogs. In 2008 and 2009, captive ferrets were fed 7300 golden hamsters, 5100 of them offered alive, plus 2466 black-tailed prairie dogs, 1480 offered alive, according to figures supplied by the programme. The hamsters are bred solely to be practice prey.

Some defend the use of hamsters and prairie dogs as prey on the grounds that they are not endangered, and are therefore disposable and replaceable. I disagree. Like humans, these sentient rodents have neural structures that are important in processing emotions. Surely they endure pain and suffering as the ferrets hone their killing skills on them.

Ethics suggest this project be more carefully evaluated. In view of its inhumane training protocol, I would argue for its termination. There are behavioural studies in which animals are made to interact with inanimate objects. Something similar could have been tried to train the ferrets.

The use of prey species to hone the hunting skills of predators is just one of the issues that will be discussed next week at a long-overdue meeting in Oxford, UK. Called [Compassionate Conservation](#), the meeting will bring together two disciplines that are often perceived as mutually exclusive: animal welfare and conservation.

Among the questions on the table will be: Should we kill for the sake of conservation? Can conservation biologists do good science, saving species and ecosystems while also being compassionate? Can people who value individual lives work with those who are willing to sacrifice lives for the good of a species or an ecosystem? What role should animal sentience play in such decisions?

These are very practical issues. For example, we often move animals from one place to another to "restore" ecosystems, and in doing so harm individuals. Wolves have been reintroduced into Yellowstone national park and Canadian lynx to Colorado in the full knowledge that some of them will die "for the good of their species". Other animals have died too: in one area of Yellowstone more than 90 per cent of coyotes have been killed as a result of the reintroduction of wolves.

Compassionate conservation mandates that individual lives matter and would argue against these reintroductions. It also warrants against playing the numbers game - arguing, for example that the deaths of thousands of hamsters is a price worth paying for the survival of a few black-footed ferrets. Likewise, we should provide care for all oiled birds even if they do not belong to an endangered species, and factor compassion into decisions about whether to exterminate alien species when they compete with native ones.

The guiding principles of compassionate conservation are: do no intentional harm; respect all life; treat all individuals with respect and dignity; and tread lightly when stepping into the lives of animals.

This is not an easy sell. Many researchers believe allowing subjective feelings for animals to influence their decisions - even if driven by ethics - invariably taints their science. Compassion, sentimentality and anthropomorphism have no place in conservation, the argument goes.

Not all conservation biologists agree. Renowned field biologist George Schaller, interviewed by *New Scientist* (7 April 2007, p 46), summarised years of ground-breaking research on behavioural ecology and conservation thus: "Without emotion you have a dead study. How can you possibly sit for months and look at something you don't particularly like, that you see simply as an object? You're dealing with individual beings who have their own feelings, desires and fears. To understand them is very difficult and you cannot do it unless you try to have some emotional contact and intuition. Some scientists will say they are wholly objective, but I think that's impossible."

It's not radical to ask difficult questions about our interactions with animals. In fact, it is in the best traditions of science to factor ethics into our practices. Human activities that cause intentional suffering and death in the name of conservation demand careful scrutiny.

However, I accept that we need to come to practical solutions with which everyone is satisfied. The question then becomes, what ethical trade-offs need to be considered, and which are negotiable and which not? I would argue that we need to focus on solutions that advocate the well-being of individual animals and not allow them to be harmed or killed for the good of their own or other species.

Compassionate conservation is no longer an oxymoron. Ethics must be firmly implanted in conservation biology, even if doing so moves us outside our comfort zones and causes some projects to be put on hold or abandoned.

Ethics must be firmly implanted in conservation biology even if it moves us out of our comfort zones

*Marc Bekoff is professor emeritus of ecology and evolutionary biology at the University of Colorado, Boulder, and on the advisory board of Project Coyote, which promotes "educated coexistence between people and coyotes". His latest book is The Animal Manifesto: Six reasons for expanding our compassion footprint (New World Library)*

<http://www.newscientist.com/article/mg20727750.100-conservation-and-compassion-first-do-no-harm.html>



## Arctic ice: Less than meets the eye

- 31 August 2010 by Chris Mooney



The CCGS Amundsen makes light work of unexpectedly thin ice (Image: Paul Nicklen/National Geographic/Getty)

*The ice may not retreat as much as feared this year, but what remains may be more rotten than robust*

LAST September, David Barber was on board the Canadian icebreaker CCGS Amundsen (pictured), heading into the Beaufort Sea, north of Alaska. He was part of a team investigating ice conditions in autumn, the time when Arctic sea ice shrinks to its smallest extent before starting to grow again as winter sets in.

Barber, an environmental scientist at the University of Manitoba in Winnipeg, Canada, went to sleep one night at midnight, just before the ship was due to reach a region of very thick sea ice. The Amundsen is only capable of breaking solid ice about a metre thick, so according to the ice forecasts for ships, the region should have been impassable.

Yet when Barber woke up early the next morning, the ship was still cruising along almost as fast as usual. Either someone had made a mistake and the ship was headed for catastrophe, or there was something very wrong with the ice, he thought, as he rushed to the bridge in his pyjamas.

On the surface, the situation in the Arctic looks dramatic enough. In September 2007, the total extent of sea with surface ice shrank further than ever recorded before - to nearly 40 per cent below the long-term average. This low has yet to be surpassed. But the extent of sea ice is not all that matters, as Barber found. Look deeper and there are even more dramatic changes. This is something everyone should be concerned about because the transformation of the Arctic will affect us all.

The record low in 2007 cannot be blamed on global warming alone; weather played a big role too. That year saw a build-up of high pressure over the Beaufort Sea and a trough of low pressure over northern Siberia - a weather pattern called the Arctic dipole anomaly. It brings warm, southerly winds that increase melting. The winds also drive sea ice away from the Siberian coast and out of the Arctic Ocean towards the Atlantic, where it melts.



In 2008 and 2009, the dipole anomaly did not dominate and the extent of ice did not shrink as much during summer. This rebound led to much talk of a recovery in Arctic ice.

This June, the dipole anomaly returned and the ice extent for the month was the lowest ever. In July, however, the dipole pattern broke up and the rate of ice loss slowed. "Whether or not we set a new record depends very much on the weather patterns," says Mark Serreze of the US National Snow and Ice Data Center based in Boulder, Colorado, which monitors the extent of sea ice - a particular way of measuring its area.

While much attention is likely to be paid to whether or not a new record is reached in the next month, there is more to sea ice than area alone. New sea ice can grow up to 2 metres thick during the winter. If it survives the summer melt, it can grow even thicker over the three to six years it might last before being swept past Greenland and out into the Atlantic Ocean, or succumbing to the summer melt. In places, this multi-year ice can pile up forming "pressure ridges" as much as 50 metres deep. But its average thickness is now less than 3 metres according to ICESat, the only satellite capable of measuring ice height and thus thickness (Geophysical Research Letters, vol 36, L15501).

There is no long-term record of the total volume of ice because we have only patchy data; ICESat was launched in 2003 and failed earlier this year. The nearest thing we have are estimates from PIOMAS, developed by Jinlun Zhang and his colleagues at the University of Washington's Polar Science Center in Seattle. Actual satellite measurements of sea ice concentration since 1978 are fed into a computer model of the growth, melting and motion of sea ice to produce an estimate of ice volume. PIOMAS's results correspond well with independent measurements by submarines and by ICESat.

According to PIOMAS estimates supplied to *New Scientist* by Zhang, the average volume of Arctic ice between July and September has fallen from 21,000 cubic kilometres in 1979 to 8000 cubic kilometres in 2009. That is a 55 per cent fall compared with the 1979 to 2000 average. "The loss of ice volume is faster than the loss of ice extent," says Zhang. His model suggests that not only has the total volume of Arctic ice continued to decline since 2007, but that the rate of loss is accelerating (see "Going, going...").

Not only has the volume of ice continued to decline, the rate of loss is accelerating

How can ice volume have kept falling when extent increased again after 2007? Because less and less ice is surviving to see its first birthday. "First-year ice is now the dominant ice type in the Arctic, whereas a few years ago multi-year ice was dominant," says Barber.

Young ice is thinner than multi-year ice, and thus more likely to break into smaller pieces that melt more quickly, and more likely to be swept out of the Arctic and into warmer seas. That is precisely what happened in 2007, when persistent winds blew a thinner ice pack through the Fram Strait between Greenland and the island of Spitsbergen, leading to the dramatic ice loss. "The same wind 30 years ago when the ice was thicker would not have done as much damage," says Bruno Tremblay, a climate researcher at McGill University in Montreal, Canada.

And while the area of young ice increased in 2008 and 2009, the amount of multi-year ice continued to fall. "There wasn't a recovery at all," Barber says.

Even the nature of the remaining sea ice might be changing. When Barber rushed up to the bridge that morning in September 2009, the first officer told him that while it looked like there was ice, it was no barrier to the ship at all. The reason: the ice was rotten.



It consisted of multi-year ice that had become riddled with surface thaw holes and had broken into pieces. Over winter, a 5-centimetre layer of new ice had formed over the dispersed floes. If a person tried standing on it they would fall right through, so it was no obstacle to the Amundsen. It is not clear how widespread these conditions are because satellites cannot distinguish between rotten and more solid ice ([Geophysical Research Letters, vol 36, p L24501](#)). The rotten ice is less of a barrier to waves as well as ships, meaning waves can penetrate further into ice packs and break up more ice.

What it all means is that, much like the Amundsen, we are now cruising effortlessly into a world that may soon feature an essentially ice-free Arctic during at least part of the year. "Thirty years from now, maybe even 20 years from now, if you were to look at the Arctic from space you would see a blue ocean [in summer]," says Serreze.

The implications of such changes for wildlife and the human inhabitants of the region, for the global climate and for geopolitics are profound. The Arctic would be traversable by ship. It would be far more open to oil and gas exploration, and mineral extraction. Its dark ocean waters, mostly devoid of ice, would absorb still more sunlight, further warming the overlying atmosphere during an increasingly lengthy ice-free season, reshaping weather throughout the region and well beyond it.

Worryingly, the melting of the Arctic sea ice is proceeding considerably more quickly than most climate models have predicted. Among the suite of models submitted for the 2007 report of the Intergovernmental Panel on Climate Change (IPCC), only two out of 23 yielded results for Arctic sea ice that were consistent with observations, says Cecilia Bitz of the University of Washington in Seattle.

According to the 2007 models, the Arctic will not become ice-free in summer until some time after 2050. However, researchers like Barber and Serreze think this landmark occurrence will come much earlier. Barber has predicted that it will occur sometime between 2013 and 2030.

If most models aren't capturing the full extent of changes in the Arctic, it is probably because the modelled feedbacks are too weak, says Bitz. In other words, they may not be sensitive enough to processes that, once they get going, self-amplify in a continuing loop.

Every model includes the "ice albedo feedback", in which the melting of ice that reflects most of the sun's heat exposes dark water that absorbs most heat. That leads to more melting and so on - a positive feedback. But there could be many others.

Consider, for instance, the role of Arctic storms. They break up ice with their winds and waves, making it more prone to melting - and the more open water there is, the more powerful waves can become. These larger waves - which were not included in any models - then penetrate further into the ice pack, breaking it up into smaller and smaller pieces, says Barber. From the bridge of the Amundsen as it sat moored in the ice last year, Barber himself watched as a large swell broke a chunk of ice the size of Manhattan into a number of pieces roughly 100 metres across.

Storms also bring snow, which in autumn and winter actually slows the growth of sea ice by insulating it from cold winds, as well as reducing heat loss from the sea below. So if climate change leads to more snow in autumn and winter, this will be yet another factor contributing to the loss of sea ice.

Bitz thinks the 2007 low was a wake-up call for climate modellers, compelling them to look more closely at how their programs handle sea ice. She expects that when the next set of models is submitted to the IPCC for its 2013 report, their outputs will be much more in line with observations. "The modelling centres are short of

resources for giving focus to a particular part of the model," she says. "But when a big story comes out like 2007, they redirect, and that will pay off."

The implications of the loss of Arctic sea ice in the summer are hard to overstate. Most attention has focused on charismatic megafauna like polar bears and walrus, but they are just the icons of a broader ecosystem that is already being dramatically disrupted. The sea ice is as important as the trees to a rainforest, Barber says.

The loss of sea ice will also have many other impacts. For instance, the increase in the size of waves has already begun to cause serious coastal erosion in places like Alaska, with the effect magnified by warmer waters and rising sea level. The impact of the waves eventually melts the permafrost of which the coastline is composed. "Some of those coastlines are made of very fine silt," says Tremblay. "The land just washes away."

A warmer Arctic will also affect weather in the mid-latitudes - indeed, it has already begun. Take the Great Plains of the US. According to Michael MacCracken of the Climate Institute in Washington DC, this region's weather is very much determined by clashes between cold air masses coming down from the Arctic and warm air masses from the Gulf of Mexico. As the Arctic blasts are less cold than they used to be, the Gulf's warm air tends to push further northwards. The result is a northward shift of weather patterns, and more extreme storms and heavy precipitation events in regions not used to them.

Finally, there are the economic and industrial implications. "The engineering challenges get simpler," says Barber, "for drilling, for putting drill ships in place, for having icebreakers, to make tankers carry oil across the pole - all those kinds of challenges associated with industrial development." Such challenges will diminish, or even vanish entirely. The Amundsen's surprisingly easy voyage through the Beaufort Sea in September 2009 could be a herald of things to come.

*Chris Mooney is a host of the Point of Inquiry*

<http://www.newscientist.com/article/mg20727751.300-arctic-ice-less-than-meets-the-eye.html>

## Success, not size 0, makes women want to eat less

- 10:10 01 September 2010 by **Jo Marchant**



Seeing successful women could lead to eating disorders (Image: Stockbyte/Getty)

Encouraging models to put on weight may not be enough to prevent the influence that media images have on rising rates of bulimia and anorexia nervosa. It turns out that images of successful people contribute to such illnesses, regardless of how thin they are.

Studies have shown that media images contribute to the development of eating disorders. To understand how, psychologist Norman Li of Singapore Management University and colleagues showed portraits accompanied by character descriptions to 841 volunteers in Austin, Texas.

They found that women were less happy with their bodies and more likely to restrict their eating after seeing pictures of competitive women – described as "playing to win", for example – compared with other women. This was despite the fact that pictured individuals were of the same average weight and that another set of volunteers had rated them as equally attractive.

The effect did not occur in heterosexual men. But with homosexual participants, results were reversed. Gay men but not lesbian women tended to restrict their eating more after viewing the competitive profiles.

Li believes this behaviour has an evolutionary origin. He suggests that because people in the west tend to gain weight as they get older, they have come to equate thinness with youth and attractiveness, and competitive advantages in general. Media that show excessively thin women therefore send our competitive instincts into overdrive, he says.

### Gossip magazines

If reading about high-status starlets makes women feel so bad about themselves, why are they still drawn to fashion and gossip magazines?



Li says that it would have been beneficial for our ancestors to be intensely interested in how attractive, successful and popular people were doing, so they could compete with them for mates.

That's all very well in a small village. But modern media expose us to a much wider social circle, and push our appetite for gossip to extreme levels. "Fashion models, celebrities and television characters are not actually our peers," says Li. "Their presence makes us look to standards that are largely unattainable or ultimately harmful."

Trying to compete with such a wide social circle can lead to psychological problems such as eating disorders, workaholism and depression, but according to Li, evolution has hard-wired us to do it anyway.

Li compares this to our love of junk food. "In ancestral times, a sweet and fatty tooth would have led us to eat fruit and nuts, and meat when animals were occasionally caught." In the modern world, it means we can't resist candy bars and burgers.

Journal reference: *Evolution and Human Behavior*, vol 31, p 365

<http://www.newscientist.com/article/dn19384-success-not-size-0-makes-women-want-to-eat-less.html>

## Psychoactive drugs: From recreation to medication

- 01 September 2010 by Catherine de Lange

Try peer-reviewing that (Image: Ted Streshinsky/Corbis)

FROM the relaxing effects of cannabis to the highs of LSD and ecstasy, illegal drugs are not generally associated with the lab bench. Now, for the first time in decades, that is starting to change.

For almost 40 years, mainstream research has shied away from investigating the therapeutic benefits of drugs whose recreational use is prohibited by law. But a better understanding of how these drugs work in animal studies, and the advancement of brain-imaging techniques, has sparked a swathe of new research. What's more, clinical trials of MDMA (ecstasy), LSD and other psychoactive drugs are starting to yield some positive results. This could lead to a call for governments to take a new approach to the funding and regulation of research into the potential benefits of such chemicals.



LSD was developed in the 1940s (see "[The highs and lows of LSD](#)") but by the 1970s it and many other drugs became classed as [schedule 1](#) in many countries - described as "abuse" drugs with no accepted medical use. "Research on psychedelics was severely restricted and interest in the therapeutic use of these drugs faded," says Franz Vollenweider of the neuropsychopharmacology and brain-imaging unit at the Zurich University Hospital of Psychiatry, Switzerland.

The classification of LSD as schedule 1 was a mistake born of "ignorance and taboo", says Amanda Feilding, director of the [Beckley Foundation](#), a charitable trust that promotes investigation into consciousness and its modulation, based in Oxford, UK.

These kinds of decisions are political not scientific, says Michael Mithoefer, a psychiatrist in Mount Pleasant, California. "When the US [Drug Enforcement Agency](#) held hearings about MDMA, the judge ruled it did not meet criteria for schedule 1 and should be schedule 3, so it could be used by physicians but not sold in bars. The DEA administrator put it in schedule 1 despite it not meeting the criteria."

Despite these hurdles, a number of [trials are now under way](#) in the US and Switzerland to investigate the potential of LSD and psilocybin - the psychoactive component of magic mushrooms - in [helping terminal cancer patients deal with anxiety and depression](#).

Feilding is also working with [David Nutt](#) of Imperial College London on the first UK study using psychedelics for 40 years. Among other things, they are researching how psilocybin can help in recalling distant memories, which they say could help with psychotherapy following trauma.



Psilocybin from magic mushrooms could help with psychotherapy following trauma

Meanwhile, in a study at Johns Hopkins University in Baltimore, Maryland, funded by the Beckley Foundation, [Roland Griffiths](#) and colleagues have seen positive results in their study into the use of psilocybin as an aid to psychotherapy to treat tobacco addiction. At Hanover Medical School in Germany, a team led by Matthias Karst has been investigating whether bromo-LSD - a non-psychoactive form of the drug - can be used to treat painful cluster headaches.

Cannabis is already known to have a soothing effect on the symptoms of multiple sclerosis. Canada recently approved the use of Sativex - derived from cannabis plant extracts - for relief of spasticity in adults with MS. This week saw the publication of the first study suggesting that smoking cannabis can also reduce neuropathic pain, caused by damage to the nervous system.

Mark Ware and colleagues at McGill University in Montreal, Canada, gave patients suffering from chronic pain one of three different doses of cannabis, or a placebo. On average, patients reported lower pain intensity and a better quality of sleep when they smoked the highest dose of cannabis compared with the placebo, and the reported side effects were minimal (*Canadian Medical Association Journal*, DOI: [10.1503/cmaj.091414](#)).

"Previous studies have looked at cannabis and pain, but this is the first one I've seen looking at smoked cannabis," says Tony Dickinson, a pharmacologist at University College London. Although there were only 21 participants, and smoking of course raises health issues, the study is nevertheless important, Dickinson says, because neuropathic pain is notoriously resistant to other forms of treatment.

While many drugs could have medical uses, don't their psychoactive effects limit their use? Feilding doesn't think so. LSD, psilocybin and MDMA are neither addictive nor dangerous in controlled doses, she argues. Others disagree. "The psychiatric risks of these substances are well known," says [Ken Checinski](#), who studies addictive behaviour at St George's, University of London. "There may be a narrow therapeutic window between potential benefits and significant adverse events."

However, this problem isn't unique to psychoactive drugs. "We use many things in medicine that can be misused and be very dangerous in the wrong doses," says Mithoefer. Feilding thinks governments need to see past the stigma of schedule 1 drugs and fund medical research that could be "very valuable".

Some funding organisations already exist, including the Beckley Foundation, and the Multidisciplinary Association for Psychedelic Studies in the US. Their funds are limited, though. "As research progresses, larger studies will get more expensive and it would be most helpful to have government funding," Mithoefer says.

His latest study investigated whether [MDMA could help people suffering from post-traumatic stress disorder \(PTSD\)](#). MDMA decreases the fear response, so he reasoned it might help people undergo therapy "without being overwhelmed by anxiety while revisiting traumatic experiences".

Of the 12 patients who received the drug, 10 saw such an improvement in their symptoms that they were no longer categorised as suffering from PTSD, compared with two out of the eight patients who received a placebo (*Journal of Psychopharmacology*, DOI: [10.1177/0269881110378371](#)).

Government funding may still be some way off, though. For one thing, it is hard to design an effective double-blind trial when the secondary effects of the drug are so well known, says Dickinson. In Mithoefer's



study, for example, all but one of the patients correctly guessed whether they were receiving the placebo or MDMA.

It is hard to design trials. In one study, most people guessed whether they had been given ecstasy or not

"There is much to be learned and we're still in the early stages," Mithoefer says, "but it's important that the research moves forward so we can establish whether or not [psychoactive drugs] can be safe and effective therapeutic tools."

### **The highs and lows of LSD**

"With a remarkable restlessness and slight dizziness, I sank into a not unpleasant intoxicated-like condition. In a dreamlike state, I perceived an uninterrupted stream of fantastic pictures, extraordinary shapes with intense, kaleidoscopic colours."

This is the description of the first LSD trip taken by Albert Hofmann, the inventor of the drug, in 1943.

He initially developed LSD in 1938 on the premise that it may act as a circulatory and respiratory stimulant. Working as a chemist at Sandoz Laboratories (now Novartis) in Basel, Switzerland, Hofmann shelved the compound - known as LSD-25 - after it had no obvious effects in mice. Five years later, while re-synthesising the drug, he was interrupted by the unusual activity described above.

Realising the symptoms must have occurred from inhalation or absorption of LSD-25, Hofmann took an oral dose of the chemical, estimating that 250 micrograms would be the threshold at which effects would occur. In reality, the threshold is closer to 20 micrograms. After 6 hours of positive and negative experiences, which involved thinking his neighbour was "an insidious witch", the effects subsided.

"I was aware that LSD, with such properties, would be of use in pharmacology, in neurology, and especially in psychiatry," Hofmann wrote in his biography.

Over the next 20 years, thousands of papers were published on the drug's effects, including treatment for alcohol addiction and psychosis. Several positive outcomes were also reported for the treatment of autism, such as an increase in social behaviours manifested by increased eye-to-face contact (*Behavioral Neuropsychiatry*, vol 1, p 44).

Unfortunately many of the studies lacked proper experimental controls and presented largely descriptive data. The lack of long-term follow-up studies and a realistic placebo have been major limitations of the work to date.

The drug quickly leaked into the general population, which led to an investigation by the US Food and Drug Administration, and in 1970, LSD was classified as a drug of abuse with no medical value. Research into any therapeutic effects stopped.

Today, many researchers believe that LSD poses no risk to health when administered in a controlled environment and that the case for medicinal LSD should be reopened (see main story). **Helen Thomson**

<http://www.newscientist.com/article/mg20727764.000-psychoactive-drugs-from-recreation-to-medication.html>



## Oxytocin fails 'trust elixir' test

- 13:29 27 August 2010 by **Cian O'Luanaigh**

Oxytocin is not the "trust elixir" that internet vendors would have you believe. While the hormone does enhance trust, it won't make you gullible.

Moira Mikolajczak's team at the Catholic University of Louvain (UCL), Belgium, gave 60 male volunteers either oxytocin or a placebo. The volunteers played a game in which they could choose to give money to a trustee partner, in whose hands the amount could triple. The trustee could then choose to give back some or all of the money. Participants were told they were playing with partners described to make them seem reliable or unreliable, by providing their hobbies, for instance.

Subjects given oxytocin made larger transfers to reliable partners than the placebo group, but not when partners were primed as untrustworthy.

"On the internet there are companies that sell oxytocin as a kind of truth elixir," says Mikolajczak. "They give the idea that oxytocin renders people completely naïve: 'Give it to a business man and he'll buy your product; give it to a woman and she'll fall in love with you'. Our study shows exactly the opposite."

"This is the first human study showing that oxytocin does not unfold its effect in every situation," says neuropsychologist Thomas Baumgartner of the University of Basel, Switzerland. The next question is what is happening in the brain to make this happen, he adds.

Journal reference: (*Psychological Science*, DOI: [10.1177/0956797610377343](https://doi.org/10.1177/0956797610377343))

<http://www.newscientist.com/article/dn19373-oxytocin-fails-trust-elixir-test.html>

## Macabre details of suicide hangings revealed

- 27 August 2010 by **Cian O'Luanaigh**

Magazine issue 2775.



Mechanism of death (Image: Charles Gullung/Getty)

WHAT happens when someone hangs themselves, and how quickly do they die? The results of this grisly area of research could be significant in court cases where prison officers are accused of negligence or foul play.

Judicial hangings are designed to snap the condemned person's neck, severing the spinal cord and causing immediate death. Suicide by hanging usually follows a different course: the victim dies of asphyxia - a lack of oxygen to the brain.

Exactly what it is that stops oxygen reaching the brain and how long it takes to die have been the subject of debate since the 18th century. Three main mechanisms have been proposed: compression of the airways, obstruction of the blood vessels to the brain, or pressure on the vagus nerve that triggers an abnormal heart rate and so leads to cardiac arrest.

Now a study of videos left behind by people who recorded their own hangings points to obstruction of the blood vessels being to blame.

Anny Sauvageau, a forensic pathologist at Alberta's Office of the Chief Medical Examiner in Edmonton, Canada, and colleagues analysed videos of eight hangings: two were suicides and six were accidents in which the victim was seeking an auto-erotic experience. This showed that the victims lose consciousness in as little as 8 seconds, and then perform a complex sequence of involuntary movements and seizures, before eventually becoming limp.

Despite constriction of the neck, they continued to make breathing sounds, supporting the idea that obstruction of blood vessels was the dominant effect. The quickest death in the study was estimated to have occurred after 62 seconds, and the slowest after 7 minutes 31 seconds (*Journal of Forensic Sciences*, DOI: 10.1111/j.1556-4029.2010.01434.x).



The injuries the dying victims were seen to sustain as their limbs hit walls during seizures caught the attention of co-author Vernon Geberth of Practical Homicide Investigations, a consultancy in New York. "Injuries that might have been thought to have occurred before the suicide could actually be a result of these seizures," he says.

Injuries of the dying victims could be relevant in court cases involving mistreatment in prisons

The new information could have a bearing on cases in which police or prison officers are accused of negligence in their treatment and surveillance of prisoners at risk of suicide.

"This raises the possibility that people could commit suicide between a reasonable schedule of checks," says Stuart Hamilton, a pathologist at Sunderland Royal Hospital, in the UK. "It's certainly something that will assist in cases of negligence in prisons."

<http://www.newscientist.com/article/mg20727754.300-macabre-details-of-suicide-hangings-revealed.html>

**Zoologger: Death by world's longest animal**

- 15:59 01 September 2010 by **Michael Marshall**



Walnut killer (Image: Scott Leslie/Getty)

**Species:** *Cyanea capillata*

**Habitat:** cold waters of the Arctic, north Atlantic and north Pacific Oceans

A venomous medusa-like beast as long as a blue whale has emerged as an unlikely defender of the world's oceans.

The lion's mane jellyfish is the largest jellyfish known and a contender for the longest animal of all time. Its bell can be 2.5 metres across, and its tentacles can stretch over 30 metres – about the same length as a blue whale. This is 10 metres longer than the tentacles of the famous Portuguese man-of-war – which in any case is not a true jellyfish but a hydrozoan.

Now Aino Hosia of the Institute of Marine Research in Bergen, Norway, and Josefin Titelman of the University of Gothenburg in Sweden have found that captive lion's manes will readily prey on sea walnuts – transparent animals of the comb jelly type and a voracious invaders of the world's oceans – and may help to control their numbers in the wild.

The sea walnut is native to the western Atlantic, but has now spread to the North Sea and even to the chill waters of the Baltic. It feeds on tiny plankton, devastating their populations – and in turn it brings about crashes in the numbers of fish that depend on the plankton for food. Like many species invading new territories, it had been thought to have avoided significant predation – but no longer.

**Four ages**

The lion's mane jellyfish passes through four stages over the course of its life: larva, polyp, ephyra and the familiar medusa. Each medusa is either male or female, and the female carries her fertilised eggs with her until they develop into larvae.



Each tiny, free-swimming larva – also known as a planula – heads off and installs itself on a rock, which is carefully selected to allow it to hang head-down in the shade, and develops into a polyp. This looks like a miniature sea anemone, and is also known as the scyphistoma because the terminology wasn't confusing enough already.

After feeding for several months the polyp begins reproducing asexually, making many identical ephyrae. This generally happens in early spring. Each ephyra breaks away and sets off on its own, and may – if it gets enough gelatinous prey – eventually become a full-size medusa.

### Sunscreen and stings

The name "lion's mane" comes from the jellyfish's tentacles, which come in shades between yellow and red. They are covered with tiny cells bearing dangerous toxins that can paralyse prey animals and cause fatal heart attacks in lab rats.

Humans who get caught in the tentacles generally suffer only mild reactions, unless they are allergic or receive many stings. Slathering yourself with sunscreen apparently protects against the worst of it.

Nevertheless, and despite giving only a limited ability to move around, the tentacles make the lion's mane a formidable predator. It readily catches small fish, and also targets many other jellies, including the large moon jellyfish.

So it should come as no surprise that the lion's mane targets the invasive sea walnut – though it is not as successful as it is against more familiar prey. Hoshia and Titelman found that the sea walnuts escaped 90 per cent of the time, though they generally suffered damage in the process and were more likely to succumb after repeated assaults.

Still, with enemies like the sea walnut, we need friends like this.

Journal reference: *Journal of Plankton Research*, DOI: [10.1093/plankt/fbq106](https://doi.org/10.1093/plankt/fbq106)

<http://www.newscientist.com/article/dn19387-zoologger-death-by-worlds-longest-animal.html>

## Ancient bacteria could improve anti-ageing cosmetics

- 19:00 02 September 2010 by **James Urquhart**

Where better to look for a sunscreen formula than in cyanobacteria – organisms that thrived on Earth before there was enough oxygen to block harmful ultraviolet light? The genes and enzymes responsible for producing sunscreen molecules in one such cyanobacterium have now been identified, a step towards making bio-inspired sun protection.

Also known as blue-green algae, cyanobacteria have existed on Earth for 3.4 billion years. They get their energy from sunlight via photosynthesis, but in doing so, they must expose themselves to UV radiation, which damages DNA molecules – a serious problem for early life, before the "great oxygenation event" around 2.4 billion years ago. One way today's cyanobacteria combat UV exposure is to make small-molecule sunscreens called mycosporines and mycosporine-like amino acids (MAAs) that absorb the harmful rays.

Previous studies have focused on the chemical structures of these UV-blocking molecules and the kinds of organisms that make or accumulate them in different habitats. No one knew how the organisms make the molecules, however. Now Emily Balskus and **Christopher Walsh** of Harvard Medical School in Boston, Massachusetts, have found the genes and enzymes involved in the biosynthesis of these sunscreen molecules for the first time.

### Genome mining

Using a genome-mining approach, the duo identified a gene cluster that could be responsible for making sunscreen molecules in a cyanobacterium called *Anabaena variabilis*. To test the genes, they expressed the cluster in the bacterium *Escherichia coli*, which normally does not make sunscreen molecules. Afterwards, the team found the bacteria could make the molecules.

The pair then found that four enzymes were responsible for synthesising the MAA molecules. Each MAA has two amino acids linked to a central organic group. It's the amino-acid linkages that are important for determining the wavelength and strength of UV absorbance, they say.

The MAAs shinorine and porphyra-334 have already been used in an "anti-ageing" cosmetic product, **Helioguard 365**, manufactured by **Mibelle Biochemistry**, a company based in Buchs, Switzerland. However, Mibelle extracts these chemicals directly from algae. "Our work could be a starting point for devising new routes to these molecules or analogues using a biocatalytic or biological engineering approach," says Balskus.

"We don't yet know if biological sunscreens will end up being any better than man-made sunscreen ingredients, since Helioguard is a relatively new product. But they do have the photochemical properties desirable in sunscreens," she adds. **Bradley Moore** of the University of California, San Diego, says the work solves a long-standing biosynthetic question concerning MAAs in diverse organisms. "It's a beautiful study and a very illuminating one that may have applicability for the development of new sunscreens."

Journal reference: *Science*, DOI: 10.1126/science.1193637

<http://www.newscientist.com/article/dn19392-ancient-bacteria-could-improve-antiageing-cosmetics.html>



## Hawking hasn't changed his mind about God

- 16:36 02 September 2010 by **Roger Highfield**

Hold the front page: the big bang was an inevitable consequence of the laws of physics. Or indeed, as the front page of the London *Times* put it today: "Hawking: God did not create universe". Media furore over Stephen Hawking's new book, *The Grand Design*, has made it the biggest science news story of the day. But it's not like Hawking has suddenly given up a religious belief – let alone proved that God doesn't exist.

Hawking's position on religion has remained unchanged since he wrote his bestseller, *A Brief History of Time*. At the end of that book he famously used God as a metaphor for the laws of nature: "If we discover a complete theory, it would be the ultimate triumph of reason – for then we should know the mind of God." This quotation is billed in *The Times* today as his "previous view" on religion. It was certainly influential – the book sold 6 million copies – but Hawking has always looked at God metaphorically, in much the same way, incidentally, as Einstein. "I cannot believe that God plays dice with the cosmos" was Einstein's famous quip about his discomfort with quantum mechanics. He also declared, "I want to know how God created the world."

But Einstein was not really religious. He remarked that "the idea of a personal God is an anthropological concept which I cannot take seriously". When asked if he believed in God, Einstein explained: "I believe in Spinoza's God who reveals himself in the orderly harmony of what exists, not in a God who concerns himself with fates and actions of human beings."

### Dodging the inquisition

Likewise, in 2001 I interviewed Hawking and he made a telling remark underlining how he was not religious. He told me: "If you believe in science, like I do, you believe that there are certain laws that are always obeyed. If you like, you can say the laws are the work of God, but that is more a definition of God than a proof of his existence." And in a piece by him that I edited in 2008, he described how he attended a conference on cosmology at the Vatican, where the pope told the delegates they should not inquire into the beginning of the universe itself, because that was the moment of creation and the work of God.

Hawking joked, "I was glad he didn't realise I had already presented a paper at the conference investigating precisely that issue: I didn't fancy the thought of being handed over to the inquisition like Galileo."

### Silly season

As Hawking's long-suffering assistant dealt with a deluge of enquiries from journalists from around the world, she told me how the furore says more about the silly season than any change of mind. It also says much about how God is used to sell science to the public. The Higgs boson, labelled the "God particle" – a moniker that Peter Higgs himself finds embarrassing – springs to mind. And after all, *The Times* is serialising Hawking's book, which he wrote with Leonard Mlodinow. In it, Hawking describes how M-theory, a candidate ultimate theory of everything, may offer answers to the question of creation. "According to M-theory, ours is not the only universe," Hawking writes. "Instead M-theory predicts that a great many universes were created out of nothing. Their creation does not require the intervention of some supernatural being or god." The universe arises from scientific processes, not God – as Hawking himself would have agreed decades ago.

<http://www.newscientist.com/article/dn19391-hawking-hasnt-changed-his-mind-about-god.html>

## Remains of the oldest feast found

- 20:00 30 August 2010 by Michael Marshall

Magazine issue 2776.



Feasts have a longer history than we thought (Image: Keren Su/Getty)

In a cave 12,000 years ago, a group of people settled down to a dinner that has rarely been matched: 71 tortoises that had been roasted in their shells.

The discovery of the shells shows that feasting occurred 2500 years earlier than previously thought, at a critical stage in the transition from hunter-gathering to settled farming.

The remains of the feast were found in Hilazon Tachtit cave (see picture) in Israel by Natalie Munro of the University of Connecticut in Storrs and Leore Grosman of the Hebrew University in Jerusalem. It is a burial ground that contains the bones of 28 people.

The tortoise shells (see picture) were buried in 12,000-year-old pit lined with limestone slabs, along with the body of an elderly woman (see picture). "She had a lot of health problems and probably limped," Munro says. "She was buried with a collection of unusual animal parts such as a leopard pelvis." These items were probably symbols of status and may indicate that she was a shaman. Munro thinks that the tortoises were eaten during the woman's funeral.



## Funeral feasts

In a second pit of the same age they found another burial, this one accompanied by the bones of three wild cattle ([see picture](#)). This suggests there may have been two separate funeral feasts.

At the time the region was inhabited by the Natufian people, who were beginning to settle down in fixed communities. "Suddenly you have hundreds of people living in the same place for most of the year, and that creates friction," says [Alan Simmons](#) of the University of Nevada, Las Vegas. Feasts may have helped smooth things over and brought communities together, he says.

However, archaeologist [Brian Hayden](#) of Simon Fraser University in Burnaby, British Columbia, Canada, argues that feasting tends to be used by political leaders to cement their power. "It converts surplus food production into useful things, like debts and political support," he says.

Journal reference: *Proceedings of the National Academy of Sciences*, DOI: [10.1073/pnas.1001809107](https://doi.org/10.1073/pnas.1001809107)

<http://www.newscientist.com/article/dn19376-tortoise-banquet-remains-of-the-oldest-feast-found.html>

## The mind's eye: How the brain sorts out what you see

- 30 August 2010 by **David Robson**

Magazine issue 2775.

Seeing isn't believing (Image: Brian Stauffer)

*Can you tell a snake from a pretzel? Some can't – and their experiences are revealing how the brain builds up a coherent picture of the world*

AFTER her minor stroke, BP started to feel as if her eyes were playing tricks on her. TV shows became confusing: in one film, she was surprised to see a character reel as if punched by an invisible man. Sometimes BP would miss seeing things that were right before her eyes, causing her to bump into furniture or people.



BP's stroke had damaged a key part of her visual system, giving rise to a rare disorder called simultanagnosia. This meant that she often saw just one object at a time. When looking at her place setting on the dinner table, for example, BP might see just a spoon, with everything else a blur (*Brain*, vol 114, p 1523).

BP's problems are just one example of a group of disorders known collectively as visual agnosias, usually caused by some kind of brain damage. Another form results in people having trouble recognising and naming objects, as experienced by the agnostic immortalised in the title of Oliver Sacks's 1985 best-seller *The Man Who Mistook His Wife for a Hat*.

Agnosias have become particularly interesting to neuroscientists in the past decade or so, as advances in brain scanning techniques have allowed them to close in on what's going on in the brain. This gives researchers a unique opportunity to work out how the brain normally makes sense of the world. "Humans are naturally so good at this, it's difficult to see our inner workings," says Marlene Behrmann, a psychologist who studies vision at Carnegie Mellon University in Pittsburgh, Pennsylvania. Cases like BP's are even shedding light on how our unconscious informs our conscious mind. "Agnosias allow us to adopt a reverse-engineering approach and infer how [the brain] would normally work," says Behrmann.

Although we may not give it much thought, our ability to perceive our world visually is no mean feat; the most sophisticated robots in the world cannot yet match it. From a splash of photons falling on the retina - a 3-centimetre-wide patch of light-sensitive cells - we can discern complex scenes comprising multiple items, some near, some far, some well lit, some shaded, and with many objects partly obscured by others.

The information from the photons hitting a particular spot on the retina is restricted to their wavelength (which we perceive as colour), and their number (which determines brightness). Turning that data into meaningful mental images is a tough challenge, because so many variables are involved. For example, the number of photons bouncing off an object depends both on the brightness of the light source and on how pale or dark the object is. "The information that the visual system receives is very impoverished," says Behrmann.

It is in the visual cortex, located at the back of the brain, where much of the processing goes on. When items obscure each other, the brain must work out where one thing ends and another begins, and take a stab at their underlying shapes. It must recognise things from different perspectives: consider the image of a chair viewed from the side compared with from above. Then there's the challenge of recognising novel objects - a futuristic new chair, for example. "Somehow, almost magically, we derive a meaningful interpretation of complex scenes very rapidly," says Behrmann. "How we do this is the million-dollar question in vision research."

So how does the brain work its magic? In the early 20th century, European psychologists used simple experiments on people with normal vision to glean some basic rules that they called the "gestalt principles". For example, the brain groups two elements in an image together if they look similar, having the same colour, shape or size, for example. And if not all of an object is visible, we mentally fill in the gaps - that's the "closure principle" (see "Constructing reality").

The gestalt principles can only go part of the way to describing visual perception, though. They cover how we separate the different objects in a scene, but they cannot explain how we know what those objects are. How, for example, do we know that a teacup is a teacup whether we see it from above or from the side, in light or in shadow?

It's here that people with visual agnosias come in handy. Behrmann had previously studied people with integrative agnosia, who have difficulty recognising and naming complex objects as a whole, and instead seem to pay unusual attention to their individual features. One person, for example, mistook a picture of a harmonica for a computer keyboard, presumably thinking the row of air-holes in the mouthpiece were computer keys (*Journal of Experimental Psychology: Human Perception and Performance*, vol 29, p 19). Others have mistaken a picture of an octopus for a spider, and a pretzel for a snake.

In 2006, Behrmann put one of her patients, known as SM, through a series of experiments alongside people with normal vision. All were shown a set of three-dimensional objects on a screen, each made from two simple geometric shapes. Afterwards, the volunteers were shown a stream of these images, with a few new objects thrown in. Their task was to report whether or not they had seen the objects before.

While those with normal vision performed with nearly 100 per cent accuracy, SM made some intriguing mistakes. He knew he hadn't seen an object before if it contained a new part, but those that had the same parts in a different configuration confused him. About half the time he mistook these for the familiar objects (*Journal of Experimental Psychology: Human Perception and Performance*, vol 32, p 1169).

To Behrmann, the results suggest that our brains normally construct objects from a series of smaller building blocks, which she calls our "visual vocabulary". To recall our concept of an object, she says, we form a mental map of the way these parts fit together. It was at this stage that SM failed. "He had a good representation of the parts, but understood little of how they were combined," Behrmann says.

Behrmann's work could help resolve a long-standing dispute among vision researchers. One theory has it that to interpret what we see, we flick through a mental catalogue of objects we have seen before - and preferably, a view of these objects from every vantage point - to try to find a best fit with the current image. Behrmann's study lends weight to a different view, that we remember the typical form of an object as a construction of a few generic building blocks.



## Essential elements

It would be quicker to try to match a new object to a building block construction than flick through a catalogue of every single example of the object we've ever seen, Behrmann says. Importantly, the basic building blocks, and their configuration, would probably stay the same whether we view the objects from different angles or in different lighting, making the comparison and recognition easier and more robust.

After object recognition comes the next stage of visual perception: conscious awareness of what we see. Other kinds of agnosia have posed some serious questions about this process. "Agnosias are a breakdown in the unity of consciousness," says Rocco Gennaro, a philosopher studying consciousness at the University of Southern Indiana in Evansville. "It leads to an inability to perceive the coherent whole."

These disorders are a breakdown in the unity of consciousness, an inability to see the coherent whole

Take the case of visual form agnosia. People with this disorder cannot consciously discern the shape, size or orientation of objects, yet they have no problem manipulating those objects. Studies have shown that, for example, while they could not describe the angle of a slot in a specially built mailbox, they had no difficulty posting an object through it.

Intriguingly, there are also people with the opposite problem: they can describe the shape and size of an object, but with manual tasks they are clumsy, often missing the thing they are reaching for. This condition has been termed optic ataxia.

Brain scans have revealed that people with visual form agnosia tend to have damage to the ventral (lower) part of the brain's visual area. People with optic ataxia, on the other hand, have damage to the dorsal (upper) part. This led to the idea that we have two streams of visual processing. The ventral pathway is necessary for perceiving or recognising an object, while the dorsal pathway deals with an object's physical location in our visual field and, if we need to perform an action on it, guides the movement of our bodies. For this reason, scientists often refer to the two processes as the perception-action, or the what-where, streams of visual processing.

This idea was necessarily based on studies of just a few people. To make matters worse, most of the cases of visual form agnosia arose from carbon monoxide poisoning, which can cause widespread brain damage, so it was hard to work out which part of the ventral pathway was most affected.

So for some time the search was on for an agnosic with just a small area of damage to their ventral pathway. Last year Hans-Otto Karnath, a cognitive neuroscientist at the University of Tübingen in Germany, found a stroke patient with damage only to the central structures of the ventral pathway. Besides providing further evidence for the perception-action theory of vision, this person's symptoms suggest that this area is vital for our normal understanding of shape and contour information (*Journal of Neuroscience*, vol 29, p 5854).

In fact, the closer neuroscientists look, the more modular our visual systems appear. MRI scans of people with and without agnosias have suggested that within the ventral stream, separate aspects of appearance are processed independently. This year, psychologist Cristiana Cavina-Pratesi at Durham University in the UK found that shape, texture and colour are all processed in individual regions (*Cerebral Cortex*, DOI: [10.1093/cercor/bhp298](https://doi.org/10.1093/cercor/bhp298)).

Yet our experience feels markedly different. When we consciously see something, all these disparate elements are stitched seamlessly together, so we know instantly that an apple is smooth, green and round. The question of how we accomplish this is central to the study of conscious perception.

Some neuroscientists, like H. Branch Coslett at the University of Pennsylvania in Philadelphia, think that the brain binds all the different features from the ventral stream to a "master map of location", which is held in the dorsal stream. This binding process is so fundamental, he claims, that it is only once this link has been formed that an image can pop into our consciousness; without it, images lurk somewhere in the subconscious.

Coslett says that evidence for the binding theory comes from people with simultanagnosia, such as BP, who can only see one object at a time. These people tend to have damage to the posterior parietal lobe (PPL), which may be crucial for linking information processed by the dorsal and ventral pathways. The damage appears to reduce the amount of information that can be bound together, meaning affected individuals can only bind enough data for one object at a time, while everything else remains beyond conscious reach.

Further support for the idea came in 2008, when Coslett discovered a simultanagnosic man who had damage to his PPL, leading to some curious symptoms. Like other simultanagnosics, the man, known as KE, could only see one object at a time but, uniquely, he struggled to see more than one aspect of an object at a time. In one experiment, for example, he could report an object's shape or patterning, but not both at once. When he read words written in coloured ink, he could read the word but not report the colour (*Journal of Cognitive Neuroscience*, vol 20, p 36).

Yet KE was not completely blind to the features he couldn't describe. In another experiment, he was asked to say what was depicted in line drawings of objects like lemons and tomatoes. Sometimes, these images were coloured appropriately - the lemon would be yellow, for example - while others would be mismatched. Although KE reported seeing no colour when naming the figures, his accuracy was better when the objects had the right colour, showing that some colour processing was occurring in his subconscious.

All of this fits with the binding theory. "KE could only link one channel - the colour, shape, or name of an object - to the 'where' information at any one time," says Coslett. Without the necessary binding to the dorsal map, however, all of the other features were unavailable to his conscious mind.

### **What lies beneath**

These findings seem to support the view emerging from several disparate fields of neuroscience - that the subconscious mind has a bigger role than previously supposed. When it comes to the mental faculties we prize as uniquely human, including creativity, language and aspects of memory and learning, subconscious thought processes are far from playing second fiddle to the conscious mind (*New Scientist*, 1 December, 2007, p 42).

The subconscious has a bigger role than we thought in the mental faculties we prize as uniquely human

To Coslett and other neuroscientists studying consciousness, our attention is like a spotlight that points to a specific location in our visual representation of the world around us. As the spotlight hits a particular region, it selects the relevant information bubbling away in our subconscious, binding the different features to their location, before they pop into our consciousness as a single, unified experience.

So important is the role vision plays in most people's everyday lives that most research has concentrated on visual agnosias. Now the hunt is on for similar disorders that affect the other senses. Recently, for example,



neurologists found a person who could understand speech but not other sounds. Coslett, meanwhile, is investigating whether simultanagnosics also have trouble binding other sensory sensations together, such as sights and sounds.

Understanding such deficits could reveal how the brain processes different types of sensory information. Indeed, Behrmann hopes that working with a wider range of senses might reveal general principles of sensory perception.

Press even further down this road and we could unlock one of the most fascinating mysteries of modern neuroscience: how the brain binds together all of our disparate sensory experiences into the single, flowing conscious experience that we call "the present moment".

### **Now you see it...**

There are many visual disorders, typically caused by damage to specific parts of the brain.

- Simultanagnosia - Seeing only one object at a time, even when viewing a scene comprising many items
- Integrative agnosia - Inability to recognise whole objects, tending to focus instead on individual features of an object
- Visual form agnosia - Inability to describe the shape, size or orientation of objects, yet exhibiting no problem in manipulating them
- Optic ataxia - Ability to report the shape and size of an object, though attempts to manipulate it are clumsy
- Prosopagnosia - Failure to recognise the faces of familiar people
- Pure alexia (aka agnosia for words) - Inability to identify individual characters or read text, even though subjects are sometimes able to write
- Agnosia for scenes - Inability to recognise known landmarks or scenes
- Colour agnosia - Ability to perceive colours without being able to identify, name or group them according to similarity

*David Robson is a features editor at New Scientist*

<http://www.newscientist.com/article/mg20727751.200-the-minds-eye-how-the-brain-sorts-out-what-you-see.html>

***The first printed books came with a question: What do you do with these things?***

By Tom Scocca | August 29, 2010



In the beginning, before there was such a thing as a Gutenberg Bible, Johannes Gutenberg laid out his rows of metal type and brushed them with ink and, using the mechanism that would change the world, produced an ordinary little schoolbook. It was probably an edition of a fourth-century grammar text by Aelius Donatus, some 28 pages long. Only a few fragments of the printed sheets survive, because no one thought the book was worth keeping.

“Now had he kept to that, doing grammars...it probably would all have been well,” said Andrew Pettegree, a professor of modern history at the University of St. Andrews and author of “The Book in the Renaissance,” the story of the birth of print. Instead, Gutenberg was bent on making a grand statement, an edition of Scripture that would cost half as much as a house and would live through the ages. “And it was a towering success, as a cultural artifact, but it was horribly expensive,” Pettegree said. In the end, struggling for capital to support the Bible project, Gutenberg was forced out of his own print shop by his business partner, Johann Fust.

Inventing the printing press was not the same thing as inventing the publishing business. Technologically, craftsmen were ready to follow Gutenberg’s example, opening presses across Europe. But they could only guess at what to print, and the public saw no particular need to buy books. The books they knew, manuscript texts, were valuable items and were copied to order. The habit of spending money to read something a printer had decided to publish was an alien one.

Nor was print clearly destined to replace manuscript, from the point of view of the book owners of the day. A few fussy color-printing experiments aside, the new books were monochrome, dull in comparison to illuminated manuscripts. Many books left blank spaces for adding hand decoration, and collectors frequently bound printed pages together with manuscript ones.

“It’s a great mistake to think of an absolute disjunction between a manuscript world of the Middle Ages and a print world of the 16th century,” Pettegree said.

As in our own Internet era, culture and commerce went through upheaval as Europe tried to figure out what to make of the new medium and its possibilities. Should it serve to spread familiar Latin texts, or to promote new ideas, written in the vernacular? Was print a vessel for great and serious works, or for quick and sloppy ones? As with the iPad (or the Newton before it), who would want to buy a printed book, and why?

Pettegree explores this time of cultural change by looking at the actual published matter it produced. Drawing on the power of 21st century information technology, he and a team of researchers pulled together the catalogs of thousands of small, scattered libraries, assembling the broadest picture to date of the earliest publications.

What made print viable, Pettegree found, was not the earth-shaking impact of mighty tomes, but the rustle of countless little pages: almanacs, calendars, municipal announcements. Indulgence certificates, the documents showing that sinners had paid the Catholic church for reduced time in purgatory, were especially popular. These ephemeral jobs were what made printing a viable business through the long decades while book publishers — and the public — struggled to find what else this new technology might be good for.

Pettegree spoke to Ideas by phone from Scotland.

**IDEAS:** People hadn’t really figured out how to find customers and sell books.

**PETTEGREE:** What you’ve got to do once you’ve got 300 identical copies of a book is you’ve got to sell it to people who don’t even yet know they want it. And that’s a very, very different way of selling.

And whereas the printers were taking advice from 15th-century humanist scholars, who said, “Wouldn’t it be good to have this? Wouldn’t it be good to have that?” they weren’t in any position to give them any advice on how to dispose of these 300 copies. And in due course they found that the only way to do this is to create a market which is trans-European.

It’s this classic example of how you get technological innovation without people really being aware of the commercial implications, of how you can make money from it. There’s quite a little similarity in the first generation of print with the dot-com boom and bust of the ’90s, where people have this fantastic new innovation, a lot of creative energy is put into it, a lot of development capital is put into it, and then people say, “Well, yeah, but how are we going to make money from the Internet?” And that takes another 10 years to work out.

**IDEAS:** The one thing that most early printers seemed to do was to go out of business.

**PETTEGREE:** And the ones who didn’t were the ones who tended to have a close relationship with official customers. And this really I think is the new part of the story that we’ve been able to put together.

Most narratives of print have relied on looking at the most eye-catching products — whether it's Gutenberg's Bible or Copernicus or the polyglot Bible of Plantin — these are the ones which seem to push civilization forward. In fact, these are very untypical productions of the 16th-century press.

I've done a specific study of the Low Countries, and there, something like 40 percent of all the books published before 1600 would have taken less than two days to print. That's a phenomenal market, and it's a very productive one for the printers. These are the sort of books they want to produce, tiny books. Very often they're not even trying to sell them retail. They're a commissioned book for a particular customer, who might be the town council or a local church, and they get paid for the whole edition. And those are the people who tended to stay in business in the first age of print.

**IDEAS:** And it's these smaller books that there's been this perceptual bias against.

**PETTIGREE:** The most astonishing single fact that's emerged from the work we've done: We've documented I think now about 350,000 editions published throughout Europe before 1600. Of those, around 40 percent of those items survive in only one copy.

Many of the books that are best known are actually not at all rare. Because they were collected near the time, they survived in a great number of copies. The famous Nuremberg Chronicle, one of the great 15th-century books — I think something like 500 copies of that survive.

But these little books, they weren't collectible. They were pragmatic announcements by the town council that bread prices would go up, or they were indulgence certificates, or they were almanacs for the following year, which would lose currency, or they were little schoolbooks which the school kid would be only too pleased to throw away when they got out of the class.

**IDEAS:** We think of the book as this tremendous force for innovation, but you write that books were confronting a customer base that was conservative in its tastes, both in what sort of texts they wanted to read and in the typography. Roman type showed up and then people didn't like it —

**PETTEGREE:** So they went back to the black letter. I mean, people could be trained to treat the book, the printed book, as a different thing and not inferior. That was, I think, the work of about 40 years.

But the conservatism in terms of choice of texts seems to be an enduring phenomenon. The result is that for authors, it's a very, very hard period. Contemporary authors clearly think that print is an opportunity for them. What they find, though, of course, is that the printers are looking for surefire winners.

And first of all, they think this is going to be the texts humanists admire, editions of the classics, and they flood the market with those. When they get their fingers burned with that, what they reach back for is medieval medical textbooks, medieval scientific works, and medieval literature, so the opportunity for living authors is very restricted. And in the first instance is mostly for celebrity preachers, who manage to get volumes of their sermons printed and circulated.

**IDEAS:** There's the case of Martin Luther, and his effect on the industry, where he both took away a huge part of what their business depended on, in the indulgences, but then became a prolific source of small books.

**PETTEGREE:** It's really not been remarked before, that when Luther was attacking indulgences, he was actually attacking a mainstay of the press. But he really was. I mean, the quantities that were published of these indulgences is quite phenomenal and often in very large editions. And this is the absolute dream



commission for a printer, when they're asked to produce a very large quantity of a single sheet item, a broadsheet, printed on only one side, which is what an indulgence is.

But the speed with which Luther's works take off as a popular phenomenon is quite extraordinary. It's fair to say that by 1530, 1540, Wittenberg was essentially a one-industry town. If you put together the printing that was going out and the students who were coming in to study in the university there, drawn by Luther, it has a phenomenal impact on Wittenberg.

Have you ever been to Wittenberg? It's wonderful. I was there again last week. You can still visit all of the stages of his life, you can make the walk that he did up the street from his house at one end of the city to the Schloss at the other so as to post the 95 Theses. It is a very deeply atmospheric place.

But you can see how the people who lived off Luther spent their loot. Lucas Cranach, the famous painter, also had a monopoly on woodcuts for these Reformation [religious pamphlets]. And you can stand in front of the town hall and see the two houses he built with the money he made.

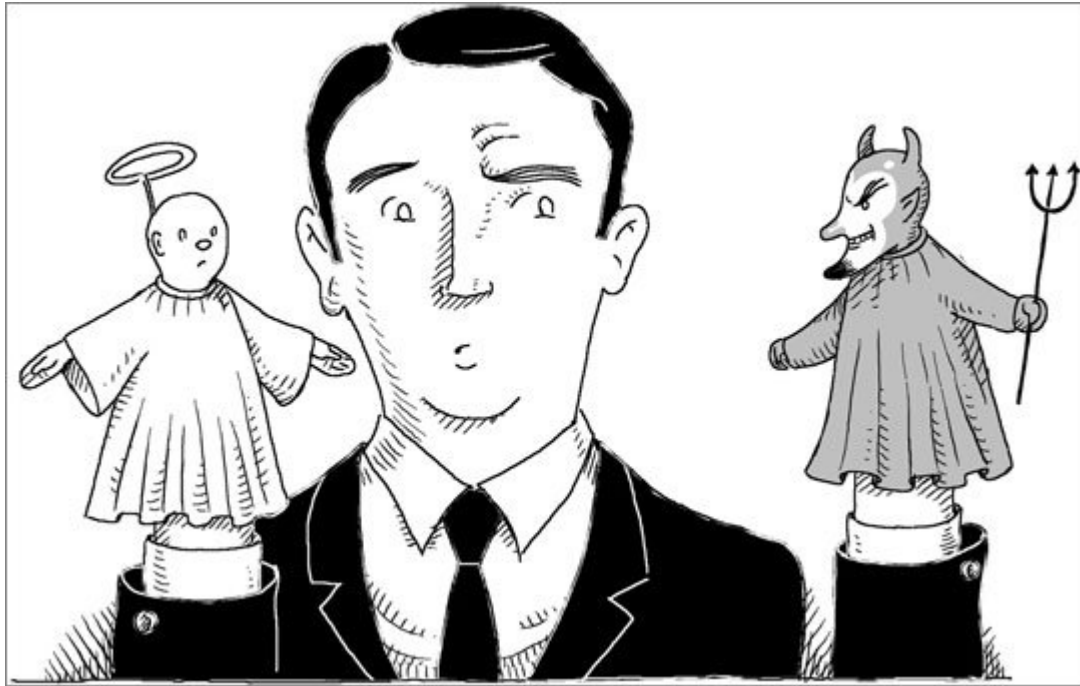
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[http://www.boston.com/bostonglobe/ideas/articles/2010/08/29/cover\\_story/](http://www.boston.com/bostonglobe/ideas/articles/2010/08/29/cover_story/)



## Surprising insights from the social sciences

By Kevin Lewis | August 29, 2010



Right is right, left is wrong. Because most people are righthanded, this bias has become customary. Thus, according to a recent paper, “the Latin words for right and left, dexter and sinister, form the roots of English words meaning skillful and evil, respectively,” and “according to Islamic doctrine, the left hand should only be used for dirty jobs, whereas the right hand is used for eating,” and “the left foot is used for stepping into the bathroom, and the right foot for entering the mosque.” But what do lefthanders think? The authors of the paper compared the gestures made by the presidential candidates in the final debates of the 2004 and 2008 elections to the phrases that were spoken at the same time. John McCain and Barack Obama, who are both lefthanded, preferred their left hands for positive comments and their right hands for negative comments, while the pattern was reversed for George W. Bush and John Kerry, who are both righthanded.

*Casasanto, D. & Jasmin, K., “Good and Bad in the Hands of Politicians: Spontaneous Gestures during Positive and Negative Speech,” PLoS ONE (July 2010).*

### Couples therapy

Some marriages are healthier than others, both figuratively and literally. A team of researchers observed the social interactions of several dozen married couples. The researchers also collected blood samples from everyone and created small blisters on each person’s forearm, and then monitored the healing process. The level of two hormones (oxytocin and vasopressin) in a person’s blood was associated with both the quality of that person’s marital communication and how quickly that person’s wound healed. Those with higher levels of these hormones were more positive and less negative with their partner and exhibited faster wound healing.

Gouin, J. et al., "Marital Behavior, Oxytocin, Vasopressin, and Wound Healing," *Psychoneuroendocrinology* (August 2010).

#### Teen sex and TV

As long as humans have communicated, they have probably debated the question of whether kids are influenced by lurid content. The issue is a big part of the culture wars and is especially acute in the age of cable TV and the Internet. However, a reanalysis of data from a widely cited study suggests that lurid media content may be getting too much blame. The original study in the journal *Pediatrics* surveyed hundreds of middle-school students about their media exposure and virginity and followed up with them two years later. Although the authors of the original study claimed to find an effect, the authors of this latest analysis — using a "more stringent approach" — found no effect of media exposure on the age when adolescents began to have sex. Instead, it appears that the kind of adolescent who has sex at an earlier age also just happens to be the kind of adolescent who consumes lurid media content.

Steinberg, L. & Monahan, K., "Adolescents' Exposure to Sexy Media Does Not Hasten the Initiation of Sexual Intercourse," *Developmental Psychology* (forthcoming).

#### The prejudice of the times

In this country, most discussions about race are concerned with blacks and Latinos. Blacks still confront the legacy of slavery, while Latinos are at the center of the immigration debate. Another group, Asian-Americans, has seemingly managed to stay above the fray. But is this wishful thinking? Perhaps, according to a new study. After reading an editorial about the economic downturn, participants became more prejudiced against Asian-Americans, but not against blacks. An editorial about global warming didn't have the same effect. The authors attribute this to the perception that Asian-Americans are more of a competitive threat with regard to jobs and other economic resources.

Butz, D. & Yogeewaran, K., "A New Threat in the Air: Macroeconomic Threat Increases Prejudice against Asian Americans," *Journal of Experimental Social Psychology* (forthcoming).

#### Slogan backlash

A slogan is a set of words designed to influence your thoughts. You know this, and, according to a new study, your subconscious does, too. In fact, your subconscious tries to employ its own reverse psychology. When people were asked to remember slogans related to saving money, they were inclined to spend more later on; likewise, when remembering slogans related to spending money, people were inclined to spend less. However, brand names seem to get the job done: People spent less after being asked to remember a brand related to saving money, and people spent more after being asked to remember a brand related to spending money. So perhaps every company should have a brand like Tiffany and a slogan like "Every Day Low Prices."

Laran, J. et al., "The Curious Case of Behavioral Backlash: Why Brands Produce Priming Effects and Slogans Produce Reverse Priming Effects," *Journal of Consumer Research* (forthcoming).

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## In New York Ballet Companies, Corps Is a Thrill

By REBECCA MILZOFF



At 19, April Giangeruso speaks of her first six months dancing with American Ballet Theater in a girlish tone of awe and utter joy: “ABT is absolutely the place I wanted to be.” She’s thrilled to be dancing onstage with her childhood idols, Julie Kent and Marcelo Gomes — or, more precisely, behind them.

Ms. Giangeruso spent two years performing major pas de deux and soloist roles with ABT II, Ballet Theater’s studio company, but that all changed when she became an apprentice in the main company in January, then a full corps member in June: away went the spotlight.

“You go from being a huge fish in a really tiny pond to being a really small fish in a huge lake,” she said matter-of-factly. “Nobody really says anything to you about your dancing. You’re standing in the back, and you don’t hear your name.” For all this, she is still elated.

At New York’s major ballet companies, every summer brings a flurry of promotions just as momentous, though hardly as well publicized, as those of soloists and principal dancers: the admission of new apprentices and corps members, the young performers whose names are clustered in tiny print at the bottom of the company roster, who dance as so many snowflakes, waltzing flowers and decorative court members. With the troupes heading back to rehearsal rooms — for an inaugural fall season at New York City Ballet, and for Alexei Ratmansky’s new “Nutcracker” at Ballet Theater — these talented few are about to start a new chapter in their careers.

“As a director, if you can give someone good news, savor that moment,” Kevin McKenzie, Ballet Theater’s artistic director, said. He had recently delivered good news to Calvin Royal III, 21, who will become Ballet Theater’s only new apprentice this year. Mr. Royal, one of the six men in ABT II, was at Jacob’s Pillow, the idyllic dance retreat, taking classes this summer and pondering career options outside the Ballet Theater bubble when he received a call asking him to return to New York. Mr. McKenzie wanted to meet with him.

“When I got back, I found out I got into ABT,” Mr. Royal said, still exhilarated. “It was just like, God is so good.”

In addition to one apprentice, Ballet Theater accepted only three new corps members.

At City Ballet, this year's crop is sizable — 5 new apprentices and 10 new corps members. The numbers vary according to a combination of factors: economics, available openings (when many dancers retire or leave for other reasons), and, of course, talent.

Peter Martins, ballet master in chief at City Ballet, said the most important quality he looked for was actually not one that could be taught.

“Some people are much more hungry and eager than others,” he said. “I’ve learned over the years that some people can be very shy, stand in the back of class, and on a superficial level, it seems they’re not as interested as the one pushing herself to the front row. But often it’s deceiving. The most crucial thing is their mind: Are they dedicated? The worst thing you want to see is some sort of complacency.”

Since its creation of the Jacqueline Kennedy Onassis School in 2004, Ballet Theater has largely drawn apprentices from those alumni, who go on to dance for up to two years in ABT II. City Ballet takes young dancers exclusively from the affiliated School of American Ballet. (Only four of the company's current dancers did not attend that school.)

“It’s like home cooking,” Mr. Martins said. “We train our dancers very specifically with the idea that that’s how we want people to dance at New York City Ballet.”

Apprenticeships are relatively brief — usually about half a year, because of union regulations — and dancers must quickly adjust from the coddled life of a senior student (or, in the case of ABT II members, that of a soloist) to one in which attention is a precious and rarely bestowed commodity. Ms. Giangeruso of Ballet Theater said it took some time to realize that feeling ignored wasn’t necessarily a bad thing.

“Kevin told me in my initiation meeting, ‘As long as I’m not running across the room, screaming your name, you know you’re doing good,’ ” she recalled. “You don’t want attention as a starting corps member. It’s just how ballet is; nobody’s going to hold your hand.”

As Mr. McKenzie noted: “There’s a myth, I think, that some kids are just plain talented — you train them and let them go. Because dancers tend to become enormously proficient by their 20s, people think they’re more mature than they are — but they’ve spent their whole life in a myopic view. You have to let them grow into their talent.”

To that end, both he and Mr. Martins do not offer critiques to apprentices and new corps members, other than brief mid- and end-of-year evaluations. “Of course if I observe something I’m not happy with, I’ll call that person in and talk to them,” Mr. Martins said, “but it’s very rare. It’s not unlike life: sink or swim.”

That applies to learning the ins and outs of day-to-day company life as well. There’s minutiae like sewing extra pairs of point shoes and remembering to sign in before show time (to be paid). And then there are larger concerns.

“Things are thrown together a whole lot faster in the company than in school,” said Lauren Lovette, 18, a new corps member at City Ballet. For her year-end school performance, she had two months to rehearse. “Now, most of the ballets we put on,” she said, “you get maybe a week’s notice, a few rehearsals.”

A key element of that maturation experience has to do with learning the corps style. “Corps 101 is all about matching each other: you breathe as one, you listen to the music as one,” said Meaghan Hinkis, 19, a new corps member at Ballet Theater.

But that unity comes with significant physical challenges. Recalling the Shades scene of “La Bayadère,” Courtney Lavine, 21, who came up with Ms. Hinkis, said: “It’s funny because we all say, ‘It’s just arabesques.’ But when you get out there, you’re like, this is a lot of arabesques.”

There’s even an art to learning what most corps members spend a majority of their stage time doing: standing still. “It’s really hard, like Lamaze breathing,” Ms. Lavine said. “You can’t even describe that pain.”

That first year isn’t all endless arabesques, though. The newest dancers on occasion receive special opportunities, which most likely speak to yet another lesson: one dancer’s injury is another’s gain. Taylor Stanley, 19, now a corps member at City Ballet, was thrown into Jerome Robbins’s “N.Y. Export: Opus Jazz” in the spring. At Ballet Theater, Ms. Hinkis danced in John Neumeier’s “Lady of the Camellias” this summer.

“It was unbelievable,” she recalled. “It was one of those roles you could really embellish on and make your own, and there was real partnering” — a rare opportunity for most corps members.

Yet in interviews the young dancers didn’t dwell on those exceptional moments — they reveled in the seemingly more mundane aspects of corps life.

“We always hope for more rehearsal time,” Ms. Lovette said. “We get really excited when it’s like, ‘Oh, I have such a full day. I’m on tonight, and I’ve got rehearsals.’ That’s the most exciting thing about being an apprentice. You look up at the casting, and you just hope you’re in something. Even if you’re standing in the back in some weird-looking costume, you’re just happy to be there.”

[http://www.nytimes.com/2010/09/01/arts/dance/01corps.html?\\_r=1](http://www.nytimes.com/2010/09/01/arts/dance/01corps.html?_r=1)

## At Lincoln Center, Information Is Architecture

By **ROBIN POGREBIN**



Elizabeth Diller would seem to have her hands full. Even as work winds down on its redesign of Lincoln Center, the architecture firm in which she is a partner, Diller Scofidio & Renfro, has just won two major commissions — a new museum in downtown Los Angeles for the financier Eli Broad and a new Berkeley Art Museum and Pacific Film Archive for the University of California. The firm is also designing a major structure for the new Governors Island park and an inflatable meeting hall for the Hirshhorn Museum and Sculpture Garden in Washington that is due to open in 2012.

Yet the other day Ms. Diller was scrutinizing L.E.D. modules in a sign at Lincoln Center.

Such small details are commanding Ms. Diller's attention because what she refers to as Lincoln Center's electronic infoscape — the final elements of which are being installed this week — amounts to a great deal more than just signs. As Ms. Diller and her partners see it, the media elements are not just finishing touches: they are an extension, and in many ways the ultimate expression, of a wholesale reimagining of the complex as more porous, inviting and immediate.

This electronic component of the project includes — in addition to the words that have been adorning the risers of the new grand entrance stair on Columbus Avenue for the last few months — five screens at the back of the new bleachers facing Alice Tully Hall, scrolling text on the West 65th Street staircase to the north plaza, and 13 new vertical 4-by-8-foot L.E.D. screens, or blades, lined up along the south side of West 65th Street between Columbus and Amsterdam Avenues.

On top of the information they will provide about performances, the blades — 50 feet apart and facing east toward Columbus — will combine text and video images and are meant to enliven the street and convey the vitality and accessibility of the center.

“New Yorkers are notorious for passing anything,” said Reynold Levy, Lincoln Center’s president. “We think this will cause them to stop in their tracks and really take a look. We are endeavoring to create a feeling, engender a mood, provide a sense of the drama and the beauty of what goes on in our halls. We want to attract passers-by, but we also want to surprise Upper West Siders.”

From the start, Ms. Diller said, the infoscape was integral to the architects’ efforts to turn Lincoln Center inside out, so that it would no longer be, in her words, “just something carved out of stone.”

“The monumentality of the scale of the buildings really needed to be softened up by a different, pedestrian scale,” she added. “The media is really part of the architectural expression of that.”

The grand main staircase on Columbus Avenue, for example, with its informational text, is “an electronic welcome mat,” Ms. Diller said, “or a marquee that you step on.”

The architects also designed the content for the 24-hour blades, trying to make them informative, visually arresting and at times whimsical. The point is to make these screens “much more atmospheric and gestural and impressionistic” than mere posters, Ms. Diller said. There are 37 blade templates — video sequences of 20 to 90 seconds with different themes; they use both Lincoln Center performers and outside actors.

One of them provides a series of evocative single images — a conductor’s hands, a violin bow, someone applauding. Another features life-size pedestrians suddenly breaking out into dance on the sidewalk in their street clothes. Sometimes an image passes across all the blades sequentially, like one of hands moving up and down piano keys.

There is also backstage footage of performers getting ready — strings being tuned, toe shoes tied, makeup applied. And sometimes there are simply rundowns of the evening’s performances. The density of the information varies with the time of day. It is at its most concentrated in the pre-curtain hours. Later the blades revert to night mode, with quieter images, like one of someone sitting by the central fountain in silhouette, her feet dangling as the water bubbles up in the background. In another sequence a stagehand hauls a trunk off the stage, signaling the end of the work day.

The infoscape is among the final elements of the center’s redevelopment, which has included a new fountain, a new plaza, a refurbished Alice Tully Hall and a transformation of the West 65th Street block (including a narrowed street and a widened sidewalk). A few more projects still remain. These include a black-box stage for Lincoln Center Theater atop the Vivian Beaumont Theater, a new cinema for the Film Society of Lincoln Center, a glass bridge across West 65th Street that will connect the Juilliard School with the rest of the campus, and a new restaurant with a lawn for a roof on the north plaza, which is to open this month.

The Lincoln Center project has markedly raised the profile of Diller Scofidio & Renfro and has contributed to its recent flurry of large cultural commissions. Mr. Levy said that he took pride in the firm’s growing prominence.

“In a way Diller Scofidio & Renfro is a metaphor for what Lincoln Center tries to do with its performing artists,” he said. “Sometimes they’re discovered brand new, sometimes they’re promising but not wholly proven. We picked Diller Scofidio & Renfro when it was a surprise.” The firm’s growing success in the cultural realm, he added, is something “we like to think of as an affirmation and an appreciation of what they’ve done here.”

<http://www.nytimes.com/2010/09/02/arts/design/02lincoln.html?ref=design>

## Restoring the Studio of a Meticulous Sculptor

By EVE M. KAHN



Daniel Chester French, the sculptor best known for the saddened seated president portrayed in the Lincoln Memorial in Washington, lived tidily in studios full of plaster dust and stone chips. He wore a jacket and tie while sculpturing at his homes in Greenwich Village and the Berkshires. He kept meticulous records of his trips abroad, modeling and casting processes and clients' payments of tens of thousands of dollars for statues of politicians, soldiers and goddesses.

His daughter, Margaret French Cresson, an accomplished realist sculptor in her own right, made a public museum out of the family's estate in Stockbridge, Mass., named Chesterwood. In French's stuccoed backyard studio she displayed chisels, mallets and plaster casts of disembodied human limbs. In drawers around the main house, she stashed his archive, including minutiae like party invitations and canceled checks.

This summer the papers were taken away in a few vanloads. The National Trust for Historic Preservation, which took over Chesterwood after Ms. Cresson's death in 1973, gave them to the Chapin Library of Rare Books at Williams College. The Trust had long kept the boxes in the sometimes stuffy attic; when scholars stopped by to examine documents, the staff would have to run up and down the stairs.

"It was a difficult place" for maintaining climate controls and public access, said Donna Hassler, Chesterwood's director.

Chapin librarians are now digitizing pages and creating online indexes for French's 270 linear feet of files, and scholars are already poring through them. The college is preserving the Trust's detailed notes about where Cresson stored the sheets, like "second floor hallway, chest-on-chest, third tier drawer."



The library will lend pages for shows about French's work. "I like to use the word, and it's not pejorative, the 'exploitation' of this material for scholarship and exhibition," said Robert L. Volz, Chapin's head librarian. Because of Ms. Cresson's reverential treatment and the Trust's care, he added: "The collection is amazingly fresh. There's no paper deterioration."

Chesterwood will be sending its own researchers on the 45-minute drive north to Williams. They are exploring exhibition ideas with the Williams faculty, Ms. Hassler said, and preparing for a restoration of French's deteriorated studio.

"We are going to be studying period photographs," she said, "to understand what was in his studio in his lifetime, and what Margaret brought in."

## TOOLS OF YESTERYEAR

Andrew Alpern, a New York architectural historian, studied architecture at Columbia in the 1950s and nostalgically brought along some 1910s German drafting tools that he had inherited from his father. He had to twist knobs on the steel pens to widen his lines, tasks that now require just mouse clicks.

"Can you imagine how long it took to make a drawing, and then make a revision?" Mr. Alpern, 71, asked a few weeks ago while standing before display cases full of hundreds of vintage drafting instruments at the Avery Architectural and Fine Arts Library at Columbia. He collected them during the last 50 years and has donated them to Avery, which is exhibiting his gifts this fall in a basement gallery. He is the show's curator and wrote and helped finance its heavily illustrated catalog from W. W. Norton.

The boxed instruments sometimes cost him more than \$1,000 each at auctions, antiques stores and flea markets. The collection dates back to the 1710s and represents the luxurious materials of choice for European and American gentlemen architects, including ivory, silver, tortoiseshell and mother-of-pearl.

Mr. Alpern tosses around terms like "knurled knobs" and "opisometers" (instruments to measure curved lines) to explain how the tools worked and who used them. Cubes of dried pigment in a Victorian set suggest that the owner had a strained budget; he would have dissolved shavings from the cubes to create low-cost inks.

The owner's name, A. H. Locock, is engraved on the mahogany box lid; a Web search turned up few signs of Locock's professional success except for an 1897 award for an ironwork dragon. "This is the fellow who had the probably not enviable job of preparing all the detail drawings," Mr. Alpern said.

Next to the Locock box on the Avery shelves are ivory and silver tools made around 1880 for Samuel Verplanck Hoffman, a New York real estate heir who devoted much of his life to collecting astrolabes. He most likely used the monogrammed tool set only while studying engineering as a teenager; "it's so pristine," Mr. Alpern said.

Mr. Alpern gave the instruments to Columbia, he added, partly because stacked boxes had overrun his one-bedroom Manhattan apartment. "They were getting to be a lot of stuff, and I wasn't really looking at them all that much," he said.

He has also cleared out about 750 pieces of Edward Gorey memorabilia and given them to Columbia's Rare Book and Manuscript Library. Mr. Alpern often shopped at the Gotham Book Mart, Gorey's longtime gallery, and collected his prints, drawings and books, as well as licensed products like T-shirts, mugs and tote bags.







“I even have a heavyweight clear plastic shower curtain” with Gorey drawings of opera singers, Mr. Alpern said.

In a year or so Columbia will exhibit his Gorey gifts. He is using his somewhat rusty architectural drawing skills to design the library displays. The planning will distract him only slightly from his current shopping sprees: he now collects letter openers, inkwells and canes shaped like claws and skulls.

Friends gave him a few, he said, “and you know what you have to do with a collection: you have to feed it.”

### **MILLION-DOLLAR WINDOW**

The corner of 57th Street and Park Avenue, near Christie’s old headquarters, which closed in 1998, and around the corner from Bonhams, is becoming an auction hub. Across from Phillips de Pury’s three-story uptown branch slated to open in November, the Dallas-based Heritage Auction Galleries has installed offices and a gallery.

Its storefront window at 445 Park Avenue will be kept lighted around the clock for displays of coming auction lots. It opens on Sept. 1 with Garth Williams’s 1952 cover illustration for “Charlotte’s Web”; a 1939 Batman comic (consigned by the original owner, who paid 10 cents for it at a newsstand); and paintings including a 1903 Venice Grand Canal scene by Thomas Moran.

Estimates for objects behind the shatterproof glass will total at most \$1 million. “That’s the insurance limit,” said Gregory J. Rohan, Heritage’s president.

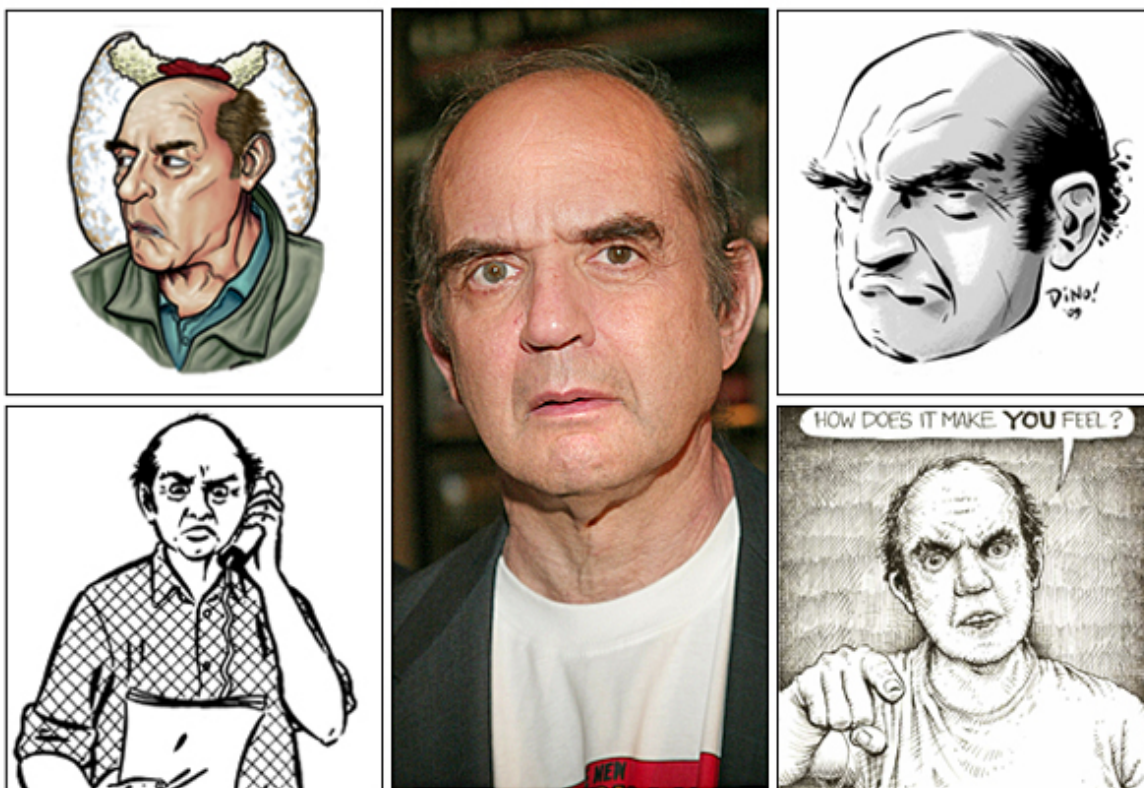
The company will not hold auctions inside the shoebox Park Avenue space; most lots shown there will be sold in Dallas. This fall Heritage will start conducting a few auctions a year at the Ukrainian Institute of America’s neo-Gothic town house on Fifth Avenue at 79th Street.

<http://www.nytimes.com/2010/08/27/arts/design/27antiques.html?ref=design>



## The Unfinished Tale of an Unlikely Hero

By DAVE ITZKOFF



DESCRIBING a walk through the garden outside her home in Cleveland Heights, Ohio, after a rainstorm, Joyce Brabner said she was looking for a dry place to sit and talk about how things have been going since the death of her husband, Harvey Pekar, the comic-book writer.

“He’s still dead,” Ms. Brabner said over the phone, in a characteristic display of resilience through black comedy. “When he comes back, rolls away the rock, I’ll let you know.”

It was the sort of unromanticized scene, mundane with an edge of mordancy, that Mr. Pekar might have liked to preserve in his long-running series of autobiographical comics, American Splendor, or in one of his many graphic novels.

But when Mr. Pekar died at 70 on July 12 — suddenly it seemed to some, but in painful stages as those closest to him knew — it brought an end to his compulsive chronicling of Cleveland’s commonplace lives, including, most frequently, his own.

Known for the irascible, self-doubting persona he cultivated in American Splendor and his day-to-day existence, the frizzy-haired, wild-eyed Mr. Pekar, a writer whose comics were illustrated by other artists, was an improbable candidate for lasting glory. A major influence in the underground world but never a big seller, he was always waiting for his cult fame to recede each time it unexpectedly crested.

His obsessive drive combined with the sheer number of his collaborations produced a two-dimensional record of his shaggy life, rendered in varying styles by numerous illustrators. Now only his widow and the artists he worked with are left to narrate his final chapter, a tale of bruised feelings and allegations of opportunism, with nothing more at stake than the writer's modest legacy. But no matter how it plays out, Mr. Pekar is bound to emerge as enigmatic as ever.

As Dean Haspiel, an artist who worked with Mr. Pekar in his final years, said in an interview, "There was never one version of Harvey."

"Put it this way," he added. "Nobody owns Harvey Pekar. Not even Harvey Pekar."

Beginning in the 1970s, when Mr. Pekar, a longtime file clerk at a Veterans Affairs hospital, started writing *American Splendor* at the suggestion of the cartoonist R. Crumb, he enjoyed brief brushes with fame, and was a recurring guest on "Late Night With David Letterman" in the 1980s.

But when an "American Splendor" film was released in 2003, starring Paul Giamatti as Mr. Pekar and Hope Davis as Ms. Brabner, it introduced Mr. Pekar to a new generation of artists who regarded him as a bohemian celebrity.

"There was always this dichotomy with Pekar," said Joseph Remnant, a Los Angeles illustrator who started working with him in 2008. "He had his sophisticated, avant-garde writing gig, and the next day he had to go to work in this hospital."

Younger colleagues revered Mr. Pekar as much for giving them their earliest breaks as for his personality quirks. They now speak fondly of his raspy voice, his fixations on work and money, and his general disregard for modern technology.

"He would still send faxes, long after no one else was sending faxes," said Josh Neufeld, who drew Mr. Pekar's stories for 13 years. "Sometimes he would call me up and dictate a script over the phone. Most of the time he would send it in the mail — snail mail."

Ms. Brabner, however, coped with Mr. Pekar's fragility along with his idiosyncrasies. His wife of 27 years and a guardian of their foster daughter, Danielle, Ms. Brabner, 58, a comics writer and political activist, helped nurse Mr. Pekar through his battle with lymphoma in the 1990s (as told in their graphic novel "Our Cancer Year") and then through a recurrence of the disease.

When Mr. Pekar was recently given another diagnosis of lymphoma, Ms. Brabner said she knew "he was really winding down."

"I had kind of conned him into thinking this third time was going to be like having the flu, for a while," she said. "But he knew."

In the final months of his life, Ms. Brabner said, her strategy was to "let Harvey be Harvey." She allowed him to lapse on his diet of organic foods and go back to keeping Beefaroni in the house and, she said, "Little Debbies and potato chips hidden in linen cupboards and underneath sofas."

Ms. Brabner was long accustomed to her husband's irrational fears, screaming nightmares and bouts of sleepwalking and depression, and to accommodating his neuroses. (If that meant, she said, "packing his things in transparent bags so he could find stuff, because he'd panic if he were traveling, I would do that.")

But his last illness took a toll on her. "He had real trouble getting up and doing things on a daily basis," Ms. Brabner said. "That made him vulnerable to some people. Some people exploited that."

Facing Mr. Pekar's degeneration, Ms. Brabner said, "it was my job to be the dragon, to be the guardian, to be the distraction."

Among the illustrators Mr. Pekar began working with in his final months was [Tara Seibel](#), a Cleveland graphic artist. Ms. Seibel, 37, can still recall the exact date — March 20, 2008 — of the panel discussion at a local college at which they struck up their partnership.

"I just sat down next to him," Ms. Seibel said, "and we just started talking like we had known each other for a long time. He felt very comfortable with me."

Ms. Seibel made no secret of her admiration for the pioneering comic work of Mr. Pekar, whom she described as "a 70-year-old hipster who loved listening to the [Beastie Boys](#) in the car." In turn he provided her with stories that she illustrated for publications like *Chicago Newcity*, [The Austin Chronicle](#) and [The Jewish Review of Books](#).

Ms. Seibel was also one of four artists whom Mr. Pekar invited to work on [the Pekar Project](#), which starting in 2009 was an effort to translate his work and persona to the Internet. Hosted by the Web site of [Smith magazine](#), an online publication, the Pekar Project published more or less weekly installments written by Mr. Pekar and drawn by a rotating team that also included Mr. Remnant and the artists Sean Pryor and [Rick Parker](#).

Hoping to duplicate the success of earlier graphic-book projects that began as Smith magazine Web comics (including Mr. Neufeld's nonfiction account of [Hurricane Katrina](#) survivors, "[A.D.: New Orleans After the Deluge](#)"), the Pekar Project contributors deferred compensation for their online work, with the possibility of a payday if a book was published.

"I totally understand, from a 20th-century point of view, why a deal like that might sound nuts," said Jeff Newelt, the Smith comics editor and editor of the Pekar Project. But with hard work and luck, he said, it could produce a graphic novel that "sells 60,000 or 70,000 copies instead of 5,000," instead of "getting 50 bucks up front and you're done."

The arrangement was different from what Mr. Pekar and Ms. Brabner were used to. "People think that they should get paid up front especially when they have a history of getting paid up front," said Mr. Haspiel, who runs his own Web comics site, [act-i-vate.com](#). But Mr. Pekar agreed to it because "he understood that you have to promote yourself, and you have to be out there constantly," Mr. Haspiel said. "Not only working with Joyce."

As the Pekar Project continued, it became apparent that Ms. Brabner was displeased with one contributor in particular: Ms. Seibel, the only female artist involved, and the only one who worked face to face with Mr. Pekar.

Ms. Seibel, whose husband and three children also became acquainted with Mr. Pekar, said that Ms. Brabner would abruptly pull Mr. Pekar out of their telephone conversations, and that she tried to interfere with a Brooklyn book-signing event at which Ms. Seibel appeared with Mr. Pekar in November. Ms. Seibel said Mr. Pekar told her these conflicts were “for him to worry about,” not her. “He put it under his business,” she said. (Ms. Brabner declined to comment on these matters.)

No one in their artistic circle believes the relationship between Mr. Pekar and Ms. Seibel crossed professional boundaries, but some could see how it strained Mr. Pekar’s marriage.

“A part of him was enjoying the attention he was getting from this very good-looking young woman,” said Mr. Parker, one of the Pekar Project artists. “And, naturally, Joyce, how could she enjoy that? You don’t have to be a psychologist to see that one’s not going to be good.”

Not even Mr. Pekar’s death quelled the tensions between Ms. Seibel, who has said she spent part of his last day alive with him, and Ms. Brabner.

Among her husband’s work with Ms. Seibel that Ms. Brabner has objected to is an illustration created for the catalog of “Graphic Details: Confessional Comics by Jewish Women,” an exhibition opening Oct. 1 at the Cartoon Art Museum in San Francisco. (Ms. Brabner said she was embarrassed that the show, ostensibly about Jewish women, is “being hyped by way of saying we’ve got an old dead Jewish guy.”)

Mr. Parker said he was contacted by Ms. Brabner, who wanted to “cut Tara out of the equation” of the Pekar Project’s work. Other people with direct knowledge of the project’s operations, but who did not want to speak for attribution for fear of offending Ms. Brabner, said she would not allow a book to be published if it included Ms. Seibel’s contributions.

Ms. Brabner said Mr. Pekar left no formal will but might have signed a draft still buried among his papers. In any case, she said, “I’m the one who decides about what gets published and what doesn’t in any venue.” She declined to comment on a possible Pekar Project book.

Mr. Newelt wrote in an e-mail that he hoped “we can still realize the vision of Harvey, myself and the team, and produce a wonderful Pekar Project book,” adding that Ms. Brabner “is a terrific writer herself, and I look forward to collaborating with her.”

Ms. Seibel said it would be “extremely wasteful” if this book were to be prevented from happening.

In any event, there are many posthumous works to come. Mr. Remnant is illustrating a graphic novel called “Harvey Pekar’s Cleveland,” about the city’s history and Mr. Pekar’s upbringing, for a new imprint called Zip Comics. Random House is publishing at least two more of his graphic books: one, called “Huntington, West Virginia, ‘On the Fly,’” in which Mr. Pekar reflects on promoting his movie and other books, and a second, written with Ms. Brabner, called “Harvey and Joyce’s Big Book of Marriage.” And Farrar, Straus & Giroux plans to publish “Not the Israel My Parents Promised,” about Mr. Pekar’s thoughts on Israel and Zionism, illustrated by JT Waldman, which Ms. Brabner is helping complete.

Mr. Haspiel, who illustrated Mr. Pekar’s 2005 autobiographical work “The Quitter,” said Mr. Pekar’s prolific output might have stemmed from his fears that he would die of Alzheimer’s disease, as both of his parents did.

“The guy was unstoppable,” Mr. Haspiel said. “Of course, when you really read his stuff, he could only write about one thing, and that was himself, or his worldview. Which is what kept everything honest.”

Mr. Neufeld, an American Splendor artist, said he was skeptical about whether the coming books would add to Mr. Pekar’s reputation. Emphasizing his reverence for Mr. Pekar and his work, Mr. Neufeld said, “I don’t think they’re going to be all that consequential in relation to all the other stuff he did.” He was, Mr. Neufeld said, “a legend already, not to overstate it.”

For now Ms. Brabner said her priority was burying Mr. Pekar’s ashes, near a spot in Cleveland where they walked on dates that he wrote about in American Splendor. “There’s nothing left,” she said. “He just looks like kitty litter.”

She joked that she might solicit pennies from Mr. Pekar’s fans to raise money for a statue in his likeness. “Things being what they are,” she said, “we’re probably going to be lucky to get one of his shoes. If it is his shoe, it’ll be a shoe that’s untied.”

Then she plans to return to the home that Mr. Pekar piled high with the vintage books and jazz records that she said were his true legacy. Imagining herself as an insect from Roald Dahl’s “James and the Giant Peach,” she said, “I can just sit here and nibble them from the inside out, like some caterpillar.”

<http://www.nytimes.com/2010/09/05/arts/design/05pekar.html?ref=design>



## A Cathedral to the Shrine of Nature

By **EDWARD ROTHSTEIN**



YELLOWSTONE NATIONAL PARK, Wyo. — The view from the cathedral-size windows of the \$27 million visitor center that opened here last week leads down a paved path toward a gently curved mound of rock. A mist of hissing steam drifts from the mound, but every 90 minutes or so, water starts to spurt fitfully, then more aggressively, until it erupts into a tower as high as 180 feet, whose spray may be spread by the breeze toward the hundreds of viewers gathered to watch the spectacle.

Old Faithful was the name given to this geyser by the 1870 team whose survey of these exotic wilderness lands helped inspire Congress to make Yellowstone a national park — the first land to get that designation. And names given by those early chroniclers still adhere to the geothermal phenomena they cataloged: Beehive Geyser, Mastiff Geyser, Old Faithful.

In this unearthly landscape — where gray mud pots emit burbling bubbles, where sickly blood-orange fluids seep into otherworldly green pools, where eye-burning sulfurous mist hisses from dim crevices — Old Faithful is almost mundane. It is neither the tallest geyser nor the most remarkable. It simply promises routine reliability. That means audiences know when to come and go.

And they do, in great numbers. The National Park Service, which maintains elaborate records, says that four out of five visitors to Yellowstone come to see Old Faithful; last year, that meant 80 percent of 3.3 million tourists. There is even a live Webcam so millions more can follow Old Faithful's doings.

But as the symbol of one of the country's most visited national parks, Old Faithful actually seems least faithful — least suggestive of untrammelled nature. From its measured eruptions to its paved surroundings, it can seem a manufactured extravaganza. Three hotels have grown around it, the most famous of which, the 1904 Old Faithful Inn, probably inspires far more gasps, with its fanciful, rustic, pine-log construction, than the famed geyser's jets of water. And as for spectacle, the Bellagio's Las Vegas fountains outdo nature, at least in this case.





Maybe that taming is part of the point: there is something about Old Faithful that seems to encapsulate all the passions and paradoxes of national parks. The Old Faithful Visitor Education Center acknowledges that: you enter the new building (designed by CTA Architects Engineers of Billings, Mont., to echo the inn and other park architecture) and you face a 36.5-foot-high pentagonal window space looking out on Old Faithful as if the geyser were the altar of a new form of cathedral.

Homage is being paid. The geyser is the center of attention as you enter the 26,000-square-foot building; its spacious entrance hall and peaked roof lead the gaze outward and upward. But the geyser is so carefully framed here, it can seem almost denatured. The center contains a bookstore, a gift shop, a theater for introductory films, a research area and a 4,500-square-foot exhibition space. It is grander than many Park Service facilities; the park has a private fund-raising associate, the Yellowstone Park Foundation, which collected \$15 million in donations, matched by \$12 million in federal money. Nature is here being presented for the delight of millions, and if it isn't seen from behind glass, it might as well be.

The building is also meticulously deferential to nature. Signs explain its LEED certification as a "green" building with minimal environmental impact. Almost all the construction waste was recycled; the floors and exhibition components are made from renewable resources. The building's shallow foundation does not interfere with the subterranean hydrothermal systems that produce the exquisite effects outside. Nature is deferred to and seems to return the compliment.

A happy balance, then? Not really, and this is the tension of the park experience. In the lobby, displays present maps of geyser activity, but also show warnings: "Danger! Hot Water Can Kill." Bears, we learn, attack; bison gore. One book sold here is "Death in Yellowstone: Accidents and Foolhardiness in the First National Park" by Lee H. Whittlesey. There is the 1981 incident of the man who leapt into a 202-degree hot spring to rescue his dog, both perishing, and the 1970 tragedy of the 9-year-old boy who fatally jumped or slipped into another pool. In Yellowstone, whose geothermal areas are generally seen by driving from one hot spot to another, it can be easy to forget this is not a theme park.

The center, though, reminds us that this is nature tamed, not nature made harmless. And for all its fierceness, we learn, nature is also fragile. Soldiers housed in the park a century ago used Old Faithful to do their laundry with no lasting ill effects, but other geysers have been stifled by human carelessness. Springs and pools are viewed by walking on boardwalks, protecting nature and humans from each other.

So nature here is carefully packaged. And the center's exhibition shows why, examining the fearsome geological forces that have shaped this section of the park. Designed by Christopher Chadbourne & Associates of Boston and shaped by Linda Young, Yellowstone's chief of interpretation, and other park educators, the exhibition could have been stronger had it been more ambitious. But as is, it clearly explains the phenomena. It shows in patient (and sometimes repetitive) displays that Yellowstone is not only on a 40-some-mile-wide caldera — the crater from a volcanic eruption about 640,000 years ago — it actually also lies on the surface of a live volcano, its land mass undulating on a chain of magma.

That molten rock's interactions with waters seeping downward create a topography with more hydrothermal phenomena than any other site in the world. Pressurized waters are heated well over the boiling point and then periodically burst through constricted channels. Gases of subsurface boilings escape through rocks like steam from radiator valves; mild eruptions and earthquakes are regularly felt. Yellowstone is a laboratory of geological change, which is how, some displays here show, it is also being studied.

Touch screens can lead you through some of the more dramatic Yellowstone features, like Morning Glory Pool, whose spectacular flowerings were thwarted by generations of visitors tossing in coins and clothing, and the Mud Volcano, which erupts rarely but fills the air with the stench of hydrogen sulfide gas.

Some exhibits are less imaginative, including those that survey the remarkable scientific research now taking place or catalog the range of the waters' acidity across the park. But in the Young Scientist gallery, everything becomes vividly concrete. That room includes an enclosed ceiling-high geyser, with adjustable dials, a model created by the Exploratorium in San Francisco. Another display, using jawbone models, shows why animals in the hydrothermal areas of the park tend to live shorter lives: silica deposits on vegetation prematurely wear away their teeth.

It is here, too, that we learn that Old Faithful's schedule is estimated from the length of a previous eruption: a shorter display of waterworks means pressure below will build up more quickly. Such examples would have made the main exhibition more compelling as well.

But Ms. Young explained in an e-mail that, unlike most museums, a visitor center is not the main destination; the park is. So people will spend widely varying amounts of time here before rushing out for the real thing. The exhibition seeks to prepare the visitor. It can also act as a supplement, with the Web site ([www.nps.gov/features/yell/ofvec/exhibits/index.htm](http://www.nps.gov/features/yell/ofvec/exhibits/index.htm)) offering even more details.

But still, more could have been done. Other visitor centers in the park focus on particular geological features. In this main center, perhaps the history and nature of the park itself could have been explored as well, offering some hint of the strangeness and importance of the enterprise. We visit this park and confront not nature, but managed nature, in the midst of which we find nearly unmanageable human controversies.

The Yellowstone study "Resources and Issues 2010," for example, examines some of the unexpected consequences of reintroducing animal species once native to the park, like wolves, or the troubling results of the accidental introduction of lake trout. Bear and bison populations, we learn, are not simply left in a state of nature: they too are managed. And that is not an easy matter. The effects of managed nature can be seen in the walkways, the guard rails and this new visitor center, but also in the landscape: after the 1988 forest fires that scarred almost 800,000 acres — 36 percent of the park — the policy of letting naturally caused fires burn without human intervention was revised. Walk far enough along the trails here, and charred logs can still dominate the barren landscape.

But at least in the area around Old Faithful, it is difficult to interfere much with nature's own organization. When the pioneering naturalist John Muir visited Yellowstone in 1898, he wrote: "The air is electric and full of ozone, healing, reviving, exhilarating, kept pure by frost and fire, while the scenery is wild enough to awaken the dead." He said it was as if nature had gathered from all over the world "specimens of her rarest fountains, to show in one place what she can do" — an exhibition to which any human curatorial effort must defer.

The Old Faithful Visitor Education Center is in Yellowstone National Park, Wyoming; [nps.gov/yell](http://nps.gov/yell).

<http://www.nytimes.com/2010/08/31/arts/design/31yellowstone.html?ref=design>

## A Fix for Bare Walls

By **JOSEPH BERGER**



THE first thing you need to know when entering Philip Williams Posters is the definition of the word “poster.” A poster, at least according to Philip Williams, is not necessarily a lithograph or an art print or a reproduction.

“I like to say that it’s something designed by artists to compel you to do something — give money, join the army, see an exhibition or inform you,” said Mr. Williams, a decorous, soft-spoken man of 61.

“Posters were the first opportunity that an average person could have a nice colorful work in their house,” he said. “In France, everyone did posters — Picasso, Matisse — and there wasn’t the distinction between high art and low art we have here.”

Mr. Williams has more than 100,000 of these, perish the words, advertisements and propaganda, in his block-long, three-floor, Civil War-era store on Chambers Street near City Hall. He calls his the world’s largest poster shop, and as someone who prowls the globe for posters, he may know.

He has sold a Toulouse-Lautrec for \$250,000, but do not let that intimidate you. You can buy a small Obamaman for \$15 as well. He has gems like an 1895 advertisement for lait stérilisé (pasteurized milk) by the Swiss-born master Théophile Steinlen (\$30,000); a 1950s ad for the film “Ladri di Biciclette,” (“The Bicycle Thief”) which, felicitously, is about an Italian who plasters posters to eke out a living after World War II (\$650); an 1897 bill for Barnum & Bailey, the owners looking like stodgy bankers to counter the circus’s sleazy reputation (\$600); and a 1947 boast about how well “Mr. and Mrs. Average American” live (\$250).

The posters, many backed with canvas, are piled on tables, rolled up in tubes or pinned to the walls of the 187-foot-long ground floor, where the 15-foot ceilings are molded tin and the water pipes run naked just below. In the clutter, Mr. Williams can spot what a customer is looking for in seconds — the arrangement is largely in his brain, though he relies on a computer for backup.



Mr. Williams is the son of an Army sergeant who dragged him to bases in Alaska, the Philippines and Europe, where posters decorating kiosks and sewer vents may have been his Rosebud. Drawn to New York as a teenager, he spent more than a few days homeless and hungry, but found work in construction. He asked a contractor if he could buy trunks stashed in a hotel basement, and one turned out to contain three letters by Orville Wright. The \$1,200 he made selling the letters led to a leased nook in an antique shop, where he discovered that posters were an increasingly popular way to decorate homes.

Now he gets hedge-fund operators looking for investments, movie stars seeking a personal statement for their dens, and curators. For an exhibit on censorship, a Berlin museum wanted a poster of German soldiers hurling books into a bonfire. Parents look for circus posters for a child's room; others seek something edgier and darkly psychological to stimulate dinner conversation.

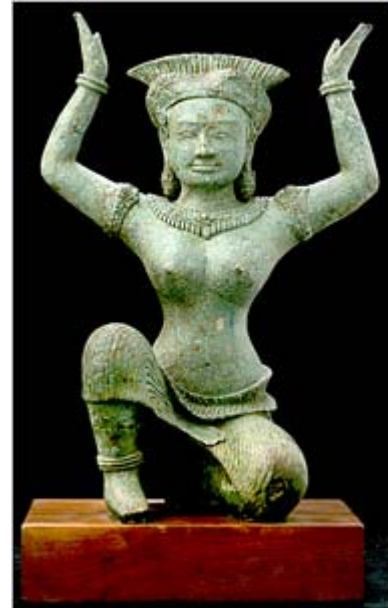
Once there were several dozen vintage-poster stores in the city, but now there are only a few.

“This is what New York is about, these kind of quirky shops,” Mr. Williams said. “We’re part of that vanishing New York where something quirky can make a living.”

<http://www.nytimes.com/2010/08/29/nyregion/29joint.html>

## **Emerald Deities of Fervor and Flux**

By **HOLLAND COTTER**



WASHINGTON — “From whatever vantage point we look, if we are prepared to look historically, civilizations reveal themselves to be processes and not things.” These true words by Sheldon Pollock, a scholar of Sanskrit and Indian history at [Columbia University](#), also apply to art.

As fixed and solid as they seem, art objects never stay still. They are not the same from one century, or second, to the next. Not only do they change in meaning and value through time, but they also change physically. With their molecules flying off into space, they grow lighter and smaller and, if we’re paying attention, more insistently alive.

So if on a visit to “Gods of Angkor: Bronzes From the National Museum of [Cambodia](#),” at the [Arthur M. Sackler Gallery](#), you imagine Buddhas and Shivas hovering and buzzing around you like so many emerald green hummingbirds — here, gone, here again — you won’t be entirely wrong.

This compact exhibition of 36 metal sculptures is literally about change, or rather about attempts to reverse and forestall it. Between 1975 and 1979, the [National Museum of Cambodia](#) in Phnom Penh, one of the jewels of Southeast Asia, was all but destroyed. [Khmer Rouge](#) purges wiped out much of its staff; its buildings, abandoned, were disintegrating. The art that didn’t disappear was severely damaged.

In the decades since, the museum has struggled to become again what it was, but also something different, more modern. And other institutions have lent a hand in the recovery. In 2005 the Freer and Sackler galleries, collaborating with the Getty Foundation in Los Angeles, provided financial and technical support for the Cambodian museum’s first metal-conservation laboratory, primarily for the care and study of the collection’s magnificent bronzes.

This Sackler show — organized by Paul Jett, head of conservation at the Freer and Sackler, and Louise Allison Cort, curator of ceramics there — demonstrates some of the results of that care. It is also a reminder of how crucial is the search for fresh news from the past, a past that is every bit as much in flux as the present, and just as easy to miss if we're not looking.

For ancient art from Southeast Asia, we need every scrap of news we can get. Even the most basic facts elude us. We have no clear idea, for example, of when metal casting arrived in Cambodia, or where it came from when it did.

A prehistoric bronze urn in the exhibition, pear-shaped and stamped with fiddle-head scrolls, has stylistic links to China, but with its archaeological recovery spot unrecorded, there's no way to tell where it was actually made, or why. All we know is a little about its peripatetic recent history: before it came to the National Museum, it was being used by farmers to transport water.

Cambodian traditions for casting figures in metal seem to have had two influences, Chinese and Indian. Seven pintsize bronze Buddhist figures, dating from the sixth and seventh century A.D., point to both. Dug up in a village garden in 2006, these little statues were the first beneficiaries of the museum's metal conservation and they glow, their patinas a powdery, succulent green.

Two are pretty clearly Chinese imports. Of the other five, three show evidence of Indian-inspired art trends from central Thailand. The remaining pair are in a homegrown Cambodian Khmer style. Together, they form a visual essay in cultural volatility, from a time when people everywhere were on the move.

Chinese monks were making their way through Southeast Asia to the Buddhist holy spots in India, toting sculptures and leaving some en route. In India, the Buddhist monastic universities were sending missionaries, equipped with icons, eastward by sea, while Hindu priests from temple cities like Chidambaram were heading east too.

With so much commotion, change was inevitable, both within indigenous Southeast Asian religions and within Buddhism and Hinduism. Art was changing too, though seldom in easily definable ways. The only thing you can say with absolute certainty about those village-garden Buddhas is that no two are exactly alike. In religious art, variety and experimentation were the names of the game, within certain bounds.

Cambodia's religious history was not, it should be said, only or even primarily Buddhist. The favored religion of the Khmer empire during much of its span from the 9th through the 13th centuries was Hinduism. The fabled city of Angkor Wat was a Hindu monument with Buddhism folded in. Angkor Thom, built later by the ruler Jayavarman VII, was Buddhist but with a Hindu overlay.

And the intermingling of faiths came with complications. Hinduism and Buddhism were each divided into separate strains. Cambodia's ancestor-centered native religions were vital and popular. So were royal personality cults promoted by self-celebrating Khmer kings.

In short, the varieties of religious experience available in ancient Cambodia were many and interlocking. Little wonder that the Chinese diplomat Zhou Daguan, visiting Angkor in 1296, mistook a colossal Vishnu for a Buddha. It was easy enough to do.

Visual distinctions between religions, like doctrinal differences, were often vague. This is true at the Sackler. One impressive 10th-century figure of a broad-shouldered, four-armed male deity could be either Hindu or

Buddhist. We might be able to tell if we could see the symbols in his crown. But at some point his head was knocked off and lost, so we'll never know.

Even intact sculptures can be baffling. Another multi-armed figure, dressed in a hip-hugging kilt, is for sure a Hindu god, but which one? The items in his hands — an orb, a conch shell, a disc, a mace — belong to Vishnu. But the towering Ronettes hairdo says Shiva loud and clear. As it turns out, he embodies three separate but equal aspects of Vishnu, one of which resembles Shiva in his crazy-sadhu mode.

But to learn the identity of this symbol-stoked icon is only to begin to know it. The closer you look, the more meanings emerge, and, for a devotee, the more intense the mystical potential grows. In some ways, the art experience and the religious experience are similar. In both, specific objects reveal their vitality and agency. They can change you, and you, with your attention, change them. You create them as surely as the artist did because psychically you complete them, make them fully exist.

The trinitarian Vishnu, with its avian features and miss-nothing eyes, has been in Washington before, in 1997, in a much grander exhibition called “Millennium of Glory: Sculpture of Angkor and Ancient Cambodia” at the National Gallery of Art. Some half-dozen of the bronzes at the Sackler were in that show too, including the exquisite figure of a kneeling woman with upraised hands — she probably supported a mirror — and a sculpture of the Buddha seated on the coiled body of a snake and flanked by a male and a female attendant.

This intricate ensemble may have been made for Jayavarman VII, the last major Khmer king. And its image, combining absolutist politics, divinity and autobiography, became a sort of logo for his reign. He routinely commissioned idealized portraits of himself; in stone sculptures, the faces are so inhumanly smooth and serene that they seem bathed in mist. And he peppered his domain with them. In this bronze — small enough for a private shrine or for carrying in processions — he's depicted as the Buddha, with his mother and father, in the guise of bodhisattvas, standing on either side.

After the king's death, the imperial enterprise began to wind down. In 1431 Thai armies seized Angkor, which was then abandoned as the Khmer shifted their capital to what is now Phnom Penh. In that city, centuries later, the bronzes visiting the Sackler have found a museum home, where they continue to be works very much in progress, losing substance, but also gaining it thanks to conservation, as they purposefully float, ever-changing, through time.

“Gods of Angkor: Bronzes From the National Museum of Cambodia” remains through Jan. 23 at the Arthur M. Sackler Gallery, Smithsonian Institution, 1050 Independence Avenue SW, Washington; (202) 633-1000, [asia.si.edu](http://asia.si.edu).

<http://www.nytimes.com/2010/08/27/arts/design/27sackler.html?ref=design>



## Who's the Voyeur Now, Picasso?

By KAREN ROSENBERG



WILLIAMSTOWN, Mass. — Degas and Picasso make an odd couple, a Realist-Impressionist and a restless Modernist born nearly 50 years apart. But their relationship, as seen through the Sterling and Francine Clark Art Institute's "Picasso Looks at Degas," isn't the tempestuous kind typical of blockbuster shows. Neither a partnership ("Picasso and Degas") nor a competition ("Picasso/Degas"), it's about one artist regarding another, calmly and from a distance.

The title tells us that Picasso is the subject, Degas the object, but it's not always clear who's doing more looking. Degas, after all, is the notorious voyeur, whose fly-on-the-wall views of women bathing, dancers resting between scenes, and prostitutes awaiting customers are in turn, in this exhibition, surveyed by Picasso.

The Clark is the only North American stop for the show, which runs through mid-September and is the perfect coda to a summer of Picasso in New York's museums. Its organizers, the Picasso expert Elizabeth Cowling and the Degas scholar Richard Kendall, have wrangled some extraordinary loans and assembled some inspired pairings (as well as an excellent catalog). In the process they have found a revealing new angle on Picasso and exposed Degas as a proto-Modernist, if not quite on par with Cézanne.

We don't know whether the artists ever met, although their studios in Paris were just blocks from each other in the first decade or so of the 20th century. As a young artist in Spain, Picasso encountered reproductions of Degas's work; in Paris he had many opportunities to see it in person. But his most intimate acquaintance with Degas came only after the elder artist's death in 1917, when the contents of his studio — including many unfinished works — were displayed and sold in a series of very public auctions.

At the Clark the raw and unpolished version of Degas is much in evidence — a refreshing change from the sanitized, Impressionist-focused presentation to which we are accustomed. The show gives us Degas as Picasso saw him: an artist with a classical hand and a modern eye, who idolized Ingres but indulged in coarser and more outré forms of eroticism.

The show's first few galleries delve a little too deeply into the early lives of both artists in an effort to show parallels: Picasso and Degas were strong draftsmen, with overbearing fathers who pushed them to specialize in portraiture. The works of interest here — there aren't many — include Picasso's expressive sketch of his sister Lola and a preparatory drawing for Degas's gloomy group portrait "The Bellelli Family."

After this false start the show begins in earnest with Parisian cafe scenes by both. From the Musée d'Orsay comes Degas's marvelously bleak painting of a woman slumped over her glass, "In a Café (L'Absinthe)"; it hangs next to a boozy blue-period Picasso from the [Los Angeles County Museum of Art](#), "Portrait of Sebastia Junyer i Vidal."

Yet the link to Degas feels a bit forced: To Picasso, Degas was one cafe-goer among many; a small oil sketch of a male cabaret audience, "Stuffed Shirts," finds Picasso emulating Toulouse-Lautrec.

Two striking paintings of dark-eyed women, Picasso's "Portrait of Benedetta Canals" and Degas's "Woman With an Umbrella (Berthe Jeantaud)," make a deeper connection. Degas knew Mme. Canals, who was a friend of Picasso's lover Fernande Olivier, but the point made by these paintings is that he and Picasso were acquainted through [Goya](#).

Among the exhibition's numerous images of women at their toilette, no third-party introduction is needed. Picasso's blocky nudes of around 1906 respond, clearly enough, to the physical awkwardness and perverse sensuality of Degas's crouched bathers. And decades later his violent painting "Nude Wringing Her Hair" (1952) picks up on the masochism inherent in Degas's paintings and drawings of women yanking brushes through their tresses.

But as another pairing shows, Picasso also grasped Degas's sympathy for working women. In 1904 he made a painting after Degas's "Woman Ironing," translating the earlier work's sturdy Parisian laundress into a pinched figure with a bony, raised shoulder.

He could sometimes be oblivious to subtleties in Degas, a point reinforced by two sculptures of pregnant women. Degas's small bronze statuette bends slightly at the waist, cradling her belly in her palms. Picasso's version, a straight-backed figure with milk jars for bosoms, is more grotesque than tender.

The show includes many other small bronzes by Degas, some of which were cast after his death from wax molds found in his studio. They relate closely to the paintings and drawings, emphasizing a tendency (shared by Picasso) to slip back and forth between mediums.

Degas's most famous sculpture, "Little Dancer, Aged Fourteen," anchors a brilliant, and mischievous, grouping in the next gallery. This snub-nosed, pubescent diva is flanked by two Picasso paintings: one of a dwarf in a tutu and another of a come-hither nude in the style of his "Demoiselles d'Avignon." Both figures ape the little dancer's pose, with their hands behind their backs.

Other sculptures and works on paper flesh out the ballet theme, including two luscious Degas pastels from the Clark's collection that show dancers catching their breath in the wings. Picasso had his own reasons for

lurking backstage; drawings and family photographs remind you that one of his wives was the ballerina Olga Khokhlova.

The Picassos here, like most of the works in the previous galleries, date from the first two decades of the 20th century. At this point you may start to wonder whether Degas had any real hold on Picasso after that time. The answer is in the next and final gallery, and it will surprise you.

On view is a series of 39 etchings made by Picasso in 1971, just two years before his death. It's a lucid, highly specific response to a group of monotypes by Degas, known informally as the "brothel series" and based on the close observation of Parisian prostitutes.

Only a few of these louche, smeary prints are at the Clark, but you can see reproductions commissioned by the dealer Ambroise Vollard (who, in all likelihood, introduced Picasso to this furtively circulated body of work). Picasso was taken with the monotypes, and in the late 1950s he finally had the opportunity to buy some of them. He already owned a photograph of Degas, which he kept in his Cannes studio.

The women in Degas's pictures are scantily clad but not very active; what they do, mostly, is wait. In Picasso's etchings they're Gorgon-faced exhibitionists who intimidate potential clients with enlarged, mazelike genitals. More shocking, though, is the presence of Degas as a recurring character in this oversexed narrative. (And it is most certainly Degas; the titles mention him by name.)

He's most often shown in profile, peering in from the edge of the composition with wide saucerlike eyes. In one scene he has his hands clasped behind his back, as does the prostitute standing in front of him — a pair of "Little Dancers." In another he's there twice, as customer and spectator.

What, exactly, is Picasso doing here? Why, at the end of his life, did he summon an artist associated with the 19th century? Was he using Degas, who was reportedly celibate, to satirize his own sexually voracious reputation? Identifying as an outsider, a voyeur on the art world of the 1960s and '70s? Letting it all hang out, a privilege of old age?

Maybe he was simply reminding us that art is about finding distance, even in close proximity. And that Degas had been in the room, with him, all along.

"Picasso Looks at Degas" continues through Sept. 12 at the Sterling and Francine Clark Art Institute, Williamstown, Mass.; (413) 458-2303, [clarkart.edu](http://clarkart.edu).

<http://www.nytimes.com/2010/08/27/arts/design/27picasso.html?ref=design>

## When Stoic Samurai Faced the Camera

By MARTHA SCHWENDENER



It's obvious from the start that "Samurai in New York" isn't going to be about robed warriors taking the city, in spite of the sensational name. The show's subtitle — "The First Japanese Delegation, 1860" — makes that pretty clear, and the introductory wall text spells it out: The visit in question, 150 years ago, was "all about trade," a matter of setting up a business agreement.

And yet "Samurai" is one of those small, in-the-hallway exhibitions at the [Museum of the City of New York](#) that delivers more than you'd expect. In this case it offers a lot to think about in terms of photography and its role in early publicity and celebrity culture as well as a fascinating look at how different societies responded to 19th-century stirrings of globalization.

The event commemorated is significant: a visit to the United States by more than 70 samurai, elite members of the Japanese military, who were the first known group to leave Japan in more than 200 years. The reasons for this isolation date back to the 17th century, when the ruling Tokugawa Shogunate closed the country in response to the efforts of Spanish and Portuguese missionaries to convert Japanese to Catholicism. After 1630 no foreigners could enter the country, and no Japanese could leave, on penalty of death.

The visit was possible after Commodore Matthew C. Perry of the United States sailed into Tokyo Bay in 1854, after being dispatched by [President Millard Fillmore](#) on the errand, and reached a trade agreement with the Japanese. Six years later the samurai were sent to deliver a treaty of amity and commerce to [President James Buchanan](#) and ordered to avoid fraternizing with their American hosts. But good old aggressive American hospitality took over. There were parades and parties, and [Walt Whitman](#) even wrote a poem, which was printed on Page 2 of The New York Times. And the samurai were asked to pose for photographs.

“Ever since our arrival at the American capital,” Norimasa Muragaki, an ambassador, wrote in his diary on June 4, 1860, in Washington, “we have frequently been asked by photographers to allow our photographs to be taken, but we have hitherto refused, as it is not the custom in our country. Today, however, we had to submit, in deference to the President’s wishes.” He ended, “We therefore, for the first time, faced the photograph machine.”

After that initial session, the samurai — particularly lower-ranking members — spent plenty of time facing cameras. The show includes a silver print of a photograph by Mathew Brady of samurai with United States naval officers, taken in the Washington Navy Yard. A reproduction of an illustration from Frank Leslie’s *Illustrated*, a weekly newspaper, shows Brady, later known for his grisly Civil War pictures, with a box camera, photographing the gifts brought by the Japanese. Here you can see how, in the 1860s, the proto-photojournalist with a camera the size of a television console was still working in the shadow of the sketch artist.

The most interesting objects, however, are the small cartes-de-visite photographs, which in the cases of famous subjects like the samurai were treated as trading cards, and the stereographic images, printed on cards that would be inserted into viewing devices. The samurai’s poses are stiff and formal: not only an exigency of early photography — the need to hold still — but also evidence of Bushido, the strict code of behavior to which the military elite was bound.

In one photograph a young man wears traditional samurai dress but also Western leather shoes. Another shows a woman, identified only as a “New York Lady” flanked by members of the delegation. Painted studio backdrops create even odder juxtapositions, as the “exotic” samurai pose in front of palm trees or what appear to be scenes of India or Classical Greece or Rome. (A clue to which Americans might have been particularly interested in these images: The photograph of the samurai in leather shoes is owned the Peabody Museum of Archaeology and Ethnology at [Harvard University](http://www.harvard.edu).)

The jarring collision of cultures is also seen in a Japanese woodcut commissioned by one of the delegates upon his return home. In it a hot-air balloon with two American flags poking out of its basket rises up over a couple of gentlemen in Western top hats. The print also features a haiku in Japanese calligraphy, describing the event witnessed by its author during the Philadelphia leg of the trip.

“Samurai in New York” presents the visit as an extraordinary moment for both countries, but especially the one that had been closed to the world for so long. Americans could take credit for introducing the Japanese to photography. But the delegates might have picked up something else as well. A week before their departure in June 1860 an article appeared in *The New York Times*, describing the delegates’ activities. “Their baggage already increases to such huge proportions,” it said, “that even the capacious ‘Niagara’ bids fair to be well filled, and still they shop.”

Unfortunately no photographs of these shopaholic samurai are included in the show.

“Samurai in New York: The First Japanese Delegation, 1860” runs through Nov. 7 at the Museum of the City of New York, Fifth Avenue at 103rd Street; [mcity.org](http://mcity.org).

<http://www.nytimes.com/2010/08/27/arts/design/27samurai.html?ref=design>

## Finding Suggests New Aim for Alzheimer's Drugs

By GINA KOLATA



In a year when news about Alzheimer's disease seems to whipsaw between encouraging and disheartening, a new discovery by an 84-year-old scientist has illuminated a new direction.

The scientist, Paul Greengard, who was awarded a Nobel Prize in 2000 for his work on signaling in brain cells, still works in his Rockefeller University laboratory in New York City seven days a week, walking there from his apartment two blocks away, taking his aging Bernese mountain dog, Alpha.

He got interested in Alzheimer's about 25 years ago when his wife's father developed it, and his research is now supported by a philanthropic foundation that was started solely to allow him to study the disease.

It was mostly these funds and federal government grants that allowed him to find a new protein that is needed to make beta amyloid, which makes up the telltale plaque that builds up in the brains of people with Alzheimer's.

The finding, to be published Thursday in the journal *Nature*, reveals a new potential drug target that, according to the prevailing hypothesis of the genesis of Alzheimer's, could slow or halt the devastating effects of this now untreatable disease.

The work involves laboratory experiments and studies with mice — it is far from ready for the doctor's office. But researchers, still reeling from the announcement two weeks ago by Eli Lilly that its experimental drug turned out to make Alzheimer's worse, not better, were encouraged.





“This really is a new approach,” said Dr. Paul Aisen, of the University of California, San Diego. “The work is very strong, and it is very convincing.” Dr. Aisen directs a program financed by the National Institute on Aging to conduct clinical trials of treatments for Alzheimer’s disease.

Over the past few years, research on Alzheimer’s has exploded. Now, Dr. Aisen said, about 200 papers on the subject are published each week. There are new scans and other tests, like spinal taps, to find signs of the disease early, enabling researchers to think of testing drugs before patients’ brains are so ravaged. And companies are testing about 100 experimental drugs that, they hope, will fundamentally alter the course of Alzheimer’s disease.

Most of the new drugs focus on an enzyme, gamma secretase, that snips a big protein to produce beta amyloid. The problem in Alzheimer’s is thought to be an overproduction of beta amyloid — the protein is made in healthy brains but, it is thought, in smaller quantities. Its normal role is not certain, but researchers recently found that beta amyloid can kill microbes, indicating that it might help fight infections.

But gamma secretase has crucial roles in the body in addition to making beta amyloid. It removes stubs of proteins left behind on the surface of nerve cells and is needed to make other proteins, so completely blocking it would be problematic. Many scientists think that was what went wrong with the Eli Lilly drug, which, researchers say, took a sledgehammer to gamma secretase, stopping all of its functions. Other companies say their experimental drugs are more subtle and targeted, but they may still affect the enzyme’s other targets.

Dr. Greengard found, though, that before gamma secretase can even get started, the protein he discovered, which he calls gamma secretase activating protein, must tell the enzyme to make beta amyloid. And since that newly discovered protein is used by the enzyme only for beta amyloid production, blocking it has no effect on the other gamma secretase activities.

It turns out that the cancer drug Gleevec, already on the market to treat some types of leukemia and a rare cancer of the digestive system, blocks that newly found protein. As a consequence, it blocks production of beta amyloid. But Gleevec cannot be used to treat Alzheimer’s because it is pumped out of the brain as fast as it comes in. Nonetheless, researchers say, it should be possible to find Gleevec-like drugs that stay in the brain.

“You could use Gleevec as a starting molecule,” said Rudolph Tanzi, a neurology professor and Alzheimer’s researcher at Harvard Medical School. “You could change the structure a little bit and try analogs until you get one that does what Gleevec does and does not get kicked out of the brain. That’s possible.”

On a clear, cool summer day last week, Dr. Greengard told the story of his discovery. He sat in a brown chair in his office on the ninth floor of an old stone building on the meticulously landscaped grounds of the university, wearing a soft yellow V-neck sweater and thick-soled black shoes. Alpha lay quietly at his feet.

Dr. Greengard’s assistant ordered lunch — cantaloupe wrapped in prosciutto; ravioli filled with pears, mascarpone and pecorino Romano; cherries; and cookies. But Dr. Greengard, caught up in the tale of his science, asked her to hold off bringing in the food.

“I thought, this is just a horrible disease and maybe there is something I can do about it,” he said.

About a decade ago, Dr. Greengard and his postdoctoral students made their first discovery on the path to finding the new protein — they got a hint that certain types of drugs might block beta amyloid production. So



they did an extensive screen of drugs that met their criteria and found that one of them, Gleevec, worked. It completely stopped beta amyloid production.

That was exciting — until Dr. Greengard discovered that Gleevec was pumped out of the brain. Still, he found that if he infused Gleevec directly into the brains of mice with Alzheimer's genes, beta amyloid went away.

"We spent the next six years or so trying to figure out how Gleevec worked" on gamma secretase, Dr. Greengard said. He knew, though, that he was on to something important.

"I had very little doubt about it," he said. "If I have an idea, I have faith in it, that it must be right."

The system he discovered — the gamma secretase activating protein — made sense, Dr. Greengard said.

"Gamma secretase belongs to a family of proteins called proteases," he explained. Proteases chop proteins into smaller molecules. But often proteases are not very specific. They can attack many different proteins. "Obviously, you can't have that kind of promiscuity in a cell," Dr. Greengard said. There has to be some sort of control over which proteins are cleaved, and when.

So, Dr. Greengard said, "what evolved is that proteases invariably have targeting proteins that help them decide which proteins to go after."

That was what he had found: a targeting protein that sets in motion the activity of gamma secretase, which makes beta amyloid. To further test the discovery, he genetically engineered a strain of mice that had a gene for Alzheimer's, but he blocked the gene for the gamma secretase activating protein. The animals appeared to be perfectly healthy. And they did not develop plaques in their brains.

For Sangram S. Sisodia, an Alzheimer's researcher at the University of Chicago, that mouse experiment was critical.

"That was the proof of concept," he said. It meant that Dr. Greengard was correct — the newly discovered protein, when blocked, does not seem to interfere with other crucial functions of gamma secretase.

"That is good news," Dr. Sisodia said.

As for Dr. Greengard, he said, "I couldn't be more excited.

"I am sure there will be a fervor in the field."

<http://www.nytimes.com/2010/09/02/health/research/02alzheimer.html?ref=science>

## Does Your Language Shape How You Think?

By GUY DEUTSCHER



**Seventy years ago, in 1940, a popular science magazine published a short article that set in motion one of the trendiest intellectual fads of the 20th century.** At first glance, there seemed little about the article to augur its subsequent celebrity. Neither the title, “Science and Linguistics,” nor the magazine, M.I.T.’s Technology Review, was most people’s idea of glamour. And the author, a chemical engineer who worked for an insurance company and moonlighted as an anthropology lecturer at Yale University, was an unlikely candidate for international superstardom. And yet Benjamin Lee Whorf let loose an alluring idea about language’s power over the mind, and his stirring prose seduced a whole generation into believing that our mother tongue restricts what we are able to think.

In particular, Whorf announced, Native American languages impose on their speakers a picture of reality that is totally different from ours, so their speakers would simply not be able to understand some of our most basic concepts, like the flow of time or the distinction between objects (like “stone”) and actions (like “fall”). For decades, Whorf’s theory dazzled both academics and the general public alike. In his shadow, others made a whole range of imaginative claims about the supposed power of language, from the assertion that Native American languages instill in their speakers an intuitive understanding of Einstein’s concept of time as a fourth dimension to the theory that the nature of the Jewish religion was determined by the tense system of ancient Hebrew.

Eventually, Whorf's theory crash-landed on hard facts and solid common sense, when it transpired that there had never actually been any evidence to support his fantastic claims. The reaction was so severe that for decades, any attempts to explore the influence of the mother tongue on our thoughts were relegated to the loony fringes of disrepute. But 70 years on, it is surely time to put the trauma of Whorf behind us. And in the last few years, new research has revealed that when we learn our mother tongue, we do after all acquire certain habits of thought that shape our experience in significant and often surprising ways.

Whorf, we now know, made many mistakes. The most serious one was to assume that our mother tongue constrains our minds and prevents us from being able to think certain thoughts. The general structure of his arguments was to claim that if a language has no word for a certain concept, then its speakers would not be able to understand this concept. If a language has no future tense, for instance, its speakers would simply not be able to grasp our notion of future time. It seems barely comprehensible that this line of argument could ever have achieved such success, given that so much contrary evidence confronts you wherever you look. When you ask, in perfectly normal English, and in the present tense, "Are you coming tomorrow?" do you feel your grip on the notion of futurity slipping away? Do English speakers who have never heard the German word *Schadenfreude* find it difficult to understand the concept of relishing someone else's misfortune? Or think about it this way: If the inventory of ready-made words in your language determined which concepts you were able to understand, how would you ever learn anything new?

**SINCE THERE IS NO EVIDENCE** that any language forbids its speakers to think anything, we must look in an entirely different direction to discover how our mother tongue really does shape our experience of the world. Some 50 years ago, the renowned linguist Roman Jakobson pointed out a crucial fact about differences between languages in a pithy maxim: "Languages differ essentially in what they *must* convey and not in what they *may* convey." This maxim offers us the key to unlocking the real force of the mother tongue: if different languages influence our minds in different ways, this is not because of what our language *allows* us to think but rather because of what it habitually *obliges* us to think *about*.

Consider this example. Suppose I say to you in English that "I spent yesterday evening with a neighbor." You may well wonder whether my companion was male or female, but I have the right to tell you politely that it's none of your business. But if we were speaking French or German, I wouldn't have the privilege to equivocate in this way, because I would be obliged by the grammar of language to choose between *voisin* or *voisine*; *Nachbar* or *Nachbarin*. These languages compel me to inform you about the sex of my companion whether or not I feel it is remotely your concern. This does not mean, of course, that English speakers are unable to understand the differences between evenings spent with male or female neighbors, but it does mean that they do not have to consider the sexes of neighbors, friends, teachers and a host of other persons each time they come up in a conversation, whereas speakers of some languages are obliged to do so.

On the other hand, English does oblige you to specify certain types of information that can be left to the context in other languages. If I want to tell you in English about a dinner with my neighbor, I may not have to mention the neighbor's sex, but I do have to tell you something about the timing of the event: I have to decide whether we *dined*, *have been dining*, *are dining*, *will be dining* and so on. Chinese, on the other hand, does not oblige its speakers to specify the exact time of the action in this way, because the same verb form can be used for past, present or future actions. Again, this does not mean that the Chinese are unable to understand the concept of time. But it does mean they are not obliged to think about timing whenever they describe an action.

When your language routinely obliges you to specify certain types of information, it forces you to be attentive to certain details in the world and to certain aspects of experience that speakers of other languages may not be required to think about all the time. And since such habits of speech are cultivated from the earliest age, it is

only natural that they can settle into habits of *mind* that go beyond language itself, affecting your experiences, perceptions, associations, feelings, memories and orientation in the world.

**BUT IS THERE** any evidence for this happening in practice?

Let's take genders again. Languages like Spanish, French, German and Russian not only oblige you to think about the sex of friends and neighbors, but they also assign a male or female gender to a whole range of inanimate objects quite at whim. What, for instance, is particularly feminine about a Frenchman's beard (*la barbe*)? Why is Russian water a she, and why does she become a he once you have dipped a tea bag into her? Mark Twain famously lamented such erratic genders as female turnips and neuter maidens in his rant "The Awful German Language." But whereas he claimed that there was something particularly perverse about the German gender system, it is in fact English that is unusual, at least among European languages, in not treating turnips and tea cups as masculine or feminine. Languages that treat an inanimate object as a he or a she force their speakers to talk about such an object as if it were a man or a woman. And as anyone whose mother tongue has a gender system will tell you, once the habit has taken hold, it is all but impossible to shake off. When I speak English, I may say about a bed that "it" is too soft, but as a native Hebrew speaker, I actually feel "she" is too soft. "She" stays feminine all the way from the lungs up to the glottis and is neutered only when she reaches the tip of the tongue.

In recent years, various experiments have shown that grammatical genders can shape the feelings and associations of speakers toward objects around them. In the 1990s, for example, psychologists compared associations between speakers of German and Spanish. There are many inanimate nouns whose genders in the two languages are reversed. A German bridge is feminine (*die Brücke*), for instance, but *el puente* is masculine in Spanish; and the same goes for clocks, apartments, forks, newspapers, pockets, shoulders, stamps, tickets, violins, the sun, the world and love. On the other hand, an apple is masculine for Germans but feminine in Spanish, and so are chairs, brooms, butterflies, keys, mountains, stars, tables, wars, rain and garbage. When speakers were asked to grade various objects on a range of characteristics, Spanish speakers deemed bridges, clocks and violins to have more "manly properties" like strength, but Germans tended to think of them as more slender or elegant. With objects like mountains or chairs, which are "he" in German but "she" in Spanish, the effect was reversed.

In a different experiment, French and Spanish speakers were asked to assign human voices to various objects in a cartoon. When French speakers saw a picture of a fork (*la fourchette*), most of them wanted it to speak in a woman's voice, but Spanish speakers, for whom *el tenedor* is masculine, preferred a gravelly male voice for it. More recently, psychologists have even shown that "gendered languages" imprint gender traits for objects so strongly in the mind that these associations obstruct speakers' ability to commit information to memory.

Of course, all this does not mean that speakers of Spanish or French or German fail to understand that inanimate objects do not really have biological sex — a German woman rarely mistakes her husband for a hat, and Spanish men are not known to confuse a bed with what might be lying in it. Nonetheless, once gender connotations have been imposed on impressionable young minds, they lead those with a gendered mother tongue to see the inanimate world through lenses tinted with associations and emotional responses that English speakers — stuck in their monochrome desert of "its" — are entirely oblivious to. Did the opposite genders of "bridge" in German and Spanish, for example, have an effect on the design of bridges in Spain and Germany? Do the emotional maps imposed by a gender system have higher-level behavioral consequences for our everyday life? Do they shape tastes, fashions, habits and preferences in the societies concerned? At the current state of our knowledge about the brain, this is not something that can be easily measured in a psychology lab. But it would be surprising if they didn't.

The area where the most striking evidence for the influence of language on thought has come to light is the language of space — how we describe the orientation of the world around us. Suppose you want to give someone directions for getting to your house. You might say: “After the traffic lights, take the first left, then the second right, and then you’ll see a white house in front of you. Our door is on the right.” But in theory, you could also say: “After the traffic lights, drive north, and then on the second crossing drive east, and you’ll see a white house directly to the east. Ours is the southern door.” These two sets of directions may describe the same route, but they rely on different systems of coordinates. The first uses *egocentric* coordinates, which depend on our own bodies: a left-right axis and a front-back axis orthogonal to it. The second system uses fixed *geographic* directions, which do not rotate with us wherever we turn.

We find it useful to use geographic directions when hiking in the open countryside, for example, but the egocentric coordinates completely dominate our speech when we describe small-scale spaces. We don’t say: “When you get out of the elevator, walk south, and then take the second door to the east.” The reason the egocentric system is so dominant in our language is that it feels so much easier and more natural. After all, we always know where “behind” or “in front of” us is. We don’t need a map or a compass to work it out, we just feel it, because the egocentric coordinates are based directly on our own bodies and our immediate visual fields.

**But then** a remote Australian aboriginal tongue, Guugu Yimithirr, from north Queensland, turned up, and with it came the astounding realization that not all languages conform to what we have always taken as simply “natural.” In fact, Guugu Yimithirr doesn’t make any use of egocentric coordinates at all. The anthropologist John Haviland and later the linguist Stephen Levinson have shown that Guugu Yimithirr does not use words like “left” or “right,” “in front of” or “behind,” to describe the position of objects. Whenever we would use the egocentric system, the Guugu Yimithirr rely on cardinal directions. If they want you to move over on the car seat to make room, they’ll say “move a bit to the east.” To tell you where exactly they left something in your house, they’ll say, “I left it on the southern edge of the western table.” Or they would warn you to “look out for that big ant just north of your foot.” Even when shown a film on television, they gave descriptions of it based on the orientation of the screen. If the television was facing north, and a man on the screen was approaching, they said that he was “coming northward.”

When these peculiarities of Guugu Yimithirr were uncovered, they inspired a large-scale research project into the language of space. And as it happens, Guugu Yimithirr is not a freak occurrence; languages that rely primarily on geographical coordinates are scattered around the world, from Polynesia to Mexico, from Namibia to Bali. For us, it might seem the height of absurdity for a dance teacher to say, “Now raise your north hand and move your south leg eastward.” But the joke would be lost on some: the Canadian-American musicologist Colin McPhee, who spent several years on Bali in the 1930s, recalls a young boy who showed great talent for dancing. As there was no instructor in the child’s village, McPhee arranged for him to stay with a teacher in a different village. But when he came to check on the boy’s progress after a few days, he found the boy dejected and the teacher exasperated. It was impossible to teach the boy anything, because he simply did not understand any of the instructions. When told to take “three steps east” or “bend southwest,” he didn’t know what to do. The boy would not have had the least trouble with these directions in his own village, but because the landscape in the new village was entirely unfamiliar, he became disoriented and confused. Why didn’t the teacher use different instructions? He would probably have replied that saying “take three steps forward” or “bend backward” would be the height of absurdity.

So different languages certainly make us *speak* about space in very different ways. But does this necessarily mean that we have to *think* about space differently? By now red lights should be flashing, because even if a language doesn’t have a word for “behind,” this doesn’t necessarily mean that its speakers wouldn’t be able to understand this concept. Instead, we should look for the possible consequences of what geographic languages



*oblige* their speakers to convey. In particular, we should be on the lookout for what habits of mind might develop because of the necessity of specifying geographic directions all the time.

In order to speak a language like Guugu Yimithirr, you need to know where the cardinal directions are at each and every moment of your waking life. You need to have a compass in your mind that operates all the time, day and night, without lunch breaks or weekends off, since otherwise you would not be able to impart the most basic information or understand what people around you are saying. Indeed, speakers of geographic languages seem to have an almost-superhuman sense of orientation. Regardless of visibility conditions, regardless of whether they are in thick forest or on an open plain, whether outside or indoors or even in caves, whether stationary or moving, they have a spot-on sense of direction. They don't look at the sun and pause for a moment of calculation before they say, "There's an ant just north of your foot." They simply feel where north, south, west and east are, just as people with perfect pitch feel what each note is without having to calculate intervals. There is a wealth of stories about what to us may seem like incredible feats of orientation but for speakers of geographic languages are just a matter of course. One report relates how a speaker of Tzeltal from southern Mexico was blindfolded and spun around more than 20 times in a darkened house. Still blindfolded and dizzy, he pointed without hesitation at the geographic directions.

**How does this work?** The convention of communicating with geographic coordinates compels speakers from the youngest age to pay attention to the clues from the physical environment (the position of the sun, wind and so on) every second of their lives, and to develop an accurate memory of their own changing orientations at any given moment. So everyday communication in a geographic language provides the most intense imaginable drilling in geographic orientation (it has been estimated that as much as 1 word in 10 in a normal Guugu Yimithirr conversation is "north," "south," "west" or "east," often accompanied by precise hand gestures). This habit of constant awareness to the geographic direction is inculcated almost from infancy: studies have shown that children in such societies start using geographic directions as early as age 2 and fully master the system by 7 or 8. With such an early and intense drilling, the habit soon becomes second nature, effortless and unconscious. When Guugu Yimithirr speakers were asked how they knew where north is, they couldn't explain it any more than you can explain how you know where "behind" is.

But there is more to the effects of a geographic language, for the sense of orientation has to extend further in time than the immediate present. If you speak a Guugu Yimithirr-style language, your memories of anything that you might ever want to report will have to be stored with cardinal directions as part of the picture. One Guugu Yimithirr speaker was filmed telling his friends the story of how in his youth, he capsized in shark-infested waters. He and an older person were caught in a storm, and their boat tipped over. They both jumped into the water and managed to swim nearly three miles to the shore, only to discover that the missionary for whom they worked was far more concerned at the loss of the boat than relieved at their miraculous escape. Apart from the dramatic content, the remarkable thing about the story was that it was remembered throughout in cardinal directions: the speaker jumped into the water on the western side of the boat, his companion to the east of the boat, they saw a giant shark swimming north and so on. Perhaps the cardinal directions were just made up for the occasion? Well, quite by chance, the same person was filmed some years later telling the same story. The cardinal directions matched exactly in the two tellings. Even more remarkable were the spontaneous hand gestures that accompanied the story. For instance, the direction in which the boat rolled over was gestured in the correct geographic orientation, regardless of the direction the speaker was facing in the two films.

Psychological experiments have also shown that under certain circumstances, speakers of Guugu Yimithirr-style languages even remember "the same reality" differently from us. There has been heated debate about the interpretation of some of these experiments, but one conclusion that seems compelling is that while we are trained to ignore directional rotations when we commit information to memory, speakers of geographic languages are trained not to do so. One way of understanding this is to imagine that you are traveling with a

speaker of such a language and staying in a large chain-style hotel, with corridor upon corridor of identical-looking doors. Your friend is staying in the room opposite yours, and when you go into his room, you'll see an exact replica of yours: the same bathroom door on the left, the same mirrored wardrobe on the right, the same main room with the same bed on the left, the same curtains drawn behind it, the same desk next to the wall on the right, the same television set on the left corner of the desk and the same telephone on the right. In short, you have seen the same room twice. But when your friend comes into your room, he will see something quite different from this, because everything is reversed north-side-south. In his room the bed was in the north, while in yours it is in the south; the telephone that in his room was in the west is now in the east, and so on. So while you will see and remember the same room twice, a speaker of a geographic language will see and remember two different rooms.

It is not easy for us to conceive how Guugu Yimithirr speakers experience the world, with a crisscrossing of cardinal directions imposed on any mental picture and any piece of graphic memory. Nor is it easy to speculate about how geographic languages affect areas of experience other than spatial orientation — whether they influence the speaker's sense of identity, for instance, or bring about a less-egocentric outlook on life. But one piece of evidence is telling: if you saw a Guugu Yimithirr speaker pointing at himself, you would naturally assume he meant to draw attention to himself. In fact, he is pointing at a cardinal direction that happens to be behind his back. While we are always at the center of the world, and it would never occur to us that pointing in the direction of our chest could mean anything other than to draw attention to ourselves, a Guugu Yimithirr speaker points through himself, as if he were thin air and his own existence were irrelevant.

**IN WHAT OTHER WAYS** might the language we speak influence our experience of the world? Recently, it has been demonstrated in a series of ingenious experiments that we even perceive colors through the lens of our mother tongue. There are radical variations in the way languages carve up the spectrum of visible light; for example, green and blue are distinct colors in English but are considered shades of the same color in many languages. And it turns out that the colors that our language routinely obliges us to treat as distinct can refine our purely visual sensitivity to certain color differences in reality, so that our brains are trained to exaggerate the distance between shades of color if these have different names in our language. As strange as it may sound, our experience of a Chagall painting actually depends to some extent on whether our language has a word for blue.

In coming years, researchers may also be able to shed light on the impact of language on more subtle areas of perception. For instance, some languages, like Matses in Peru, oblige their speakers, like the finickiest of lawyers, to specify exactly how they came to know about the facts they are reporting. You cannot simply say, as in English, "An animal passed here." You have to specify, using a different verbal form, whether this was directly experienced (you saw the animal passing), inferred (you saw footprints), conjectured (animals generally pass there that time of day), hearsay or such. If a statement is reported with the incorrect "evidentiality," it is considered a lie. So if, for instance, you ask a Matses man how many wives he has, unless he can actually see his wives at that very moment, he would have to answer in the past tense and would say something like "There were two last time I checked." After all, given that the wives are not present, he cannot be absolutely certain that one of them hasn't died or run off with another man since he last saw them, even if this was only five minutes ago. So he cannot report it as a certain fact in the present tense. Does the need to think constantly about epistemology in such a careful and sophisticated manner inform the speakers' outlook on life or their sense of truth and causation? When our experimental tools are less blunt, such questions will be amenable to empirical study.

For many years, our mother tongue was claimed to be a "prison house" that constrained our capacity to reason. Once it turned out that there was no evidence for such claims, this was taken as proof that people of all cultures think in fundamentally the same way. But surely it is a mistake to overestimate the importance of abstract reasoning in our lives. After all, how many daily decisions do we make on the basis of deductive





logic compared with those guided by gut feeling, intuition, emotions, impulse or practical skills? The habits of mind that our culture has instilled in us from infancy shape our orientation to the world and our emotional responses to the objects we encounter, and their consequences probably go far beyond what has been experimentally demonstrated so far; they may also have a marked impact on our beliefs, values and ideologies. We may not know as yet how to measure these consequences directly or how to assess their contribution to cultural or political misunderstandings. But as a first step toward understanding one another, we can do better than pretending we all think the same.

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[http://www.nytimes.com/2010/08/29/magazine/29language-t.html?\\_r=1&partner=rss&emc=rss](http://www.nytimes.com/2010/08/29/magazine/29language-t.html?_r=1&partner=rss&emc=rss)

## When Does Holding Teachers Accountable Go Too Far?

By **DAVID LEONHARDT**



**The start** of the school year brings another one of those nagging, often unquenchable worries of parenthood: How good will my child's teachers be? Teachers tend to have word-of-mouth reputations, of course. But it is hard to know how well those reputations match up with a teacher's actual abilities. Schools generally do not allow parents to see any part of a teacher's past evaluations, for instance. And there is nothing resembling a rigorous, Consumer Reports-like analysis of schools, let alone of individual teachers. For the most part, parents just have to hope for the best.

That, however, may be starting to change. A few months ago, a team of reporters at The Los Angeles Times and an education economist set out to create precisely such a consumer guide to education in Los Angeles. The reporters requested and received seven years of students' English and math elementary-school test scores from the school district. The economist then used a statistical technique called value-added analysis to see how much progress students had made, from one year to the next, under different third- through fifth-grade teachers. The variation was striking. Under some of the roughly 6,000 teachers, students made great strides year after year. Under others, often at the same school, students did not. The newspaper named a few teachers — both stars and laggards — and announced that it would release the approximate rankings for all teachers, along with their names.

The articles have caused an electric reaction. The president of the Los Angeles teachers union called for a boycott of the newspaper. But the union has also suggested it is willing to discuss whether such scores can

become part of teachers' official evaluations. Meanwhile, more than 1,700 teachers have privately reviewed their scores online, and hundreds have left comments that will accompany them.

It is not difficult to see how such attempts at measurement and accountability may be a part of the future of education. Presumably, other groups will try to repeat the exercise elsewhere. And several states, in their efforts to secure financing from the Obama administration's Race to the Top program, have committed to using value-added analysis in teacher evaluation. The Washington, D.C., schools chancellor, Michelle Rhee, fired more than 100 teachers this summer based on evaluations from principals and other educators and, when available, value-added scores.

In many respects, this movement is overdue. Given the stakes, why should districts be allowed to pretend that nearly all their teachers are similarly successful? (The same question, by the way, applies to hospitals and doctors.) The argument for measurement is not just about firing the least effective sliver of teachers. It is also about helping decent and good teachers to become better. As Arne Duncan, the secretary of education, has pointed out, the Los Angeles school district has had the test-score data for years but didn't use it to help teachers improve. When the Times reporters asked one teacher about his weak scores, he replied, "Obviously what I need to do is to look at what I'm doing and take some steps to make sure something changes."

Yet for all of the potential benefits of this new accountability, the full story is still not a simple one. You could tell as much by the ambivalent reaction to the Los Angeles imbroglio from education researchers and reform advocates. These are the people who have spent years urging schools to do better. Even so, many reformers were torn about the release of the data. Above all, they worried that although the data didn't paint a complete picture, it would offer the promise of clear and open accountability — because teachers could be sorted and ranked — and would nonetheless become gospel.

Value-added data is *not* gospel. Among the limitations, scores can bounce around from year to year for any one teacher, notes Ross Wiener of the Aspen Institute, who is generally a fan of the value-added approach. So a single year of scores — which some states may use for evaluation — can be misleading. In addition, students are not randomly assigned to teachers; indeed, principals may deliberately assign slow learners to certain teachers, unfairly lowering their scores. As for the tests themselves, most do not even try to measure the social skills that are crucial to early learning.

The value-added data probably can identify the best and worst teachers, researchers say, but it may not be very reliable at distinguishing among teachers in the middle of the pack. Joel Klein, New York's reformist superintendent, told me that he considered the Los Angeles data powerful stuff. He also said, "I wouldn't try to make big distinctions between the 47th and 55th percentiles." Yet what parent would not be tempted to?

One way to think about the Los Angeles case is as an understandable overreaction to an unacceptable status quo. For years, school administrators and union leaders have defeated almost any attempt at teacher measurement, partly by pointing to the limitations. Lately, though, the politics of education have changed. Parents know how much teachers matter and know that, just as with musicians or athletes or carpenters or money managers, some teachers are a lot better than others.

Test scores — that is, measuring students' knowledge and skills — are surely part of the solution, even if the public ranking of teachers is not. Rob Manwaring of the research group Education Sector has suggested that districts release a breakdown of teachers' value-added scores at every school, without tying the individual scores to teachers' names. This would avoid humiliating teachers while still giving a principal an incentive to employ good ones. Improving standardized tests and making peer reports part of teacher evaluation, as many states are planning, would help, too.



But there is also another, less technocratic step that is part of building better schools: we will have to acknowledge that no system is perfect. If principals and teachers are allowed to grade themselves, as they long have been, our schools are guaranteed to betray many students. If schools instead try to measure the work of teachers, some will inevitably be misjudged. “On whose behalf do you want to make the mistake — the kids or the teachers?” asks Kati Haycock, president of the Education Trust. “We’ve always erred on behalf of the adults before.”

You may want to keep that in mind if you ever get a chance to look at a list of teachers and their value-added scores. Some teachers, no doubt, are being done a disservice. Then again, so were a whole lot of students.

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<http://www.nytimes.com/2010/09/05/magazine/05FOB-wwln-t.html?ref=magazine>

## Can Preschoolers Be Depressed?

By PAMELA PAUL



**Kiran didn't seem** like the type of kid parents should worry about. "He was the easy one," his father, Raghu, a physician, says. "He always wanted to please." Unlike other children in his suburban St. Louis preschool, Kiran (a nickname his parents asked me to use to protect his identity) rarely disobeyed or acted out. If he dawdled or didn't listen, Raghu (also a nickname) had only to count to five before Kiran hastened to tie his shoes or put the toys away. He was kind to other children; if a classmate cried, Kiran immediately approached. "Our little empath!" his parents proudly called him.

But there were worrisome signs. For one thing, unlike your typical joyful and carefree 4-year-old, Kiran didn't have a lot of fun. "He wasn't running around, bouncing about, battling to get to the top of the slide like other kids," Raghu notes. Kiran's mother, Elizabeth (her middle name), an engineer, recalls constant refrains of "Nothing is fun; I'm bored." When Raghu and Elizabeth reminded a downbeat Kiran of their coming trip to Disney World, Kiran responded: "Mickey lies. Dreams don't come true."

Over time, especially in comparison with Kiran's even-keeled younger sister, it became apparent that guilt and worry infused Kiran's thoughts. "We had to be really careful when we told him he did something wrong, because he internalized it quickly," Raghu says. He was also easily frustrated. He wouldn't dare count aloud until he had perfected getting to 10. Puzzles drove him nuts. After toying with a new set of Legos, he told his father, "I can't do Legos." He then roundly declared: "I will never do them. I am not a Legos person. You should take them away."

One weekend when he was 4, Kiran carried his blanket around as his mother ferried him from one child-friendly place to the next, trying to divert him. But even at St. Louis's children's museum, he was listless and

leaned against the wall. When they got home, he lay down and said he couldn't remember anything fun about the whole day. He was "draggy and superwhiny and seeming like he was in pain." Elizabeth remembers thinking, "Something is wrong with this kid."

After talks with the director of Kiran's preschool, who was similarly troubled by his behavior, and a round of medical Googling, Kiran's parents took him to see a child psychiatrist. In the winter of 2009, when Kiran was 5, his parents were told that he had preschool depression, sometimes referred to as "early-onset depression." He was entered into a research study at the Early Emotional Development Program at Washington University Medical School in St. Louis, which tracks the diagnosis of preschool depression and the treatment of children like Kiran. "It was painful," Elizabeth says, "but also a relief to have professionals confirm that, yes, he has had a depressive episode. It's real."

Is it really possible to diagnose such a grown-up affliction in such a young child? And is diagnosing clinical depression in a preschooler a good idea, or are children that young too immature, too changeable, too temperamental to be laden with such a momentous label? Preschool depression may be a legitimate ailment, one that could gain traction with parents in the way that attention deficit hyperactivity disorder (A.D.H.D.) and oppositional defiant disorder (O.D.D.) — afflictions few people heard of 30 years ago — have entered the what-to-worry-about lexicon. But when the rate of development among children varies so widely and burgeoning personalities are still in flux, how can we know at what point a child crosses the line from altogether unremarkable to somewhat different to clinically disordered? Just how early can depression begin?

The answer, according to recent research, seems to be earlier than expected. Today a number of child psychiatrists and developmental psychologists say depression can surface in children as young as 2 or 3. "The idea is very threatening," says Joan Luby, a professor of child psychiatry at Washington University School of Medicine, who gave Kiran his diagnosis and whose research on preschool depression has often met with resistance. "In my 20 years of research, it's been slowly eroding," Luby says of that resistance. "But some hard-core scientists still brush the idea off as mushy or psychobabble, and laypeople think the idea is ridiculous."

For adults who have known depression, however, the prospect of early diagnosis makes sense. Kiran's mother had what she now recognizes was childhood depression. "There were definite signs throughout my grade-school years," she says. Had therapy been available to her then, she imagines that she would have leapt at the chance. "My parents knew my behavior wasn't right, but they really didn't know what to do."

**LIKE MANY WHO** treat depression, Daniel Klein, a professor of clinical psychology at State University of New York at Stony Brook, repeatedly heard from adult patients that they had depression their whole lives. "I've had this as long as I can remember," Klein told me they said. "I became convinced that the roots of these conditions start very early."

So Klein turned to the study of temperament and depressive tendencies in young children. About a decade later, he is one of several academics focusing on preschool depression.

The history of mental illness has been, in many ways, an ongoing lowering of the bar to entry. Depression was originally seen as an adult problem with origins in childhood, rather than something that existed in children. The psychoanalytic view was that children didn't have the mental capacity for depression; their superegos were not sufficiently developed. "One of the most important mental-health discoveries of the past 10 to 20 years has been that chronic mental illnesses are predominantly illnesses of the young," says Daniel Pine, chief of the emotion-and-development branch in the Mood and Anxiety Disorders Program of the



National Institute of Mental Health. They begin when we are young and affect us, often profoundly, during the childhood years, shaping the adults we become.

Controversy over whether major depression could occur in teenagers, something we now take as a given, persisted until the 1980s. First adolescents, then grade-school children were considered too psychologically immature to be depressed. Stigma was a major fear. “There was this big worry that once you labeled it, you actually had it,” explains Neal Ryan, a professor of child and adolescent psychiatry at the University of Pittsburgh. By the early 1990s psychiatrists had come to recognize that depression occurs in children of 8, 9 and 10.

Still, in 1990, when Luby first broached the subject of whether children could be depressed even before they entered school, her colleagues’ reactions ranged from disinterest to hostility. Then in the late ’90s, the study of early childhood entered a kind of vogue among academics and policy makers. This was the era of President Clinton’s White House Conference on Early Childhood Development and Learning, and there was a wave of interest in the importance of what was termed “0 to 3.” Researchers took a closer look at how sophisticated feelings like guilt and shame emerge before a child’s third birthday. In 1998, Luby got her first grant from the National Institute of Mental Health to begin a study of preschool depression.

“We realized, Gee, maybe we better look more carefully at preschool, too,” Pine says. “And that’s where we are today. The issue of diagnosis of depression in preschoolers is being looked at *very* carefully right now.”

Diagnosis of any mental disorder at this young age is subject to debate. No one wants to pathologize a typical preschooler’s tantrums, mood swings and torrent of developmental stages. Grandparents are highly suspicious; parents often don’t want to know. “How many times have you heard, ‘They’ll grow out of it’ or ‘That’s just how he is’?” says Melissa Nishawala, a child psychiatrist at the New York University Child Study Center.

And some in the field have reservations, too. Classifying preschool depression as a medical disorder carries a risk of disease-mongering. “Given the influence of Big Pharma, we have to be sure that every time a child’s ice cream falls off the cone and he cries, we don’t label him depressed,” cautions Rahil Briggs, an infant-toddler psychologist at Children’s Hospital at Montefiore in New York. Though research does not support the use of antidepressants in children this young, medication of preschoolers, often off label, is on the rise. One child psychologist told me about a conference he attended where he met frustrated drug-industry representatives. “They want to give these kids medicines, but we can’t figure out the diagnoses.” As Daniel Klein warns, “Right now the problem may be underdiagnosis, but these things can flip completely.”

Depression, with its recurrent, long-lasting symptoms and complex of medications, is a particularly brutal diagnosis for a young child. “Mood disorders are scary to acknowledge, and depression is especially scary,” says Mary J. O’Connor, a child psychologist, professor and founder of the infant and preschool clinic at U.C.L.A. “When we sit down with a parent and give them a diagnosis of depression, they have this fatalistic idea of something devastating and terrifying and permanent.”

And parents tend to feel responsible. Children of depressed parents are two to three times as likely to have major depression. Maternal depression in particular has been shown to have serious effects on development, primarily through an absence of responsiveness — the parent’s conscious and consistent mirroring and reciprocity of an infant’s gaze, babble and actions. “Depressed mothers often respond to their babies from the beginning in ways that dampen their enthusiasm and joy,” says Alicia Lieberman, a professor in the department of psychiatry at the University of California, San Francisco. This is problematic, as 10 to 20



percent of mothers go through depression at some point, and 1 in 11 infants experiences his mother's depression in the first year.

But it's easy to overstate the role of maternal depression. "Most kids of depressed parents don't get depressed," says Arnold Sameroff, a developmental psychologist at University of Michigan's Center for Human Growth and Development, who has studied children of parents with mental problems. Conversely, parents need not be depressed to heighten depression in their children. "There are definitely situations where the family interaction is creating the negativity in the child's life, and that is one pathway to depression," says Tamar Chansky, founder of the Children's Center for O.C.D. and Anxiety in suburban Philadelphia. "But what I see more often is the no-fault situation, where parents are baffled to hear such negative thoughts coming from their children." Despite the assumption that these kids must have experienced severe psychosocial deprivation, abuse or neglect, Luby says: "I've seen many depressed kids with nurturing, caring parents. We know that psychosocial stress is an important ingredient, but it's not the only issue. And it's not a necessary condition either."

Kiran's parents have advanced degrees and stable jobs and were invested in being good parents. Both participated in a Missouri's Parents as Teachers program, receiving instruction during Kiran's first three years. But Elizabeth says she does wonder if her behavior exacerbated some of Kiran's negative tendencies. "Sometimes I worry that we were too critical of Kiran," Elizabeth told me over the phone in January. "I was exasperated with him all the time. I wasn't intentionally trying to make him feel guilty, but the way I was interacting with him was providing a guilt trip." Elizabeth's own moods sometimes played a role. "If my mood was low, his got even lower."

**IN A SMALL LAB** slightly off the main campus of Washington University in St. Louis's School of Medicine, Joan Luby is trying to figure out exactly what constitutes preschool depression. For a new clinical diagnosis to gain sanction with psychologists, schools, doctors and insurance companies, it requires entry into the Diagnostic and Statistical Manual of Mental Disorders, the field guide to psychiatric illness. Though the manual, last thoroughly revised in 1994, purports to describe and classify the full range of mental disorders, it was not designed to capture preschool conditions. To help practitioners recognize problems earlier, the research organization Zero to Three published its own manual, the Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood, most recently in 2005. But its methods of review aren't as rigorous as those in the D.S.M., and many await the imprimatur of the updated D.S.M., due in 2013, which is expected to account for developmental stages of disorder across the lifespan.

Luby is one of the first researchers to systematically investigate the criteria for preschool depression, primarily through a longitudinal study that initially evaluated children between ages 3 and 5 for depression and was financed by the N.I.M.H. These children, who are now between 9 and 12, come into a lab every year for assessments. Offshoot studies have looked at everything from the role of tantrums in depressed children to how depressed preschoolers perform on cognitive tasks. Luby's file cabinets teem with DVDs of each of her study participants' periodic assessments. I watched one recording in which a 5-year-old squirmed in her chair while her parents answered questions. "She cries at the drop of a hat." "She realizes that something's different about her, and she's bothered by her irritability and sadness." "At times she'll accept comfort; other times, nothing will console her."

Through interviews like this, Luby is trying to identify preschool depression's characteristics; according to her research, they look a lot like those in older people. In adults, for instance, anhedonia, the inability to derive pleasure in normally enjoyable activities, can be signaled by the absence of libido; in preschoolers, it means finding little joy in toys. Other symptoms, including restlessness and irritability, are similarly downsized. These kids whine and cry. They don't want to play. Rather than voice suicidal ideation, they may orchestrate scenarios around violence or death.

The most obvious and pervasive symptom, not surprisingly, is sadness. But it's not "I didn't get the toy I wanted at Target; now I'm really sad," cautions Helen Egger, a Duke University child psychiatrist and epidemiologist. The misery needs to persist across time, in different settings, with different people. Nor is it enough just to be sad; after all, sadness in the face of unachieved goals or a loss of well-being is normal. But the depressed child apparently has such difficulty resolving the sadness that it becomes pervasive and inhibits his functioning. "You can watch two kids try to put on shoes, and as soon as something gets stuck, one child pulls it off and throws it across the room," says Tamar Chansky, who treats preschoolers who are depressed or are at risk for depression in her clinic. "He hits himself, throws objects and says things like 'I did this wrong; I'm stupid.' "

Unfortunately there is little that young children can tell us directly about what they are going through. Preschoolers not only lack the linguistic sophistication to describe the experience, but they're also still learning what emotions are. To get a sense of what a young child is feeling, Luby's team uses a technique called the Berkeley Puppet Interview, which was developed to help children articulate how they perceive themselves and process their emotions. I watched as a wiry, blond 5-year-old boy responded to a therapist's dog-faced puppets.

"My parents care a lot about me," the first puppet said in an upbeat tone. □ "My parents don't care a lot about me," the second said in an equally cheerful voice. "How about you?"

"Sometimes they care about me," the boy replied, and then paused. "They *don't* care a lot about me," he added with emphasis.

"When I do something wrong, I feel bad," the first puppet said.

"When I do something wrong, I don't feel bad," the second said. "How about you?"

"When I do something wrong, I *do* feel bad," the boy responded.

Later he told the puppets that he didn't like to be alone. He worried that other kids didn't like him, and he wished he had more friends. His insecurity, low self-image and, in particular, his sense of guilt and shame mark him as a possible depressive: it's not only that I did this thing wrong, it's *I'm a bad boy*.

But generally speaking, preschool depression, unlike autism, O.D.D. and A.D.H.D., which have clear symptoms, is not a disorder that is readily apparent to the casual observer or even to the concerned parent. Depressed preschoolers are usually not morbidly, vegetatively depressed. Though they are frequently viewed as not doing particularly well socially or emotionally, teachers rarely grasp the depth of the problem. Sometimes the kids zone out in circle time, and it's mistaken for A.D.H.D., "because they're just staring," explains Melissa Nishawala, the child psychiatrist at N.Y.U. "But inside, they're worrying or thinking negative thoughts." More often, they are simply overlooked. "These are often the good kids who tend to be timid and withdrawn," says Sylvana Côté, a researcher at the University of Montreal who studies childhood mood and behavioral disorders. "It's because they're not the oppositional, aggressive children who disrupt everyone in class that their problems go undernoticed."

Many researchers, particularly those with medical training, are eager to identify some kind of a "biologic marker" to make diagnosis scientifically conclusive. Recent studies have looked at the activity of cortisol, a hormone the body produces in response to stress. In preschoolers who have had a diagnosis of depression, as in depressed adults, cortisol levels escalate under stressful circumstances and then fail to recover with the same buoyancy as in typical children.

But in adults, cortisol reactivity can be an indication of anxiety. Other research has found that in young children, anxiety and depression are likewise intertwined. At Duke, Egger found that children who were depressed as preschoolers were more than four times as likely to have an anxiety disorder at school age. “Are these two distinct but strongly related syndromes?” asks Daniel Pine of the N.I.M.H. “Are they just slightly different-appearing clinical manifestations of the same underlying problem? Do the relationships vary at different ages? There are no definitive answers.”

Further complicating the picture is the extent to which depressed children have other ailments. In Egger’s epidemiological sample, three-fourths of depressed children had some additional disorder. In Luby’s study, about 40 percent also had A.D.H.D. or O.D.D., disruptive problems that tend to drown out signs of depression. Though it looks as if only the children with depression experience anhedonia, other symptoms like irritability and sadness are shared across several disorders.

Classifying symptoms into discrete diagnostic categories may not always be possible at this age, which leads to a reluctance among clinicians to pinpoint disorders. “There is a tension in child psychiatry about the degree to which disorders that are fairly clear in older individuals, adolescents and even school-age kids are apparent in young children, and if they are, whether they manifest in different ways,” warns Charles Zeanah, a professor of child and adolescent psychiatry at Tulane and part of the work group charged with updating the D.S.M. to reflect developmental stages. Post-traumatic stress syndrome, for example, can manifest itself differently in 4-year-olds than it does in 40-year-olds. Certain disorders like separation anxiety and selective mutism are exclusively the province of children but either disappear or evolve into anxiety or depression by adulthood. Thus far, however, depression, like obsessive-compulsive disorder, seems to be consistent across the lifespan.

But, in part to avoid stigmatizing young children, two catch-all diagnoses — adjustment disorder with depressed mood, as well as depressive disorder not otherwise specified (N.O.S.) — are frequently applied. There are benefits to such diffuse diagnoses: they spare parents the crushing word “depression” and avoid the prospect of prematurely labeling a child. They also allow for the possibility that a child may grow out of it. “We don’t like to diagnose depression in a preschooler,” says Mary O’Connor, from U.C.L.A. “These kids are still forming, so we’re more likely to call it a mood disorder N.O.S. That’s just the way we think of it here.”

But this way of thinking frustrates Luby and Egger, who say they fear that if a depressed child isn’t given the proper diagnosis, he can’t get appropriate treatment. You wouldn’t use the vague term “heart condition,” they argue, to describe a specific form of cardiac arrhythmia. “Why do we call depression in older children a ‘disorder,’ but with young children we just call it a ‘risk factor’ or ‘phase’?” Egger asks. Is it right that rather than treat children for depression, clinicians wait and see what might happen three or four years down the road?

**THEIR TENDERNESS OF** age may render preschoolers especially vulnerable to depression’s consequences. Young children are acutely sensitive but lack the skill, experience and self-sufficiency to deal with strong feelings. In general, early exposure to negative experiences — separation from a caregiver, abuse, casual neglect — can have intense and long-term effects on development, even on the neural, cardiovascular and endocrine processes that underlie and support emotional functioning. Preliminary brain scans of Luby’s depressed preschoolers show changes in the shape and size of the hippocampus, an important emotion center in the brain, and in the functional connectivity between different brain regions, similar to changes found in the brains of depressed adults. In a longitudinal study of risk factors for depression, Daniel Klein and his team found that children who were categorized as “temperamentally low in exuberance and enthusiasm” at age 3 had trouble at age 7 summoning positive words that described themselves. By 10, they were more likely to

exhibit depressive symptoms. And multiple studies have already linked depression in school-age children to adult depression.

Studies of children with other disorders that began in preschool and continued into adolescence have shown that early-onset issues don't disappear on their own; current research suggests the same is true for depression. Among the preschoolers in Luby's longitudinal study, those diagnosed with depression at the beginning of the study were four times as likely to be found depressed two years later than those in the control group. Egger found that children who met her depression criteria as preschoolers were seven times as likely to experience depression four years down the road.

But recent successes in treating autism have also shown that in many cases, the earlier the detection and intervention of a disorder, the greater chance for significant results. One principal argument for diagnosing depression early is that even with a genetic predisposition, depression isn't cemented into the psyche; the very fluidity of preschoolers' mental states seems to make them more treatable. This window is especially tantalizing because of the brain's neuroplasticity during the early years. The brain literally changes course when you prod it in a given direction. "Nobody knows exactly why, but treatment seems to affect children's brains more powerfully," Luby says, pointing out that language acquisition, for example, is easier at younger ages. Ballet, violin, swim lessons — we begin all kinds of training at age 4.

For a diagnosis of preschool depression to have any meaningful impact, an appropriate treatment must be found. Talk therapy isn't practical for children who don't have the verbal or intellectual sophistication to express and untangle their emotions. Play therapy, a favorite of preschool counselors, has yet to be proved effective.

But there may be treatments, Luby says, that could help prevent depression from interfering with a child's development, ensuring that she functions socially, cognitively and emotionally, alongside her peers. According to epidemiological studies conducted by Egger, from 1 to 3 percent of children between 2 and 5 have depression, a rate that seems to increase over the preschool years. Altogether, she and other researchers say, 84,000 of America's 6 million preschoolers may be clinically depressed. Intervention could potentially forestall, minimize or even prevent depression from becoming a lifelong condition. At a minimum, it could teach them ways to better manage future bouts. If we wait, their only options may be medication and ongoing talk therapy, forever rehashing the hurts Mom and Dad inflicted 20 years earlier.

And while practitioners quibble over what to label depression, most agree that for any mood disorder, children this age should not be treated in isolation. "Psychotherapy for depressed preschoolers should always involve the caregiver," Luby says. "Not because the caregiver is necessarily bad or doing anything wrong, but because the caregiver is an essential part of the child's psychological apparatus. The child is not an independent entity at this age." One established method is called Parent-Child Interaction Therapy, or P.C.I.T. Originally developed in the 1970s to treat disruptive disorders — which typically include violent or aggressive behavior in preschoolers — P.C.I.T. is generally a short-term program, usually 10 to 16 weeks under the supervision of a trained therapist, with ongoing follow-up in the home. Luby adapted the program for depression and began using it in 2007 in an ongoing study on a potential treatment. During each weekly hourlong session, parents are taught to encourage their children to acquire emotion regulation, stress management, guilt reparation and other coping skills. The hope is that children will learn to handle depressive symptoms and parents will reinforce those lessons. I observed one session in which a therapist deliberately invoked feelings of guilt in the same blond 5-year-old who told the puppets "When bad things happen, I *do* feel bad." Seated at a table with his mother, he turned to greet a therapist carrying a tray with two teacups, one elaborately painted. She told him that they were to have a tea party, pointing out her favorite teacup and describing the time it took to decorate it. "I'll let you use my favorite today," she beamed. As he gingerly took the rigged cup, its handle snapped off. His face darkened. The therapist lamented the break, ostensibly

distraught, and excused herself from the room. The boy's mother, guided via earset by a therapist watching through a two-way mirror, helped her child work through and resolve his feelings. "Do you feel like you're a bad boy?" his mother asked. Most parents want to distract their kids from negative emotions rather than let them process the feelings. "They want to wipe it away and move on," Luby says. In this session, the mother was instead encouraged to draw the child out.

The boy nodded tearfully. "I feel like I'm going to go into the trash can," he said. "Who would put you in the trash can?" his mother asked. "You would," he replied in an accusatory voice. "I would never do that," she said. "I love you. Accidents happen." The boy seemed to recover, and they chatted about her earrings, which he flicked playfully with a forefinger. Then his face drooped again. "Are you mad at me?" he asked, and then added, almost angrily, "I never want to do this activity again."

"You're not a bad boy," she consoled him. Often, parents don't realize that their children experience guilt or shame, Luby says. "In response to transgression, they tend to punish rather than reassure."

"I *am* a bad boy," the boy said, ducking under the table. "I don't think you love me now." He started to moan from the floor, whimpering: "I'm so sad. I'm so sad."

**SUCCESS WITH P.C.I.T.** rests heavily on parents, who are essentially tasked with reprogramming their child's brain to form new, more adaptive habits. Not all parents are equipped to handle the vigilance, the consistency, the sensitivity. But early results look promising. Though her data is preliminary, Luby and her team have documented considerable decreases in depression severity and impairment following treatment.

Could we somehow nip adult depression in the bud? We may never get a definitive answer, even if we do begin to systematically diagnose and treat preschool depression. "The promise of early-childhood mental health is that if you intervene early enough to change negative conditions, rather than perpetuate negative behaviors, you really are preventing the development of a full-fledged diagnosis," says Alicia Lieberman at U.C.S.F. "Of course, you would never then know if the child would have become a depressed adult."

This doesn't leave parents with a very clear road map. "We don't know if Kiran will be at risk of depression as an adult," Raghu told me when I spoke to him by phone in January. In the study that Kiran participated in, because he was part of the control group, he did not get to go through P.C.I.T. Nevertheless, Raghu and Elizabeth found the general parent training they received as part of the control helpful. And in the months following the study, Kiran's mood seemed to improve. A trip to his grandparents' farm last summer was particularly beneficial. But by this past winter, he seemed to be slipping and prone to bouts of anger and frustration; depression, it was explained to them at Luby's lab, tends to be episodic. "We worry that it's a lifelong thing," Elizabeth told me.

Recently, Elizabeth asked Kiran what the happiest time in his life had been. He told her about the trip they took to Spain when he was 8 months old. Elizabeth asked if he remembered going. "No," he said. "But I looked really happy in the picture." She pressed him for another answer, a time that he could actually remember. He thought hard. "I haven't had my happiest time yet," he said.

Pamela Paul is the author of "Parenting, Inc.," a book about the business of child-rearing. Her most recent article for the magazine was about a lesbian couple trying to adopt a baby.

<http://www.nytimes.com/2010/08/29/magazine/29preschool-t.html?ref=magazine>

## Does Stretching Before Running Prevent Injuries?

By GRETCHEN REYNOLDS



Angela Jimenez/Getty Images

Should you stretch before a run? That question, which has prompted countless academic studies, debates and inter-running-partner squabbles, is now at the heart of a notable new study published in August on the Web site of USA Track and Field, the sport's national governing body. The study, one of the largest of its kind, involved almost 1,400 runners, from age 13 to past 60, who were assigned randomly to two groups. The first group did not stretch before their runs, while otherwise maintaining their normal workout routine: the same mileage, warm-up (minus any stretching) and so on. The second group stretched, having received photographs and specific instructions for a series of simple, traditional poses, like leaning over and touching toes, that focused on the calf, hamstring and quadriceps muscles. The volunteers were told to hold each stretch for 20 seconds, a technique known as static stretching. The entire routine required three to five minutes and was to be completed immediately before a run.

The volunteers followed their assigned regimens for three months. Predictably, since running, as a sport, has a high injury rate, quite a few became injured during the three months. About 16 percent of the group that didn't stretch were hobbled badly enough to miss training for at least three days (the researchers' definition of a running injury), while about 16 percent of the group that did stretch were laid up for the same amount of time. The percentages, in other words, were virtually identical. Static stretching had proved to be a wash in terms of protecting against injury. It "neither prevented nor induced injury when compared with not stretching before running," the study's authors concluded, raising the obvious corollary, so why in the world do so many of us still stretch?

Stretching is, of course, a contentious issue in sports. The bulk of the available science strongly suggests that static stretching before a workout not only does not prevent overuse injuries but also may actually hinder athletic performance. "There is a very important neurological effect of stretching," said Ross Tucker, a physiologist in South Africa and co-author of the Web site The Science of Sport. "There is a reflex that prevents the muscle from being stretched too much," which is activated by static stretching, inducing the muscle to become, in effect, tighter in self-protection. Past studies have found that athletes' vertical jump is lower after a bout of static stretching than with no stretching at all. They can't generate as much power. Meanwhile, other studies have found, like the new track and field association report, that static stretching seems to have little benefit in terms of injury prevention, particularly against the overuse injuries common in



running. “The findings of this present study are totally in line with the existing literature,” said Malachy McHugh, the director of research at the Nicholas Institute of Sports Medicine and Athletic Trauma and the lead author of a comprehensive new review of decades’ worth of stretching research published in April in the Scandinavian Journal of Medicine and Science in Sports.

But many people remain fiercely attached to their stretching routines. “It was really hard to recruit runners” who, used to stretching, would agree to be randomly assigned to the nonstretching group, said Alan Roth, a former board member of USA Track and Field and coordinator of the study. Once they understood that they might be required to not stretch for three months, they declined to participate. It took the researchers more than two years to coax enough runners to join and complete the study, generating enough data for meaningful results.

And the results are “meaningful,” according to Dr. Dan Pereles, an orthopedic surgeon in the Washington area who originated and led the study. “I had gone into this thinking that stretching would prevent injuries. I was fairly sure of it. But that’s not what we found.” Instead, static stretching provided no particular benefit. On the other hand, it didn’t cause harm, either.

One anomalous finding of the USA Track and Field study was that runners who were used to stretching and were assigned to the nonstretching group became injured at a disproportionately high rate. Almost 23 percent of them wound up hurting themselves during the three months. But no experts associated with the study or who have read the results believe that this finding intimates that stretching had been keeping them uninjured in the past. More likely, Dr. McHugh said, they fell victim to a training error, which, he explained, “in reality can mean any abrupt change in training patterns. Your body adapts to its routine, and if that routine is monotonously habitual as with many runners, it doesn’t take much of a change to cause an injury.”

So is the primary takeaway of the USA Track and Field study that, whatever you’re doing now in terms of stretching or not stretching, don’t stop? Possibly, but most physiologists, taking a broader view of the available science, would probably say no. “In all our involvement with elite athletes now, we don’t do this kind of static stretching anymore,” Dr. Tucker said. Instead, the best science suggests that an ideal preworkout routine “consists of a very easy warm-up, followed by a gradual increase in intensity and then dynamic stretching,” he said. Dynamic stretching, or exercises that increase your joints’ range of motion via constant movement, does not seem to invoke the inhibitory reflex of static stretching, Dr. Tucker said. When “you stretch through movement, you involve the brain much more, teaching proprioception and control, as well as improving flexibility.”

In practice, dynamic stretching would mean that, instead of leaning over and touching your toes or pushing against a wall to stretch your calves before running, you might raise your leg before you in a marching motion, and then swing it back, in a well-controlled arc, suggested Phil Wharton, a neuromuscular therapist and founder, with his father, Jim, of the Wharton Performance clinic in New York City. Or lift your leg to the side and scissor it in front of you to warm up the hip joint.

But make any such alterations to your routine gradually, with circumspection. If there’s one lesson from the USA Track and Field study, said Dr. Pereles, it is that “sudden changes are probably not a good idea.”

<http://well.blogs.nytimes.com/2010/09/01/phys-ed-does-stretching-before-running-prevent-injuries/?ref=magazine>



## Polyamory chic, gay jealousy and the evolution of a broken heart

By Jesse Bering



There's a strange whiff in the media air, a sort of polyamory chic in which liberally minded journalists, an aggregate mass of antireligious pundits, and even scientists themselves have begun encouraging readers and viewers to use evolutionary theory to revisit and revise their sexual attitudes and, more importantly, their behaviors in ways that fit their animal libidos more happily.

Much of this discussion is being fueled by Christopher Ryan and Cacilda Jethá's scintillating new book *Sex at Dawn*, which explores how our modern, God-ridden, puritanical society conflicts with our species' evolutionary design, a tension making us pathologically ashamed of sex. There are of course many important caveats, but the basic logic is that, because human beings are not naturally monogamous but rather have been explicitly designed by natural selection to seek out 'extra-pair copulatory partners'—having sex with someone other than your partner or spouse for the replicating sake of one's mindless genes—then suppressing these deep mammalian instincts is futile and, worse, is an inevitable death knell for an otherwise honest and healthy relationship.

Intellectually, I can get on board with this. If you believe, as I do, that we live in a natural rather than a supernatural world, then there is no inherent, divinely inspired reason to be sexually exclusive to one's partner. If you and your partner want to screw your neighbors on Wednesday nights after tacos, participate in beachside orgies lit by bonfire, or pull on your eyeless, kidskin discipline helmet and be led along by bridle and bit down the road to your local bondage society's weekly sex fest, then by all means do so (and take pictures). But the amoralistic beauty of Darwinian thinking is that it does not—or at least, should not and cannot—prescribe any social behavior, sexual or otherwise, as being the “right” thing to do. Right is irrelevant. There is only what works and what doesn't work, within context, in biologically adaptive terms. And so even though any good and proper citizen is an evolutionarily informed sexual libertarian, Darwin

provides no more insight into a moral reality than, say, Dr. Laura Schlessinger.

(On a related tangent, why do we look for moral guidance about human sexuality in the rest of the animal kingdom, a logical fallacy in which what is “natural”—such as homosexual behavior in other species—is regarded as “acceptable”? As if the fact that bonobos, desert toads, and emus have occasional same-sex liaisons has any moral bearing whatsoever on gay rights in human beings—even if we were the lone queer species in this godless galaxy, even if it were entirely a “choice” between two consenting adults, why would that make it more reasonable to discriminate against people in homosexual relationships?)

Beyond these philosophical problems with seeking out social prescriptions from a nature that is completely mute as to what we should do with our penises and vaginas, however, there’s an even bigger hurdle to taking polyamory chic beyond the tabloids, talk shows, and message boards and into standard bedroom practice. And that is simply the fact that we’ve evolved to empathize with other people’s suffering, including the suffering of the people we’d betray by putting our affable genitals to their evolved promiscuous use.

Heartbreak is every bit as much a psychological adaptation as is the compulsion to have sex with those other than our partners, and it throws a monster of a monkey wrench into the evolutionists’ otherwise practical polyamory. It’s indeed natural for people—especially men—to seek sexual variety. My partner once likened this to having the same old meal over and over again, for years on end; eventually you’re going to get some serious cravings for a different dish. But I reminded him that people aren’t the equivalent of a plate of spaghetti. Unfortunately, we have feelings.

Unless you have the unfortunate luck of being coupled with a psychopath, or have the good fortune of being one yourself, broken hearts are not easily experienced at either end, nor are they easily mended by reason or waved off by all the evolutionary logic in the world. And because we’re designed by nature to be not only moderately promiscuous but also to become selfish when that natural promiscuity rears its head—again, naturally—in our partners, “reasonable people” are far from immune to getting hurt by their partner’s open and agreed-upon sex with other parties. Monogamy may not be natural, but neither is indifference to our partners’ sex lives or tolerance for polyamory. In fact, for many people, especially those naively taking guidance from evolutionary theorists without thinking deeply enough about these issues, polyamory can lead to devastating effects.

One of the better evolutionary-based accounts of the human heartbreak experience is a 2006 summary by Rutgers University anthropologist Helen Fisher. Drawing largely from work by psychiatrists, Fisher surmises that there are two main stages associated with a dead and dying romantic relationship, which is of course often preceded by a partner’s infidelities. During the “protest” stage that occurs in the immediate aftermath of rejection:

Abandoned lovers are generally dedicated to winning their sweetheart back. They obsessively dissect the relationship, trying to establish what went wrong; and they doggedly strategize about how to rekindle the romance. Disappointed lovers often make dramatic, humiliating, or even dangerous entrances into a beloved’s home or place of work, then storm out, only to return and plead anew. They visit mutual haunts and shared friends. And they phone, e-mail and write letters, pleading, accusing and/or trying to seduce their abandoner. At the neurobiological level, the protest stage is characterized by unusually heightened, even frantic activity of dopamine and norepinephrine receptors in the brain, which has the effect of pronounced alertness similar to what is found in young animals abandoned by their mothers. This impassioned protest stage—if it proves unsuccessful in re-establishing the romantic relationship—slowly disintegrates into the second stage of heartbreak, what Fisher refers to as “resignation/despair”:

With time the spurned individual gives up pursuit of the abandoning partner. Then he or she must deal with intensified feelings of helplessness, resignation and despair. Drugged by sorrow, most cry, lie in bed, stare into space, drink too much, or hole up and watch TV. Feelings of protest and anger resurface intermittently, but rejected lovers mostly just feel profound melancholy ... Some people in the despair phase of rejection kill themselves. Some die of a broken heart. Broken-hearted lovers expire from heart attacks or strokes caused by their depression ... As the abandoned partner realizes that [reunion] will never come, dopamine-making cells in the midbrain decrease their activity [causing] lethargy, despondency and depression.

It's depressing to even read about, I know, but for most people, those all-important chemicals eventually begin pulsating again when a new love affair begins. Let me note, however, that one of the more fascinating things about the resignation/despair stage, and one that Fisher doesn't really touch on, is the possibility that it actually serves an adaptive signalling function that may help salvage the doomed relationship, especially for an empathetic species such as our own. As I mentioned earlier, heartbreak is not easily experienced at either end, and when your actions have produced such a sad and lamentable reaction in another person, when you watch someone you care about (but no longer feel any real long-term or sexual desire to be with) suffer in such ways, it can be difficult to fully extricate yourself from a withered romance. If I had to guess—and this is just a hunch, in the absence of any studies that I'm aware of to support this claim—I'd say that a considerable amount of genes have replicated in our species solely because, with our damnable social cognitive abilities, we just don't have the heart to break other people's hearts.

In any event, we may not be a sexually exclusive species, but we do form deep romantic attachments, and the emotional scaffolding on which these attachments are built is extraordinarily sensitive to our partners' sexual indiscretions. I also say this as a gay man who, according to mainstream evolutionary thinking, shouldn't be terribly concerned about his partner having sex with strangers. After all, it isn't as though he's going to get pregnant and cuckold me into raising another man's offspring. But if you'd explained that to me as I was screaming invectives at one of my partners following my discovery that he was cheating on me, curled up in the fetal position in the corner of my kitchen and rocking myself into self-pitying oblivion, or as I was vomiting my guts out over the toilet for much of the next two weeks, I would have nodded in rational Darwinian ascension while still trembling like a wounded animal.

Jealousy in homosexual couples is an interesting thing. One of the most frequently cited findings in evolutionary psychology is the fact that men tend to become more jealous when their female partners have sex with other men, whereas women are more jealous when their male partners show signs of "emotional infidelity" with other women. This makes good sense from an evolutionary perspective, because prior to the era of DNA testing, men were extremely vulnerable to being cuckolded and investing their limited resources in some other guys' genes (conveniently packaged in the form of children), whereas women, who evolved to rely on their male partner to help them raise their offspring to reproductive age, were at risk of having his attention—and hence his resources—diverted to another woman and her kids.

So when it comes to homosexual affairs, writes Northern Illinois University psychologist Brad Sagarin and his colleagues in a 2003 report in *Evolution & Human Behavior*, "a same-sex infidelity does not entail the asymmetrical threats of mistaken paternity and of resources being diverted to another woman's children, suggesting both that the sexes may be similar in their jealous responses and that such responses may be less intense than in the case of opposite-sex infidelities." In fact, in studies designed to test this basic hypothesis, the researchers indeed found that jealousy was less intense when straight participants were asked how they would feel, hypothetically, if their partners had a homosexual fling than if they were to become involved with someone from the opposite sex. Personally, I think the participants would have other things to worry about besides jealousy if their partners were on the down-low, but these data do clearly show that reproductive-related concerns indeed moderate jealousy feelings in human romantic relationships.

But bisexuality aside, as any gay person with a past knows, homosexual relationships certainly aren't without their fair share of jealousy. Although as a general rule gay men are indeed less distressed by sexual infidelity than are straight men, there are meaningful individual differences in this regard—and, I'm willing to go out on a limb and say this, most of us gay men certainly aren't completely okay with the idea of our partners having sex with whomever they please, nor are most lesbians comfortable with their partners committing emotional infidelity with other women. Now perhaps I'm in a minority in caring so much about my partner's same-sex behaviors—at least, the ones not including me. Dan Savage, for example, said recently that [gay men] are “not psycho like straight people are about [sexual infidelity in their partners].” But I'm not so sure. Often we're just as psycho. In my case, when back then I informed the sexual interloper that I would gladly emasculate him with a crisp pair of scissors if ever he made contact again with my long-term partner, this was classically aggressive “mate-guarding” behavior as seen in straight men threatening their sexual rivals.

So to me, and because fatal sexually transmitted infections for which gay men are unusually vulnerable, such as HIV, were not present in the ancestral past and could not have produced any special adaptive psychological defenses, sexual jealousy in gay men can only be explained by some sort of pseudo-heterosexuality mindset simulating straight men's hypervigilance to being cuckolded by their female partners. All this is to say that I reacted the way I did because, at an unconscious level, I didn't want my testicular partner getting impregnated by another man. I don't consciously think of him as a woman, mind you; in fact, if I did, I assure you I wouldn't be with him. But tell that to my gonads and amygdalae. I would imagine the same is largely true for lesbian relationships; at an unconscious level, a lesbian's bonding with another woman may trigger concerns in her partner about her “male” spouse's disinvestment in real or prospective offspring.

And that's this once-heartbroken gay evolutionary psychologist's musings for the day.

<http://www.scientificamerican.com/blog/post.cfm?id=polyamory-chic-gay-jealousy-and-the-2010-08-25>

## Digital Devices Deprive Brain of Needed Downtime

By MATT RICHTEL



SAN FRANCISCO — It's 1 p.m. on a Thursday and Dianne Bates, 40, juggles three screens. She listens to a few songs on her iPod, then taps out a quick e-mail on her iPhone and turns her attention to the high-definition television.

Just another day at the gym.

As Ms. Bates multitasks, she is also churning her legs in fast loops on an elliptical machine in a downtown fitness center. She is in good company. In gyms and elsewhere, people use phones and other electronic devices to get work done — and as a reliable antidote to boredom.

Cellphones, which in the last few years have become full-fledged computers with high-speed Internet connections, let people relieve the tedium of exercising, the grocery store line, stoplights or lulls in the dinner conversation.

The technology makes the tiniest windows of time entertaining, and potentially productive. But scientists point to an unanticipated side effect: when people keep their brains busy with digital input, they are forfeiting downtime that could allow them to better learn and remember information, or come up with new ideas.

Ms. Bates, for example, might be clearer-headed if she went for a run outside, away from her devices, research suggests.

At the University of California, San Francisco, scientists have found that when rats have a new experience, like exploring an unfamiliar area, their brains show new patterns of activity. But only when the rats take a

break from their exploration do they process those patterns in a way that seems to create a persistent memory of the experience.

The researchers suspect that the findings also apply to how humans learn.

“Almost certainly, downtime lets the brain go over experiences it’s had, solidify them and turn them into permanent long-term memories,” said Loren Frank, assistant professor in the department of physiology at the university, where he specializes in learning and memory. He said he believed that when the brain was constantly stimulated, “you prevent this learning process.”

At the University of Michigan, a study found that people learned significantly better after a walk in nature than after a walk in a dense urban environment, suggesting that processing a barrage of information leaves people fatigued.

Even though people feel entertained, even relaxed, when they multitask while exercising, or pass a moment at the bus stop by catching a quick video clip, they might be taxing their brains, scientists say.

“People think they’re refreshing themselves, but they’re fatiguing themselves,” said Marc Berman, a University of Michigan neuroscientist.

Regardless, there is now a whole industry of mobile software developers competing to help people scratch the entertainment itch. Flurry, a company that tracks the use of apps, has found that mobile games are typically played for 6.3 minutes, but that many are played for much shorter intervals. One popular game that involves stacking blocks gets played for 2.2 minutes on average.

Today’s game makers are trying to fill small bits of free time, said Sebastien de Halleux, a co-founder of PlayFish, a game company owned by the industry giant Electronic Arts.

“Instead of having long relaxing breaks, like taking two hours for lunch, we have a lot of these micro-moments,” he said. Game makers like Electronic Arts, he added, “have reinvented the game experience to fit into micro-moments.”

Many business people, of course, have good reason to be constantly checking their phones. But this can take a mental toll. Henry Chen, 26, a self-employed auto mechanic in San Francisco, has mixed feelings about his BlackBerry habits.

“I check it a lot, whenever there is downtime,” Mr. Chen said. Moments earlier, he was texting with a friend while he stood in line at a bagel shop; he stopped only when the woman behind the counter interrupted him to ask for his order.

Mr. Chen, who recently started his business, doesn’t want to miss a potential customer. Yet he says that since he upgraded his phone a year ago to a feature-rich BlackBerry, he can feel stressed out by what he described as internal pressure to constantly stay in contact.

“It’s become a demand. Not necessarily a demand of the customer, but a demand of my head,” he said. “I told my girlfriend that I’m more tired since I got this thing.”



In the parking lot outside the bagel shop, others were filling up moments with their phones. While Eddie Umadhay, 59, a construction inspector, sat in his car waiting for his wife to grocery shop, he deleted old e-mail while listening to news on the radio. On a bench outside a coffee house, Ossie Gabriel, 44, a nurse practitioner, waited for a friend and checked e-mail “to kill time.”

Crossing the street from the grocery store to his car, David Alvarado pushed his 2-year-old daughter in a cart filled with shopping bags, his phone pressed to his ear.

He was talking to a colleague about work scheduling, noting that he wanted to steal a moment to make the call between paying for the groceries and driving.

“I wanted to take advantage of the little gap,” said Mr. Alvarado, 30, a facilities manager at a community center.

For many such people, the little digital asides come on top of heavy use of computers during the day. Take Ms. Bates, the exercising multitasker at the expansive Bakar Fitness and Recreation Center. She wakes up and peeks at her iPhone before she gets out of bed. At her job in advertising, she spends all day in front of her laptop.

But, far from wanting a break from screens when she exercises, she says she couldn’t possibly spend 55 minutes on the elliptical machine without “lots of things to do.” This includes relentless channel surfing.

“I switch constantly,” she said. “I can’t stand commercials. I have to flip around unless I’m watching ‘Project Runway’ or something I’m really into.”

Some researchers say that whatever downside there is to not resting the brain, it pales in comparison to the benefits technology can bring in motivating people to sweat. “Exercise needs to be part of our lives in the sedentary world we’re immersed in. Anything that helps us move is beneficial,” said John J. Ratey, associate clinical professor of psychiatry at the Harvard Medical School and author of “Spark: The Revolutionary New Science of Exercise and the Brain.”

But all things being equal, Mr. Ratey said, he would prefer to see people do their workouts away from their devices: “There is more bang for your buck doing it outside, for your mood and working memory.”

Of the 70 cardio machines on the main floor at Bakar Fitness, 67 have televisions attached. Most of them also have iPod docks and displays showing workout performance, and a few have games, like a rope-climbing machine that shows an animated character climbing the rope while the live human does so too.

A few months ago, the cable TV went out and some patrons were apoplectic. “It was an uproar. People said: ‘That’s what we’re paying for,’ ” said Leane Jensen, 28, the fitness manager. At least one exerciser has a different take. Two stories up from the main floor, Peter Colley, 23, churns away on one of the several dozen elliptical machines without a TV. Instead, they are bathed in sunlight, looking out onto the pool and palm trees. “I look at the wind on the trees. I watch the swimmers go back and forth,” Mr. Colley said. “I usually come here to clear my head.”

[http://www.nytimes.com/2010/08/25/technology/25brain.html?\\_r=1&src=me&ref=general](http://www.nytimes.com/2010/08/25/technology/25brain.html?_r=1&src=me&ref=general)



## They Crawl, They Bite, They Baffle Scientists

By **DONALD G. McNEIL Jr.**

Don't be too quick to dismiss the common bedbug as merely a pestiferous six-legged blood-sucker. Think of it, rather, as Cimex lectularius, international arthropod of mystery.

In comparison to other insects that bite man, or even only walk across man's food, nibble man's crops or bite man's farm animals, very little is known about the creature whose Latin name means — go figure — “bug of the bed.” Only a handful of entomologists specialize in it, and until recently it has been low on the government's research agenda because it does not transmit disease. Most study grants come from the pesticide industry and ask only one question: What kills it?

But now that it's The Bug That Ate New York, Not to Mention Other Shocked American Cities, that may change.

This month, the Environmental Protection Agency and the Centers for Disease Control and Prevention issued a joint statement on bedbug control. It was not, however, a declaration of war nor a plan of action. It was an acknowledgment that the problem is big, a reminder that federal agencies mostly give advice, plus some advice: try a mix of vacuuming, crevice-sealing, heat and chemicals to kill the things.



It also noted, twice, that bedbug research “has been very limited over the past several decades.” Ask any expert why the bugs disappeared for 40 years, why they came roaring back in the late 1990s, even why they do not spread disease, and you hear one answer: “Good question.”

“The first time I saw one that wasn't dated 1957 and mounted on a microscope slide was in 2001,” said Dini M. Miller, a Virginia Tech cockroach expert who has added bedbugs to her repertoire.

The bugs have probably been biting our ancestors since they moved from trees to caves. The bugs are “nest parasites” that fed on bats and cave birds like swallows before man moved in.

That makes their disease-free status even more baffling.

(The bites itch, and can cause anaphylactic shock in rare cases, and dust containing feces and molted shells has triggered asthma attacks, but these are all allergic reactions, not disease.)

Bats are sources of rabies, Ebola, SARS and Nipah virus. And other biting bugs are disease carriers — mosquitoes for malaria and West Nile, ticks for Lyme and babesiosis, lice for typhus, fleas for plague, tsetse flies for sleeping sickness, kissing bugs for Chagas. Even nonbiting bugs like houseflies and cockroaches transmit disease by carrying bacteria on their feet or in their feces or vomit.

But bedbugs, despite the ick factor, are clean.

Actually it is safer to say that no one has proved they aren't, said Jerome Goddard, a Mississippi State entomologist.

But not for lack of trying. South African researchers have fed them blood with the AIDS virus, but the virus died. They have shown that bugs can retain hepatitis B virus for weeks, but when they bite chimpanzees, the infection does not take. Brazilian researchers have come closest, getting bedbugs to transfer the Chagas parasite from a wild mouse to lab mice.

“Someday, somebody may come along with a better experiment,” Dr. Goddard said.

That lingering uncertainty has led to one change in lab practice. The classic bedbug strain that all newly caught bugs are compared against is a colony originally from Fort Dix, N.J., that a researcher kept alive for 30 years by letting it feed on him.

But Stephen A. Kells, a University of Minnesota entomologist, said he “prefers not to play with that risk.”

He feeds his bugs expired blood-bank blood through parafilm, which he describes as “waxy Saran Wrap.”

Coby Schal of North Carolina State said he formerly used condoms filled with rabbit blood, but switched to parafilm because his condom budget raised eyebrows with university auditors.

Why the bugs disappeared for so long and exploded so fast after they reappeared is another question. The conventional answer — that DDT was banned — is inadequate. After all, mosquitoes, roaches and other insects rebounded long ago.

Much has to do with the bugs' habits. Before central heating arrived in the early 1900s, they died back in winter. People who frequently restuffed their mattresses or dismantled their beds to pour on boiling water — easier for those with servants — suffered less, said the bedbug historian Michael F. Potter of the University of Kentucky.

Early remedies were risky: igniting gunpowder on mattresses or soaking them with gasoline, fumigating buildings with burning sulfur or cyanide gas. (The best-known brand was Zyklon B, which later became infamous at Auschwitz.)

Success finally arrived in the 1950s as the bugs were hit first with DDT and then with malathion, diazinon, lindane, chlordane and dichlorovos, as resistance to each developed. In those days, mattresses were sprayed, DDT dust was sprinkled into the sheets, nurseries were lined with DDT-impregnated wallpaper.

In North America and Western Europe, “the slate was virtually wiped clean,” said Dr. Potter, who has surveyed pest-control experts in 43 countries. In South America, the Middle East and Africa, populations fell but never vanished.

The bugs also persisted on domestic poultry farms and in a few human habitations.

One theory is that domestic bedbugs surged after pest control companies stopped spraying for cockroaches in the 1980s and switched to poisoned baits, which bedbugs do not eat.

But the prevailing theory is that new bugs were introduced from overseas, because the ones found in cities now are resistant to different insecticides from those used on poultry or cockroaches.

Exactly where they came from is a mystery. Dr. Schal is now building a “world bedbug collection” and hopes to produce a global map of variations in their genes, which might answer the question.

Experts say they’ve heard blame pinned on many foreign ethnic groups and on historic events from the fall of the Berlin Wall to the Persian Gulf war to the spread of mosquito nets in Africa. Every theory has holes, and many are simply racist.

(For example, Dr. Potter said, he has heard Mexicans blamed, but Mexican pest control companies he contacted said they rarely see the bugs except in the homes of people returning from the United States, often with scavenged furniture.)

Pest-control companies say hotels, especially airport business hotels and resorts attracting foreign tourists, had the first outbreaks, said both Dr. Potter and Richard Cooper, a pest-control specialist.

Whatever the source, the future is grim, experts agreed.

Many pesticides don’t work, and some that do are banned — though whether people should fear the bug or the bug-killer more is open to debate.

“I’d like to take some of these groups and lock them in an apartment building full of bugs and see what they say then,” Dr. Potter said of environmentalists.

Treatment, including dismantling furniture and ripping up rugs, is expensive. Rather than actively hunting for bugs, hotels and landlords often deny having them. Many people are not alert enough. (Both Mr. Cooper and Dr. Goddard said they routinely pull apart beds and even headboards when they check into hotels. Dr. Goddard keeps his luggage in the bathroom. Mr. Cooper heat-treats his when he gets home.)

Some people overreact, even developing delusional parasitosis, the illusion that bugs are crawling on them.

“People call me all the time, losing their minds, like it’s a curse from God,” Dr. Miller said. The reasonable course, Dr. Goddard said, is to recognize that we are, in effect, back in the 1920s “Sleep tight, don’t let the bedbugs bite” era. People should be aware, but not panicky.

However, he added, “I don’t even know what to say about them being in theaters. That’s kind of spooky.”

Well, he was asked — can you feel them bite? “No,” he said. “If I put them on my arm and close my eyes, I never feel them. But I once got my children to put them on my face, and I did. Maybe there are more nerve endings.”

Why in the world, he was asked, would he ask kids to do that?

“Oh, you know,” he said. “Bug people are crazy.”

<http://www.nytimes.com/2010/08/31/science/31bedbug.html?ref=science>

## Special Adhesive Helps Oysters Stick Together

By SINDYA N. BHANOO



Oysters and other marine organisms like to attach themselves to one another, creating dense reefs that in undamaged conditions can extend for miles. In sticking together, oysters avoid major impact from waves, and can more easily reproduce. By forming a dense block, the oysters also make it difficult for predators to remove individual oysters.

Now, researchers have found that the adhesive that oysters produce is a unique material. Their findings will appear in the *Journal of the American Chemical Society*. The material differs in makeup from the compound oysters produce to create their shells, and from the glue made by other marine organisms like mussels and snails.

Both oyster shell and oyster adhesive are made of protein and calcium carbonate, said Jonathan Wilker, a chemist at Purdue University and one of the study's authors. However, while shell contains about 1 to 2 percent protein, oyster adhesive contains five times this amount.

Still, oysters seem to use far less protein in their adhesive than other marine animals do. Mussels and barnacles produce a softer glue with more protein, while oysters produce a harder cementlike material.

Understanding more about oyster adhesives could help scientists develop better synthetic glues that could have applications in medicine. "It's the idea of wet-setting adhesives," Dr. Wilker said. "The one that comes to mind is a glue that could hold together skin after surgery, and eliminate the need for sutures and staples."

Such adhesives could also be used to cement bones or in dental work, he said.

<http://www.nytimes.com/2010/08/31/science/31oboyster.html?ref=science>

## From a Desert Plant, a Scented Cry for Help

By SINDYA N. BHANOO



Most animals let out a cry when they are wounded. But plants, without a voice to scream, instead let out a smell.

When plants are damaged, they emit a fragrance called green leaf volatiles, or G.L.V.'s. Most people have gotten a whiff of it — it is the smell of freshly cut grass.

But in the case of at least one type of wild tobacco plant found in the Great Basin desert of southwest Utah, it is an actual distress call. When the plant is attacked, the call triggers the arrival of bugs that act as little firefighters, according to [a new study in the journal Science](#).

It works like this: when tobacco hornworm caterpillars start munching on the plant, their saliva interacts with the G.L.V.'s, causing a chemical change to the G.L.V. compounds.

This new compound attracts the arrival of insects known as true bugs that prey on hornworm eggs and larvae, thereby preventing further damage to the plant.

“It’s as if the caterpillar is calling the police on itself,” said [Ian Baldwin](#), a molecular ecologist at the Max Planck Institute for Chemical Ecology in Germany and one of the study’s authors. “We wondered, how could this evolve this way?”

Dr. Baldwin and his colleagues believe that the caterpillar may derive some benefit from the G.L.V.'s. “This is just an idle speculation at the moment, but maybe it’s antimicrobial and the caterpillars are benefiting by getting a kind of mouthwash,” he said.

Further research could help scientists engineer other plants in similar ways to protect themselves from pests.

<http://www.nytimes.com/2010/08/31/science/31obbug.html?ref=science>



## Advances Offer Path to Further Shrink Computer Chips

By **JOHN MARKOFF**

Scientists at Rice University and Hewlett-Packard are reporting this week that they can overcome a fundamental barrier to the continued rapid miniaturization of computer memory that has been the basis for the consumer electronics revolution.

In recent years the limits of physics and finance faced by chip makers had loomed so large that experts feared a slowdown in the pace of miniaturization that would act like a brake on the ability to pack ever more power into ever smaller devices like laptops, smartphones and digital cameras.

But the new announcements, along with competing technologies being pursued by companies like IBM and Intel, offer hope that the brake will not be applied any time soon.

In one of the two new developments, Rice researchers are reporting in *Nano Letters*, a journal of the American Chemical Society, that they have succeeded in building reliable small digital switches — an essential part of computer memory — that could shrink to a significantly smaller scale than is possible using conventional methods.

More important, the advance is based on silicon oxide, one of the basic building blocks of today's chip industry, thus easing a move toward commercialization. The scientists said that PrivaTran, a Texas startup company, has made experimental chips using the technique that can store and retrieve information.

These chips store only 1,000 bits of data, but if the new technology fulfills the promise its inventors see, single chips that store as much as today's highest capacity disk drives could be possible in five years. The new method involves filaments as thin as five nanometers in width — thinner than what the industry hopes to achieve by the end of the decade using standard techniques. The initial discovery was made by Jun Yao, a graduate researcher at Rice. Mr. Yao said he stumbled on the switch by accident.

Separately, H.P. is to announce on Tuesday that it will enter into a commercial partnership with a major semiconductor company to produce a related technology that also has the potential of pushing computer data storage to astronomical densities in the next decade. H.P. and the Rice scientists are making what are called memristors, or memory resistors, switches that retain information without a source of power.

“There are a lot of new technologies pawing for attention,” said Richard Doherty, president of the Envisioneering Group, a consumer electronics market research company in Seaford, N.Y. “When you get down to these scales, you're talking about the ability to store hundreds of movies on a single chip.”

The announcements are significant in part because they indicate that the chip industry may find a way to preserve the validity of Moore's Law. Formulated in 1965 by Gordon Moore, a co-founder of Intel, the law is an observation that the industry has the ability to roughly double the number of transistors that can be printed on a wafer of silicon every 18 months.

That has been the basis for vast improvements in technological and economic capacities in the past four and a half decades. But industry consensus had shifted in recent years to a widespread belief that the end of physical progress in shrinking the size modern semiconductors was imminent. Chip makers are now confronted by such severe physical and financial challenges that they are spending \$4 billion or more for each new advanced chip-making factory.



I.B.M., Intel and other companies are already pursuing a competing technology called phase-change memory, which uses heat to transform a glassy material from an amorphous state to a crystalline one and back.

Phase-change memory has been the most promising technology for so-called flash chips, which retain information after power is switched off.

The flash memory industry has used a number of approaches to keep up with Moore's law without having a new technology. But it is as if the industry has been speeding toward a wall, without a way to get over it.

To keep up speed on the way to the wall, the industry has begun building three-dimensional chips by stacking circuits on top of one another to increase densities. It has also found ways to get single transistors to store more information. But these methods would not be enough in the long run.

The new technology being pursued by H.P. and Rice is thought to be a dark horse by industry powerhouses like Intel, I.B.M., Numonyx and Samsung. Researchers at those competing companies said that the phenomenon exploited by the Rice scientists had been seen in the literature as early as the 1960s.

"This is something that I.B.M. studied before and which is still in the research stage," said Charles Lam, an I.B.M. specialist in semiconductor memories.

H.P. has for several years been making claims that its memristor technology can compete with traditional transistors, but the company will report this week that it is now more confident that its technology can compete commercially in the future.

In contrast, the Rice advance must still be proved. Acknowledging that researchers must overcome skepticism because silicon oxide has been known as an insulator by the industry until now, Jim Tour, a nanomaterials specialist at Rice said he believed the industry would have to look seriously at the research team's new approach.

"It's a hard sell, because at first it's obvious it won't work," he said. "But my hope is that this is so simple they will have to put it in their portfolio to explore."

<http://www.nytimes.com/2010/08/31/science/31compute.html?ref=science>

## Fossil Hunters in Romania Find a 2-Clawed Relative of Velociraptor

By **JOHN NOBLE WILFORD**



Nothing quite like it, a dinosaur with two sicklelike claws on each foot, was known to live in the final period of the age of great reptiles. Little wonder fossil hunters in Romania were astonished when they unearthed remains of a distant relative of Velociraptor, the familiar single-claw predator of fierce repute, and saw its unusual stocky limbs and double-clawed feet.

The discoverers reported on Monday that the dinosaur, the size of a gigantic turkey, was a meat-eating creature that lived more than 65 million years ago in the Late Cretaceous period. They named it Balaur bondoc, which means “stocky dragon.”

Romanian scientists and other experts said that Balaur is the first reasonably complete skeleton of a predatory dinosaur from Europe at that time. Of perhaps surpassing importance, they said, the discovery may provide insights into the development of dinosaurs and other animals in a long-ago European ecosystem much different from that of today.

Before the end of the Cretaceous, Europe was an archipelago of islands in higher seas. Previous fossil discoveries indicated that life there followed the pattern known as the “island effect.” Animals in isolation, including plant-eating dinosaurs, often evolved as smaller, more primitive versions of their continental relatives. Balaur both did and did not seem to conform to the pattern.

In a report this week in The Proceedings of the National Academy of Sciences, the discovery team said the unusual species “provides support for the aberrant nature of the Late Cretaceous European island-dwelling dinosaurs, but indicates that predators on these islands were not necessarily small, geographically endemic or primitive.”

Not being geographically endemic, the scientists said, meant that Balaur showed kinship to dinosaurs outside Europe, and so there must have been connections with life in Asia and North America. But it was unclear, they noted, if “the ‘island effect’ was expressed differently, or at all, in these animals.”

The lead author of the research paper was Zoltan Csiki, a paleontologist at the University of Bucharest, and one of the co-authors was Matyas Vremir, a geologist at the Transylvanian Museum Society, who excavated the fossils over the last 10 years.

“We’ve been waiting for something like this, and it’s really, really weird,” Mark A. Norell, a dinosaur paleontologist at the American Museum of Natural History and a co-author of the paper, said in an interview last week.

The researchers said the Balaur skeleton showed at least 20 characteristics in the foot, leg and pelvis not seen in other predatory dinosaurs. The most singular of these is the two sharp claws on each foot, one evolved from the big toe, the other from the second toe. It appeared that the stout lower limbs were used to grasp and disembowel prey.

Stephen L. Brusatte, a graduate student at Columbia University who analyzed the fossils, said that compared to Velociraptor, “Balaur was probably more of a kickboxer than a sprinter, and it might have been able to take down larger animals than itself, as many carnivores do today.”

It is “a new breed of predatory dinosaur,” he said, “very different from anything we have ever known.”

<http://www.nytimes.com/2010/08/31/science/31dino.html?ref=science>

## Teary-Eyed Evolution: Crying Serves A Purpose

by [Allison Aubrey](#)



Dani Pozo/AFP/Getty Images

A supporter of the Spanish team cries while watching the World Cup final soccer match, which Spain won 1-0. Crying may have evolved as a signal to those who were in close physical proximity to us, but it also adds a powerful dimension to interpersonal communication

August 23, 2010

Many animals yelp or cry out when they're in pain. But as far as scientists can tell, we humans seem to be the only species that shed tears for emotional reasons. Scientists who study evolution say crying probably conferred some benefit and did something to advance our species — because it's stayed with us.

Tears are universal. We need them to keep our eyes lubricated, but why on earth should streams of salty drops spew forth from our eyes, blurring our vision and making our eyes puffy when we get emotional?

One theory is that crying may have evolved as a kind of signal — a signal that was valuable because it could only be picked up by those closest to us who could actually see our tears. Tears let our intimates in — people within a couple of feet of us, who would be more likely to help.

"You can imagine there'd be a selection pressure to develop a signaling system that wouldn't let predators in on the fact that you're vulnerable," says Randy Cornelius, a psychologist at Vassar College.

The notion that objects can represent ideas is one of the key traits that make us human.

### Tears Share More Than Words

Actors have a few tricks to help them cry on cue. A fresh, chopped onion can get the tear ducts going, and glycerin drops can help produce those big, beautiful tears that roll down the cheeks. Sometimes actors need these techniques because it's hard to cry unless you're really feeling something.

"Crying has to come from emotion, right? That's where we all cry from," says Jane Daly, an actress and acting instructor. She says tears come not only from grief or pain, but also from all sorts of other emotions, including joy and frustration. Tears can be cathartic and releasing. "It's what makes us human," she says.

Tears can play an important role in communication, and the extraordinary thing is that tears don't just telegraph our state of mind to others — they can also evoke strong emotions in the people who witness them.

### Studying Tears

Randolph Cornelius, a professor of psychology at Vassar College, conducted a study to see what information tears themselves convey to others -- a concept he calls "the signal value of tears." Participants in the study were shown a photograph from a common source -- a frame from a daytime television show or a scan from a newsmagazine -- whose subject had tears in his or her eyes. These images were then duplicated, with one version having the tears digitally erased, then shown to study participants who were told to evaluate what emotion the person in the tearful or non-tearful photo is feeling and expressing.

Below are three examples of images, with and without tears.



Courtesy Randolph Cornelius



Courtesy Randolph Cornelius



Courtesy Randolph Cornelius

According to Cornelius: “The presence of tears dramatically increases the level of emotionality that people infer from the photo. Tears also narrow the range of emotions people think the models are experiencing. Tearful people are mostly seen as experiencing emotions in the sadness family (sadness, grief, mourning, etc.).”

Cornelius said in an email that tears convey “very specific information” about the emotional and interpersonal state of a person and how that person would like to be treated. “Within the context of evolutionary theory, these results strongly support the notion that emotional tearing evolved as a system of communication that aids our survival by ensuring that others respond to us when we are feeling vulnerable and in need of emotional succor.”

We not only cry from our own pain, but we're moved to tears by other people's sadness, too. "I like to use the word empathy," Daly says, distinguishing that from sympathy. "With sympathy, we feel sorry for someone. But an empathetic person — a lot of actors — they feel the darn thing," she says.

She points to Tom Hanks' performance in the movie *Saving Private Ryan*, in which he played a World War II captain. She recalls the crying scene after Hanks' men have desperately attempted to save the life of the company medic.

"He just breaks down, sitting on an embankment on the side of a bridge, at another loss of a skilled, wonderful young man who barely had a chance to live," Daly recalls. "To see a grown man cry, it just brings you to your knees."

Watching the movie, we the audience feel it, too. Witnessing these tears, we get choked up. And this is because as humans, one of our signature abilities is that we're able to put ourselves in someone else's shoes to feel what someone else is feeling and predict how they might react — something academics call having a "theory of mind."

### **The Power Of Empathy**

"A theory of mind is something that even 4-year-olds have," says Jesse Bering, who directs the Institute of Cognition and Culture at Belfast University. "It basically means that you have a theory about the unobservable psychological states that are governing — or causing — other people's behaviors."



This power of empathy is huge, and it's fundamental to pretty much everything we do, from forming close relationships to living in complex societies. Bering says those of our early ancestors who were most empathic probably thrived because it helped them build strong communities, which in turn gave them protection and support.

Within these communities, Bering says, tears could be powerful tools. They did more than just signal vulnerability — they were perhaps a way of keeping social and reproductive bonds strong. Maybe good criers were survivors.

"Crying seems to elicit compassion and guilt," Bering says, "and that itself may be an evolved mechanism to save relationships in distress."

He points to a recent experience after his partner cheated on him. "I mean, it was devastating," Bering says, "and I was convinced I was going to end the relationship right there." But many apologies into a long conversation, his partner began to tear up. "It wasn't a hysterical cry," Bering says — his partner was trying to choke back tears. "When I saw him cry, I realized I was basically getting through to him."

Bering says he realizes that the tears did the heavy lifting here. The same conversation minus the tears may not have had the same effect.

### **Tears Of Protection, Shame**

This illustrates another aspect of crying — whether it's intentional or unintentional, crying is a powerful way to get what you need or want.



Noel Celis/AFP

Crying, whether intentionally or unintentionally, is a powerful way to get what you want. And some evidence shows that natural selection favored infants whose cries were most alarming. Above, an infant cries after receiving a measles vaccination in Manila.

Think about how babies get attention — they cry. And there's some evidence that natural selection favored infants whose cries were most alarming.



"As a consequence, these babies — who were our ancestors — would have been less likely to find themselves left at home or with strangers," and theoretically less likely to be harmed, Bering says.

It's possible that crying may protect us throughout our lives. Just think how you react when someone starts to cry.

"It's hard to punish somebody or argue with someone who's crying," Bering says. "It's like a trigger that tells us to back off."

And here's the thing about tears: They don't often lie. Think about Tiger Woods and his public plea for sympathy after his extramarital affairs came to light. When he choked back tears, *Men's Health* editor Peter Moore says, we all knew where those tears were coming from.

"They're kind of shameful tears," Moore says. It's like saying, "I'm a dope, look at what an idiot I am, pity me," he says. "So, spare me. I'd just as soon draw the curtain over that one!"

Maybe that's another reason evolution kept humans weeping: Tears help reveal the truth. And that's because along with the tears, we've evolved a very sophisticated ability to interpret them.

<http://www.npr.org/templates/story/story.php?storyId=129329054>

## The Two-Tier Internet

### *Fighting for Control of the Web's Future*



By Frank Dohmen, Martin U. Müller and Hilmar Schmundt

As data volumes continue to grow, it's clear that the Internet's infrastructure needs upgrading. What's not clear is who is going to pay for it. Web activists fear the development of a two-tier Internet, where corporations have priority and dissenting voices get pushed to the margins.

The group that had gathered in front of Google headquarters in Mountain View, California was relatively small. Only around 100 protesters had turned out to lend offline expression to their anger at the corporation's latest plan.

The online community, however, reacted with far more alarm. Bloggers in the United States, Europe and Asia warned of a threat to Internet freedom, while consumer protection agencies said they feared interference with data traffic that could have unforeseeable consequences for media diversity. Germany's consumer protection minister, Ilse Aigner, declared that she had "no sympathy" for companies "distorting competition at the expense of the consumer."

The cause of all this commotion was seemingly minor, a joint statement issued by Google and telecommunications giant Verizon that outlined in seven brief bullet points the two companies' proposal for a future regulatory framework for the Internet.

Most of the suggestions were hardly spectacular, but one in particular packed a significant punch: The two corporations called for governments to leave it up to the market to determine whether telecommunications companies should be allowed to charge an additional fee for certain data-intensive services -- especially if customers want speedy access. Examples could include medical services, online games or power grid management.

### **No Discrimination**

Until now, the Internet has remained largely neutral, with no one discriminated against and no one given preferential treatment. Blog posts are transmitted just as quickly as Google's data. But the flood of information continues to swell. American technology corporation Cisco predicts that annual data volumes will quadruple by 2014 to around 767 exabytes (one exabyte is equivalent to 1 billion gigabytes) -- a capacity equivalent to 12 billion DVDs per month.

In other words, many billions of euros will need to go into upgrading the Internet over the next months and years. Telecommunications companies fear this will hardly be possible if they continue to play by the conventional rules. They have been flirting for some time with the idea of a two-tier Internet, in which users could pay to have their data transmitted more quickly. Google's latest advance suits these companies quite well.

The Internet, which has been a work-in-progress for the last 30 years, is transforming itself into something new yet again. More and more people access the Internet on the go from their cell phones. Instead of browsers, they prefer a quick click on an app -- a small additional program -- that lets them, for example, listen to the radio via their cell phone.

### **A Growing Cloud**

The Web is also being used to transmit increasing volumes of videos and music, both of which put enormous strain on networks. At the same time, the proportion of Internet traffic related to old-fashioned e-mail is shrinking. Instead, vacation videos and birthday photos -- things that in the past were more likely to be stored at home -- are now being shuffled back and forth online, uploaded to services such as YouTube, Flickr and Picasa (see graphic).

This relatively new approach is known as cloud computing. Thanks to the globally accessible "cloud," home computers have lost their previous importance -- users are increasingly able to store their data on central servers run by telephone or Internet providers.

This development increases the value of the global network, but it also raises some questions. Who, for example, should call the shots in the future? Who should profit from which aspects of the system -- the service provider, the content provider or the customer portal? And which laws should apply to these channels, which are vital to both private individuals and entire economies?

This discussion sees the collision of two very different concepts of freedom. One side insists that individuals should be able to freely access information at any time. The other calls for the companies operating the system to have the freedom to devise new business models.

### **Best Effort No Longer Enough**

Until now, the Internet operated following the so-called "best effort" principle, explains Wolfgang Kopf, head of regulation at the German telecommunications company Deutsche Telekom. This means that any information sent over the Internet by any customer is treated more or less equally, each data packet directed through to its destination regardless of the identity of the customer or the importance of the information.

But as data traffic increases and services grow more sophisticated, this method becomes more difficult. Choppy video transmission, breaks in Skype conversations and incomplete transmission of televised musical events are all possible consequences.

Many telecommunications companies say it will be necessary to invest many billions of euros into the Internet in order to continue to ensure uninterrupted service. They also point out that the ones to profit so far have been providers such as Google, Apple and YouTube, who pay nothing while raking in profits. Investment costs fall instead to the telecommunications companies, who are simultaneously seeing more and more of their traditional business segments collapse. René Obermann, CEO of Telekom, doesn't want his company's role reduced to just providing Internet access for others.

As profit margins for pure Internet service providers grow ever narrower, companies are focusing instead on NGN, or next generation networking. Along with a platform for transferring data, NGN offers a separate control level which creates a simple, long-awaited ability to provide -- and charge for -- express services.

### **Are Customers Willing to Pay?**

Alongside traditional data traffic, it would allow the establishment of paid services which the customer could decide to activate by clicking, for example, on a "high-speed" button. Medical and video applications, for example, could receive a special right of way, while certain search queries could be carried out more quickly and extensively -- provided, of course, that customers are willing to pay for this service, as they are already accustomed to paying for ringtones or apps.

Since Apple's iPhone conquered the market, telecommunications companies and service providers have been experiencing firsthand what happens when network capacity is insufficient. American telephone giant AT&T has been struggling for months with quality issues in its cellular network that have led to dropped calls and sometimes even complete service blackouts, especially in population centers.

Service flat rates provided along with smartphones such as the iPhone are one cause of these problems, as is content, especially radio programs and videos, that pushes networks to their limits. Both customers and providers are getting fed up.

"No one benefits from conditions like these," says Harald Stöber, vice president of the Association of Telecommunications and Value-Added Service Providers (VATM), an interest group representing the other German telecommunications companies that compete against former monopolist Deutsche Telekom. All these competitors find themselves in agreement, for once, on the question of redesigning the Internet. It could allow the creation of new business models in the Internet, Stöber suggests, and companies shouldn't be denied the opportunity.

### **Stuck in the Slow Lane**

Torsten Gerpott, a professor of telecommunications studies in the German city of Duisburg, doesn't see Deutsche Telekom's plans causing massive changes to the system. Consumers already pay different prices for different types of access, he says, and in principle he has few objections to differentiation if the Web is truly experiencing capacity problems.

Nevertheless, critics see this as precisely where freedom for businesses collides with diversity of opinion. They envision, for example, large companies renting out a virtual fast lane for their services and content, with innovative start-ups and critical bloggers relegated to the channels for regular data, the online equivalent of a rough dirt road.

"Companies such as Verizon want to determine which data are transmitted faster, which slower and which not at all -- and who pays how much for it," says Gundolf S. Freyermuth, a professor of applied media studies at

the International Film School in Cologne. "That amounts to attempts to colonize the new public sphere of the Internet."

Organizations for data protection and consumer rights have collected examples of situations in which Internet and telecommunications companies may have abused their power over data. In one 2004 case, according to German consumer rights centers, German Internet provider Freenet blocked its clients' access to certain websites that had expressed criticism toward the company's business practices. The proposed two-class Internet, these organizations say, would open the floodgates for this type of abuse.

### **Already a Reality**

Instead, critics want to legally codify the principle of "Net neutrality." Computer experts such as Kristian Köhntopp, though, warn that this buzzword is too imprecise. "Already, the Internet is often not neutral," Köhntopp explains. Many flat rate packages are shams, he adds, and "providers reduce speeds selectively without informing customers."

"Activists and companies tend to talk as if the two-class Internet were a vision of the future, but it already became reality long ago," says Bernd Holznagel, director of the Institute for Information, Telecommunications and Media Law at the University of Münster.

It especially bothers him that some companies selectively choose what to block. T-Mobile, for one, long kept its competitor Skype from being used on the iPhone. Now, Holznagel says, the competitor is penalized with a separate €10 (\$12.60) fee.

"We need an antidiscrimination clause to make competition and innovation possible," Holznagel says. He also suggests that basic services should be openly available, as is currently the case with postal services or radio. That could create a compromise, something like a "one-and-a-half tier" Internet.

### **Distracted by Smaller Issues**

"Rather than symbolic politics, we need definitions of what Net neutrality really should be -- and this is where the Google/Verizon proposal is very helpful," Holznagel says. Now, he adds, politicians need to take the next step. Holznagel has long been waiting for a draft version of an amendment to Germany's Telecommunication Law (TKG) that the federal government is required to submit by the middle of 2011, according to EU guidelines. "The amendment to the Telecommunication Law is extremely important and there are billions of euros involved," he says.

He feels, however, that attention is being distracted by other, less important debates, such as the ongoing controversy over Google's Street View service, which will be launched in Germany later this year and which has been criticized because of privacy concerns. "Politicians would rather jump on smaller issues like Google Street View," Holznagel says. "After all, photographing buildings is easier to understand."

*Translated from the German by Ella Ornstein.*

### **URL:**

- <http://www.spiegel.de/international/business/0,1518,713835,00.html>



## Doctors Seek Way to Treat Muscle Loss

By **ANDREW POLLACK**



Bears emerge from months of hibernation with their muscles largely intact. Not so for people, who, if bedridden that long, would lose so much muscle they would have trouble standing.

Why muscles wither with age is captivating a growing number of scientists, drug and food companies, let alone aging baby boomers who, despite having spent years sweating in the gym, are confronting the body's natural loss of muscle tone over time.

Comparisons between age groups underline the muscle disparity: An 80-year-old might have 30 percent less muscle mass than a 20-year-old. And strength declines even more than mass. Weight-lifting records for 60-year-old men are 30 percent lower than for 30-year-olds; for women the drop-off is 50 percent.

With interest high among the aging, the market potential for maintaining and rebuilding muscle mass seems boundless. Drug companies already are trying to develop drugs that can build muscles or forestall their weakening without the notoriety of anabolic steroids. Food giants like Nestlé and Danone are exploring nutritional products with the same objective.

In addition, geriatric specialists, in particular, are now trying to establish the age-related loss of muscles as a medical condition under the name sarcopenia, from the Greek for loss of flesh. Simply put, sarcopenia is to muscle what osteoporosis is to bone.

“In the future, sarcopenia will be known as much as osteoporosis is now,” said Dr. Bruno Vellas, president of the International Association of Gerontology and Geriatrics.

Researchers involved in the effort say doctors and patients need to be more aware that muscle deterioration is a major reason the elderly lose mobility and cannot live independently.

“A doctor sees old people who are shrinking and getting weak, but there is no medical terminology that’s been created and made uniform to allow the doctor to make a diagnosis, look at possible causes, and make a treatment plan,” said Dr. Stephanie A. Studenski, a professor of medicine at the [University of Pittsburgh](#).

Of course, commercial interests are at play as well. “If you are trying to sell drugs, you want to have a very clear criterion for diagnosing the problem and for endpoints to treat it,” said Dr. Thomas Lang of the [University of California, San Francisco](#), who is working on techniques for diagnosing sarcopenia.

A task force of academic and industry scientists met in Rome last November and in Albuquerque last month and has submitted a proposed definition of sarcopenia for publication in a medical journal. The meeting received financial support from several drug companies and food companies.

Underscoring the focus on sarcopenia, four European medical societies proposed a somewhat different definition, and Dr. Studenski is developing yet another.

Whatever the definition, experts say, sarcopenia affects about 10 percent of those over 60, with higher rates as age advances. One study estimated that disability caused by sarcopenia accounted for \$18.5 billion in direct medical costs in 2000, equivalent to 1.5 percent of the nation’s health care spending that year.

Causes of the loss of muscle mass or strength might include hormonal changes, sedentary lifestyles, oxidative damage, infiltration of fat into muscles, inflammation and resistance to insulin. Some problems stem from the brain and nervous system, which activate the muscles.

Experts say the best approach to restoring or maintaining muscle mass and strength is exercise, particularly resistance training.

The National Institute on Aging is now sponsoring a controlled trial to test whether exercise can prevent disability in largely sedentary people, age 70 to 89. There is also some early evidence that [nutrition](#), like [vitamin D](#) or high levels of protein, might help. “At this point, what we can say is that older people are at risk for eating too little protein for adequate muscle preservation,” said Dr. Elena Volpi of the [University of Texas Medical Branch](#) in Galveston.

Pharmaceutical companies are paying more attention to muscles, a part of the body they once largely ignored. A year ago, for instance, [GlaxoSmithKline](#) hired William Evans, a leading academic expert on sarcopenia, to run a new muscle research unit.

But with sarcopenia still not established as a treatable condition, “there is no real defined regulatory path as to how one would get approved in this area,” said R. Alan Ezekowitz, a research executive at [Merck](#).

So for now, many companies are focusing on better defined illnesses like [muscular dystrophy](#) and cachexia, the rapid [muscle wasting](#) that can accompany [cancer](#) or other diseases.

One problem is that academic researchers and drug companies initially viewed sarcopenia as primarily a loss of muscle mass, a direct analogy to bone density in osteoporosis. Muscle mass can be measured by the same scans used for bone density.



But some studies have shown that strength, like gripping force, or muscle function, as measured, say, by walking speed, can be more important than mass in predicting problems seniors might have.

“There’s a lot more to the story than simply having a lot of muscle tissue,” said Brian C. Clark, an expert at Ohio University. “Most of the drug stuff has been targeting muscle mass.”

So the definition is shifting to include muscle strength and function. The academic-industry task force recommends testing whether a person can walk four meters, or about 13 feet, in four seconds.

That can be tested by any doctor, without the special equipment needed to measure muscle mass or strength, said Roger A. Fielding of Tufts University, a leader of the task force.

Experts say that to win approval from regulators and reimbursement from insurers, a drug must do more than merely improve mass or strength. It must, for example, improve walking ability or prevent people from falling.

Or perhaps it could restore mobility faster after a person is bedridden. Older people can lose so much muscle during a prolonged hospital stay that they have to move to a nursing home.

Demonstrating such benefits and cost savings would help counter criticism that doctors and drug companies are trying to turn a natural consequence of aging into a disease.

“If you can get out of a nursing home in three weeks instead of three months, wouldn’t we say it is a useful thing?” said Dr. Studenski, who consults for drug companies.

Efforts to develop muscle drugs are still in early stages, and there have been setbacks.

But for inspiration, researchers can look to the bears, though scientists have no definitive answer to the animals’ youthful secret.

Moreover, a study that has tracked 3,000 people for 50 years found that about 20 of them, now in their 80s, have not lost muscle mass.

“Maintaining the muscle is possible,” said Dr. Luigi Ferrucci of the National Institute on Aging, who directs the study, called the Baltimore Longitudinal Study of Aging. “We just don’t know the right formula yet.”

<http://www.nytimes.com/2010/08/31/health/research/31muscle.html?src=me&ref=health>

### Zeros to heroes: What's the use of electricity?

- 08 September 2010 by **Roger Highfield**
- Magazine issue 2777.

*Michael Faraday built an electric motor in 1821 and a rudimentary generator a decade later – but half a century passed before electric power took off*

OF THE many stories of how unlikely discoveries can change the world, this is the best known and remains the most relevant. Whether it is true in fact, or merely in spirit, remains an open question.

In 1821, while working at the Royal Institution in London, Michael Faraday followed up the work of the Dane Hans Christian Ørsted, who, alerted by a twitching compass needle, deduced that electricity and magnetism were linked together. Faraday developed the electric motor and then, a decade later, found that a magnet moving in a wire coil induced a current. In 1845, he formulated that cornerstone of modern physics, the field theory of electromagnetism.

As the story is usually told, the prime minister or some other senior politician was given a demonstration of induction by Faraday. When asked "What good is it?" Faraday replied: "What good is a newborn baby?" Or maybe he said: "Soon you will be able to tax it." The former version of the story originated in a letter sent in 1783 by Faraday's great predecessor in matters electrical, the American philosopher and politician Benjamin Franklin (*Nature*, vol 157, p 196). As for the source of the latter, no one knows.

Whatever was said at the time, the lesson is that it can take half a century for an investment in basic science to bear fruit. Faraday's insights were applied in the 1850s in a failed attempt to build an electrically lit lighthouse, and in long-distance telegraph signalling - which led to the Atlantic telegraph cable. But it was not until the 1880s that electric power began to be widely used.

Frank James, professor of the history of science at the Royal Institution, points to a twist in the story of the encounter. True or not, it took root and was put to use in the 1880s, when the prominent biologist Thomas Huxley and the physicist John Tyndall campaigned for the government to fund science. They succeeded.

<http://www.newscientist.com/article/mg20727771.100-zeros-to-heroes-whats-the-use-of-electricity.html>

## Zeros to heroes: Bayes's probability puzzle

- 08 September 2010 by **Robert Matthews**
- Magazine issue 2777.

*What links modern cosmology to 18th-century musings on billiards? The answer lies in a theorem devised by amateur mathematician Thomas Bayes*

AN ENGLISH cleric pondering balls on a billiard table is the improbable origin of one of the most powerful techniques in modern science. At its root is a simple question. Yet the answer, first outlined almost 250 years ago, provokes debate even now.

In 1764, the Royal Society in London published a paper by Thomas Bayes, a Presbyterian minister and amateur mathematician, which addressed a tricky problem in the theory of probability. Till then, mathematicians had focused on the familiar problem of working out what to expect from, say, a tossed die, when one knows the chance of seeing a particular face is 1 in 6. Bayes was interested in the flip side: how to turn observations of an event into an estimate of the chances of the event occurring again.

In his paper, Bayes illustrated the problem with an esoteric question about the location of billiard balls rolled onto a table. He came up with a formula that turned observations of their final locations into an estimate of the chances of future balls following them. All very trivial - except that the same basic issue underpins science: how do we turn observations into evidence for or against our beliefs? In other words, his work enabled observations to be used to infer the probability that a hypothesis may be true. Bayes was thus laying the foundations for the quantification of belief.

But there was a problem; Bayes himself recognised it, and it still sparks controversy. To derive his formula, Bayes had to make assumptions about the behaviour of the balls, even before making the observations. He believed these so-called "priors" were reasonable, but could see that others might not. He wasn't wrong. For most of the past 200 years, the application of Bayes's methods to science have been dogged by arguments over this issue of prior assumptions.

In recent years, scientists have become more comfortable with the idea of priors. As a result, Bayes's methods are becoming central to scientific progress in fields ranging from cosmology to climate science (*Nature*, vol 350, p 371). Not bad for a formula describing the behaviour of billiard balls.

<http://www.newscientist.com/article/mg20727771.200-zeros-to-heroes-bayess-probability-puzzle.html>

### Zeros to heroes: The invention that's best hidden

- 08 September 2010 by **Roger Highfield**
- Magazine issue 2777.

*A car with just two wheels looked too terrifying to catch on, but the secret of its amazing balancing act is at the heart of today's guidance systems*

LOUIS BRENNAN was an Irish-Australian engineer who devised a deeply unlikely form of transport: It proved to be a dead end, but it blazed a trail for a transport revolution.

Gyroscopes exploit the principle that a rotating object tends to conserve its angular momentum: once it starts spinning, the wheel of a gyroscope resists any force that tries to change its spin axis. Brennan realised that a gyroscope could keep a monorail upright and in 1903 patented the idea. He demonstrated a scaled-down prototype monorail at a Royal Society conversazione in London in 1907 and "aroused the amazed interest of the world" by one account. The celebrated author H. G. Wells alluded to the event in his 1908 novel, *The War in the Air*, and described how the audience was concerned by the idea of a gyro car crossing an abyss on a wire cable: "Suppose the gyroscope stopped!"

Brennan went on to demonstrate a full-scale version in 1909 but, as Wells had suggested, safety fears discouraged its commercialisation. Here, Elmer Sperry enters the story. Having been working on his own gyroscope technology, he bought Brennan's patents and went on to found the Sperry Gyroscope Company in Brooklyn, New York, to pursue marine applications including gyrocompasses and ship stabilisers. Today, devices developed by Sperry and others are ubiquitous. Gyrocompasses use the gyroscopic principle to keep the needle pointing north, and gyroscopes are also at the heart of related guidance, steering and stabilisation equipment on warships, oil tankers, missiles and more.

Gyroscopes are crucial in the systems used to steer, guide and stabilise today's ships

Some see a parallel between the unfounded fears that made Brennan's gyro-stabilised vehicles look unlikely and current opposition to some modern technologies. Brennan's monorail worked on sound principles but people feared that malfunction might cause disaster. Sperry used the same scientific principles but concealed them in the technology so they were not perceived as being risky, according to David Rooney of the Science Museum in London. "Many people still voice Wells's metaphorical concerns," he says. "What if the scientists get it wrong? Are we heading for a fall?"

<http://www.newscientist.com/article/mg20727771.300-zeros-to-heroes-the-invention-thats-best-hidden.html>



### Zeros to heroes: How we almost missed the ozone hole

- 08 September 2010 by **Roger Highfield**
- Magazine issue 2777.

*The axe was poised over the British Antarctic Survey's ozone monitoring programme when it noticed an awfully big hole in the sky*

THE great Ernest Rutherford once remarked that all science is either physics or stamp collecting. While physicists are seekers of the truth who uncover sweeping laws of nature, the rest are mere collectors, who pigeonhole things into categories. But the story of the hole shows that collecting and categorising can have a huge impact.

In the early 1980s, when British research faced government cutbacks, long-term monitoring programmes were under threat. Among them were the measurements of atmospheric ozone at the UK's Halley research station in Antarctica.

The British Antarctic Survey (BAS) was looking at ways to economise, and axing ozone monitoring seemed unlikely to be a big loss. Then, in May 1985, came a bombshell: Joe Farman, Brian Gardiner and Jonathan Shanklin reported large losses of ozone (*Nature*, vol 315, p 207). The BAS researchers were still using a 25-year-old instrument to assess the thickness of the ozone layer by measuring ultraviolet radiation penetrating the atmosphere. Until then there had only been anecdotal reports of low values, but a trend was vividly revealed when the team plotted averages of minimum measurements. Farman then worked out some of the chemistry of the hole.

While the Brits were using their old-fashioned instrument, NASA's Nimbus 7 satellite also produced clear evidence of depletion. But so overwhelming was the flood of data and so unprepared were the Americans for unusually low measurements that, fearing an instrument glitch, it was initially overlooked.

Farman's unexpected discovery showed for all to see how human activity can harm the atmosphere - in this case with the chemicals used in refrigeration, air conditioning and solvents. Governments agreed on action and today ozone levels are predicted to return to their 1950s levels by about 2080 (*Nature*, vol 465, p 34). Not a bad outcome for a boring philately project.

<http://www.newscientist.com/article/mg20727771.400-zeros-to-heroes-how-we-almost-missed-the-ozone-hole.html>

## Zeros to heroes: Putting the 'i' in iPods

- 08 September 2010 by **Michael Brooks**
- Magazine issue 2777.

*They exasperated their 16th-century discoverer, but imaginary numbers have given us everything from quantum mechanics to portable music*

WHEN students encounter imaginary numbers, a common response is: what's the point? Well, quite a lot as it happens, though it took centuries to discover how much.

An imaginary number is the square root of a negative number. Such numbers have become essential tools in microchip design and in digital compression algorithms: your MP3 player relies on imaginary stuff. Even more fundamental than that, imaginary numbers underpin quantum mechanics, the theory that gave rise to the electronics revolution. Little modern technology would exist without complex numbers - numbers which have both a real and an imaginary component.

In the 16th century, when the Italian mathematician Gerolamo Cardano came up with imaginary numbers, even negative numbers were treated with deep suspicion. Though they were difficult beasts, Cardano pressed ahead. At one point, Cardano even wrote that they were "useless", but it is clear that he found them intriguing as well as frustrating. "Cardano wrote a formal expression for complex numbers, he could add and multiply them, but he could not give them any practical or geometrical sense," says Artur Ekert of the University of Oxford.

Rafael Bombelli built on Cardano's work in the 1560s, but imaginary numbers were not taken seriously until mathematicians found links between them and constants such as  $\pi$  and  $e$ . In the 18th century, Leonhard Euler showed that  $e$  raised to the power  $i \times \pi$  equals  $-1$  (where  $i$  is the square root of  $-1$ ). Now imaginary numbers are indispensable.

It seems fitting that their role in quantum theory is to explain the most bizarre aspect of the theory: that quantum objects such as atoms and electrons can exist in two or more places at once. Physicists and philosophers still argue over what this means, but it is clear that the mathematics only works when it includes a complex number known as a "probability amplitude".

Without imaginary numbers, you won't get an answer that reflects the reality of the physical world. And you won't get an iPod either.

<http://www.newscientist.com/article/mg20727771.500-zeros-to-heroes-putting-the-i-in-ipods.html>



### Zeros to heroes: The tragic fate of a genetic pioneer

- 08 September 2010 by **Graham Lawton**
- Magazine issue 2777.

*We now know that gene activity can change significantly without changes to DNA – but did a shamed scientist who killed himself in 1926 get there first?*

WHEN Paul Kammerer shot himself on an Austrian hillside in 1926, he seemed destined to be remembered only as a scientific fraudster who had faked his results to prove a controversial theory. In fact, he might well have glimpsed epigenetics, influential changes in gene activity that do not involve alterations to the DNA sequence.

Kammerer was infamous for his experiments on the midwife toad, *Alytes obstetricans* (pictured above), an unusual amphibian which mates and raises its eggs on dry land. By keeping toads in unusually hot, dry conditions, he drove them to breed and raise their eggs in water. Only a few eggs hatched, but the offspring of these aquatic unions also bred in water. Kammerer claimed this as proof of Lamarckian inheritance - the idea (now known to be wrong) that traits acquired during an individual's lifetime can be passed on to its offspring.

In August 1926, Kammerer was condemned as a fraud in the pages of *Nature* (vol 118, p 518). He killed himself six weeks later. The sad story was largely forgotten until 1971, when Arthur Koestler published a book claiming that the biologist's experiments may have been tampered with by a Nazi sympathiser. Kammerer was a socialist who was planning to build an institute in the Soviet Union, which would have made him a target of Vienna's burgeoning Nazi movement.

Then, last year, biologist Alex Vargas of the University of Chile in Santiago re-examined Kammerer's work. He was not a fraud, Vargas suggests, but had inadvertently discovered epigenetics (*Journal of Experimental Zoology B*, vol 312, p 667). "Kammerer had the right approach," says Vargas, who hopes that the toad experiments will one day be repeated.

We now know that the patterns of inheritance of the kind Kammerer claimed to have seen can be due to epigenetics. This process is central to molecular biology, and numerous drugs based on it are in development. It would have been discovered regardless of Kammerer - but perhaps we would not still be waiting for those drugs if he had been taken seriously.

<http://www.newscientist.com/article/mg20727771.600-zeros-to-heroes-the-tragic-fate-of-a-genetic-pioneer.html>



### Zeros to heroes: The man who learned to fly

- 08 September 2010 by **Roger Highfield**
- Magazine issue 2777.

*George Cayley knew how to make a plane a century before the Wright brothers took off. If only he'd got the internal combustion engine to work*

DURING the 18th and 19th centuries, scientists and the public all believed that it was not only impossible to fly using an artificial wing, but an act of folly to suggest that you could. This did not discourage the English gentleman scientist George Cayley, even though his contemporaries - including his own son - were embarrassed by his efforts.

In 1799, Cayley engraved a silver disc with one side bearing a design for the world's first aeroplane and the other illustrating the earliest published description of the aerodynamic forces on a wing that enable a plane to fly. His three-part treatise *Aerial Navigation*, published in 1809 and 1810, was greeted with scepticism by his contemporaries.

But Cayley "didn't give a rat's ass" about what they all thought, according to Richard Dyde of York University in Ontario, Canada, author of *The Man Who Discovered Flight* - and with good reason. He had completed a series of experiments to back up his theories and "was convinced that everyone else was wrong". Cayley constructed increasingly sophisticated model flying machines, culminating in a full-scale glider, which was flown in 1853 by his grandson, George.

Cayley had completed his experiments and was convinced that everyone else was wrong

This pioneering work would prove inspirational to Orville and Wilbur Wright, who made the first controlled and sustained heavier-than-air human flight 50 years later. Their success was crucially dependent on the recent invention of the internal combustion engine - a device which Cayley, having realised its pivotal importance, had spent many fruitless years trying to develop.

<http://www.newscientist.com/article/mg20727771.700-zeros-to-heroes-the-man-who-learned-to-fly.html>

### Zeros to heroes: Tall tales or the truth of tiny life?

- 08 September 2010 by **James Mitchell Crow**
- Magazine issue 2777.

*When a 17th-century Dutch draper told London's finest minds he had seen "animalcules" through his home-made microscope, they took some convincing*

EARLY in the autumn of 1674, Henry Oldenburg, secretary of the Royal Society in London, received an extraordinary letter. Sent by Antoni van Leeuwenhoek (pictured, left), a draper from Delft in the Netherlands, it contained an unlikely sounding claim.

Using a microscope of his own invention, van Leeuwenhoek had seen tiny creatures, invisible to the naked eye, living in lake water. Some of these "animalcules" were so small, he later estimated, that 30 million of them would still be smaller than a grain of sand.

Royal Society fellows were sceptical. Even with his most powerful instruments, the celebrated English microscopist Robert Hooke had never observed anything like the little creatures.

In fact, the Dutchman had developed far superior lenses to Hooke's, and had discovered bacteria and protozoans. By producing ever smaller and more curved lenses - using a technique that he kept secret - van Leeuwenhoek was able to magnify objects up to 500 times. As well as discovering microorganisms, he was the first to see red blood cells.

In 1677, van Leeuwenhoek sent the Society further animalcule observations. Hooke eventually improved his own microscopes to the point where he, too, could see the tiny creatures. Three years later van Leeuwenhoek was made a fellow.

It was not until 1890, more than 160 years after van Leeuwenhoek's death, that bacteria were linked with disease. "Reading van Leeuwenhoek's letters, you very much get the impression of somebody dazzled by what he was finding," says Lesley Robertson, curator of the archives at Delft University's school of microbiology. "He thought he'd found a whole new world - but he certainly never picked up on the connection with illness."

*In the version of this article printed in New Scientist magazine, Lesley Robertson's name is spelled incorrectly*

<http://www.newscientist.com/article/mg20727771.800-zeros-to-heroes-tall-tales-or-the-truth-of-tiny-life.html>

### Zeros to heroes: Rogue brain-killing proteins

- 08 September 2010 by **Roger Highfield**
- Magazine issue 2777.

*Before winning his Nobel prize, Stanley Prusiner was ridiculed for suggesting that something he called a prion caused spongiform brain diseases*

WHEN the evidence suggested that the baffling "spongiform" brain disorders Creutzfeldt-Jakob disease (CJD), kuru and scrapie could not be transmitted by a virus or bacterium, the neurologist Stanley Prusiner put forward a novel type of infectious agent as the cause: a rogue protein. It was an idea considered so outrageous that Prusiner was ridiculed.

Prusiner first began to study these diseases in 1972, after one of his patients at the University of California, San Francisco, died of CJD. A decade later, in the journal *Science* (vol 216, p 136), he suggested that these diseases were caused by a "proteinaceous infectious particle", or prion.

The idea built on the findings of British researchers. In 1967, Tikvah Alper of the Medical Research Council's Radiopathology Unit showed that whatever it was that caused CJD was unscathed by levels of ultraviolet radiation that would destroy any genetic material (*Nature*, vol 214, p 764). Shortly afterwards, mathematician John Stanley Griffith of Bedford College in London devised a protein-only hypothesis for scrapie propagation. His 1967 *Nature* paper (vol 215, p 1043) states there was no reason to fear that the idea "would cause the whole theoretical structure of molecular biology to come tumbling down".

This work sparked little interest when it was published. By the time Prusiner became involved, however, indifference had hardened into scepticism. In December 1986, a sardonic profile of Prusiner appeared in *Discover* magazine, headed "The name of the game is fame: but is it science?" Yet just 11 years later, he was awarded a Nobel prize. There are still unanswered questions about the prion model, but no one doubts that Prusiner's work provides deeper understanding of this cause of dementia.

<http://www.newscientist.com/article/mg20727771.900-zeros-to-heroes-rogue-brainkilling-proteins.html>



### Zeros to heroes: Ulcer truth that was hard to stomach

- 08 September 2010 by **Michael Le Page**
- Magazine issue 2777.

*No one would believe that bacteria caused stomach ulcers – until Barry Marshall swallowed some*

BACK in 1984, a young Australian doctor called Barry Marshall swallowed a nasty-tasting solution of bacteria. This was no accident. He did it to convince his peers that his suspicions about a highly prevalent disease were not as far-fetched as they thought.

In 1981, Marshall had met pathologist Robin Warren, who had found curved bacteria in inflamed stomach tissue. In further studies, they found that this bacterium, later named *Helicobacter pylori*, was present in most people who had inflammation or ulcers of the stomach or gut. Like two long-forgotten German researchers in 1875, they concluded that these bacteria were to blame.

"I was met with constant criticism that my conclusions were premature," Marshall later wrote. "My results were disputed and disbelieved, not on the basis of science but because they simply could not be true."

It is often claimed that doctors were wedded to the idea that ulcers were caused by excess stomach acid, or that they didn't believe that bacteria could grow in the stomach. In fact, the main reason for the scepticism, says Richard Harvey of the Frenchay Hospital in Bristol, UK, was that four-fifths of ulcers were not in the stomach but further down the digestive tract.

Yet we now know that Marshall was right. After downing his bacterial concoction, he soon became far more ill than he had expected, vomiting and developing stomach inflammation. Later studies confirmed the theory. His discovery made it possible for millions of people to be cured of their ulcers with antibiotics, instead of having to take acid-reducing drugs every day.

It turns out that *H. pylori* causes ulcers by boosting acid production in the stomach. The big mystery is why, when half the world's population carries the bug, only a small proportion develop symptoms. Harvey's team has been studying the benefits of eliminating *H. pylori*, which has been shown to cause stomach cancer as well as ulcers. He has no doubts about his conclusions: "The only good *Helicobacter* is a dead one."

<http://www.newscientist.com/article/mg20727772.000-zeros-to-heroes-ulcer-truth-that-was-hard-to-stomach.html>

### Zeros to heroes: The long wait to speak in code

- 08 September 2010 by **Jeff Hecht**
- Magazine issue 2777.

*Digital sound was invented in 1937 – decades before the technology to use it had been developed*

THOUGH he didn't realise it at the time, in 1937 the British engineer Alec Reeves laid the foundation stone of modern digital telecommunications networks. The valve (vacuum tube) was then in its heyday, digital computers were still years in the future, and the transistor a decade away.

In 1927, commercial transatlantic telephone calls were made possible by radio telephones. In the early 1930s, Reeves helped develop higher-frequency radios that could carry several calls at the same time, but these conversations interfered with each other, producing a noisy, hard-to-understand signal.

Then Reeves realised that converting these analogue representations of speech into a series of telegraph-like pulses might avoid the troublesome interference. He designed circuits to measure the strength of each speaker's voice 8000 times a second and assign that signal strength to one of 32 levels. Each level was then represented by a sequence of five binary digits. As long as the receiver could tell the binary 1s from the 0s, it ought to be able to turn the stream of pulses back into interference-free speech.

That was the theory, at least. "No tools then existed that could make it economic," he wrote more than 25 years later. His employer, ITT, patented pulse-code modulation, but never earned a penny before the patent expired in the 1950s.

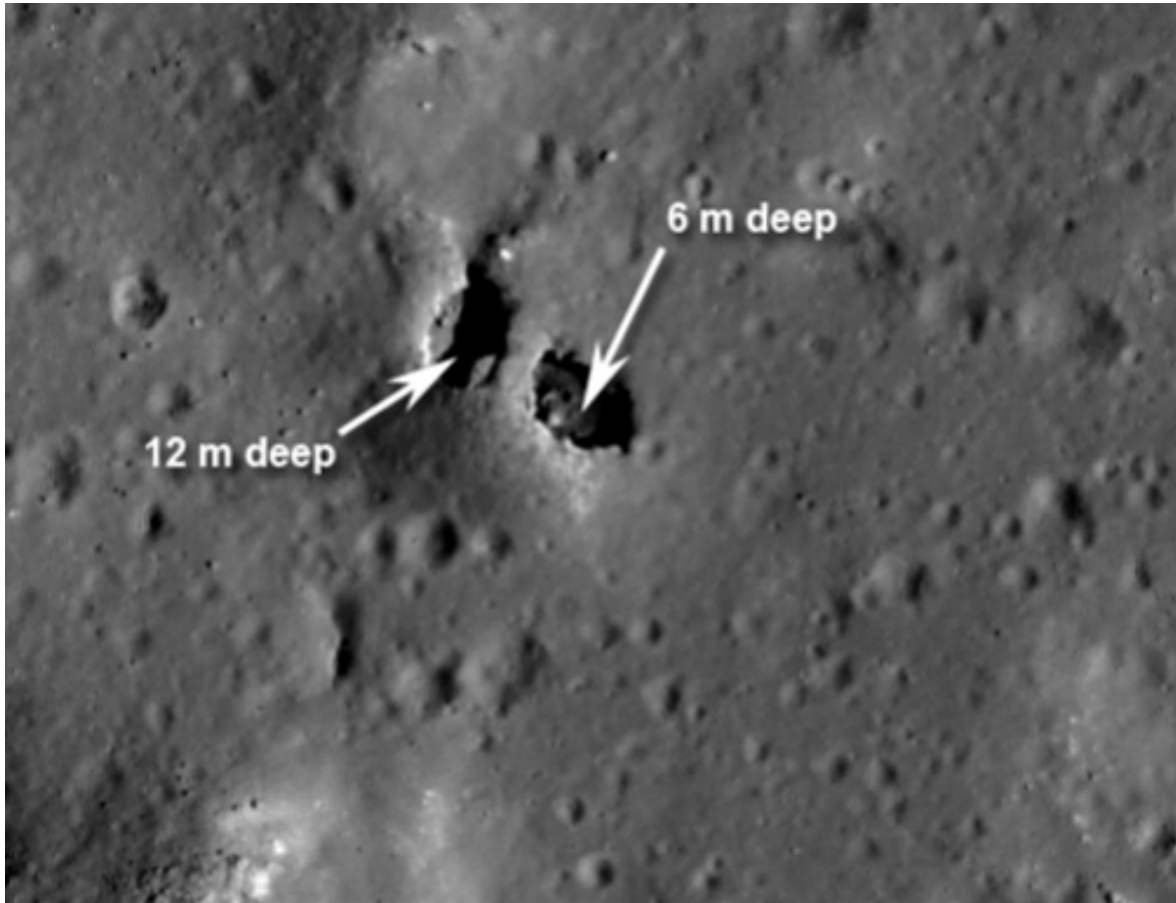
Reeves was something of a visionary, often saying: "I will be right about the things that I say are going to happen, but I will never be right about when." Perhaps he thought he really could see the future. He studied spiritualism and believed he was getting signals in Morse code from other worlds.

ITT managers eventually put him in charge of exploratory research at the Standard Telecommunications Laboratories in Harlow, Essex. In that role, he launched a group to study laser communications, and enthusiastically supported work by Charles Kao that led to the fibre-optic network that today carries pulse-code modulated light signals around the world.

<http://www.newscientist.com/article/mg20727772.100-zeros-to-heroes-the-long-wait-to-speak-in-code.html>

**Found: natural bridges on the moon**

- 17:52 09 September 2010 by Sujata Gupta



A natural bridge spans two collapsed pits. A crescent of light on the pit on the left came from under the bridge, showing that there is indeed space under the rocky arch (Image: NASA/GSFC/Arizona State University)

Natural bridges have been found on the moon for the first time in images taken by a high-resolution camera aboard NASA's Lunar Reconnaissance Orbiter.

Students scrutinising the camera's images have spotted two natural bridges on the moon's far side. The larger bridge measures 20 metres long and 7 metres wide, while its smaller neighbour is about half that size.

Unlike natural bridges on Earth, which form largely by erosion from wind and water, these lunar bridges probably formed as a result of an impact in the last billion years, says Mark Robinson, a planetary geologist at Arizona State University in Tempe and principal investigator for LRO's camera.



The impact melted the surface that it hit and gouged out a 77-kilometre-wide basin known as King crater. Some of the melted rock splashed over the crater's rim, forming a fiery pool of liquid 17 kilometres across just outside the crater's northwest rim.

Like the skin that forms on top of cooked pudding, the surface of this "melt pond" formed a crust as it cooled, while the interior remained molten for longer. As the ground shifted after impact, the molten interior likely flowed downhill, leaving behind unsupported crust that collapsed in two places, creating the natural bridge.

The rocky arches are probably strong enough to support an astronaut, Robinson says, but since the US no longer aims to return people to the moon, it may be a while before we know for sure. "If you can arrange for me to go, I would be delighted to go test its strength out," he says. "I would walk out and jump on it."

<http://www.newscientist.com/article/dn19430-found-natural-bridges-on-the-moon.html>

## Exotic matter could show up in the LHC this year

- 08 September 2010 by **Kate McAlpine**

Magazine issue 2777.



Sparticles must be in there somewhere (Image: Claudia Marcell/CERN)

THE world's most powerful particle smasher could start making major discoveries sooner than we thought.

Evidence of supersymmetry (SUSY), a theory that helps solve several cosmological mysteries, as well as exotic new types of matter may emerge at the Large Hadron Collider (LHC) at CERN near Geneva, Switzerland, by the end of the year. That is if certain particles can decay into lighter ones via newly discovered pathways that are relatively easy to spot.

The assumption had been that the LHC would not have smashed enough particles together by December to see clear evidence of (SUSY). This theory, which suggests that every known particle has a "superpartner" or sparticle, could smooth the way for a "grand unified theory" that brings together the fundamental forces of nature. It could also provide an explanation for dark matter.

To find evidence for SUSY, the LHC needs time to amass enough data to see sparticles decaying unambiguously. So the earliest evidence for SUSY was not expected until mid-2011.

Now Konstantin Matchev of the University of Florida in Gainesville and colleagues say we may not need to wait that long.

Typical SUSY models assume heavy superpartners for the gluon and quarks, and a light neutral particle as a candidate for dark matter. But since the true masses of sparticles are uncertain, Matchev's team considered hundreds of possible masses for them, and worked out the routes by which they could decay into lighter objects.

The team found that if the gluon's superpartner, the gluino, or the lightest super-quarks require at least five steps to decay to the lightest sparticle, then they should ultimately produce up to eight electrons or muons, which are both examples of a family of particles called leptons.

Decays that produce leptons are prized because these particles leave clear tracks in detectors and their energies can be accurately measured. The team calculates that eight leptons would produce a signal clear enough to disentangle even from the meagre LHC data available at the end of this year ([arxiv.org/abs/1008.2483v1](http://arxiv.org/abs/1008.2483v1)). "It's so striking," says Matchev.

Decays that produce leptons are prized as they leave clear tracks and their energies can be measured

It is not known whether the masses considered by Matchev's team are correct, so the results come with a big pinch of salt. In fact, just 1 per cent of all the mass combinations they looked at will produce the eight-lepton signal.

Sparticles aren't the only exotic particles that could turn up before the year is out: diquarks and leptoquarks could also be on the menu, say Jesse Thaler of the Massachusetts Institute of Technology and colleagues. These particles appear in grand unified theories, in which the strong, electromagnetic and weak forces merge at high energies.

Thaler describes the diquark as a single particle that has twice the "quarkness" of a single quark. A leptoquark would allow quarks and leptons to transform in ways that have never been observed and that are forbidden under the standard model of particle physics, which accounts for all particles known to date.

Thaler says that because the LHC collides quark-containing protons with each other, it should be particularly adept at creating diquarks. His team has calculated that both the diquark and leptoquark could show up at the LHC this year (*Physics Letters B*, DOI: [10.1016/j.physletb.2010.05.032](https://doi.org/10.1016/j.physletb.2010.05.032)).

### **Is the Higgs set for a surprise appearance?**

The Higgs boson, thought to give all other particles mass, tops the Large Hadron Collider's most-wanted list. It is unlikely to be seen before 2013 according to the standard model of particle physics, but exotic physics could allow it to arrive sooner.

Modifications to the LHC will require it to be shut down for all of 2012. By then it will have enough data to see a Higgs with a mass between 160 and 180 gigaelectronvolts - except that results from the Tevatron collider in Batavia, Illinois, combined with the standard model, have already ruled out a Higgs mass above about 160 GeV.

But the LHC could be in luck if there are particles and forces outside the standard model. Then the Higgs could be heavier than 160 GeV and emerge in the early data.

What's more, if heavy "fourth generation" quarks - hints of which have shown up at the Tevatron - exist, the LHC could detect a Higgs with a mass of up to 300 GeV before 2012 (*Physical Review D*, DOI: [10.1103/PhysRevD.76.075016](https://doi.org/10.1103/PhysRevD.76.075016)).

The Higgs might also be seen by then if it is lighter than 130 GeV. This could be the case if another particle outside the standard model, the Z-prime, exists as some string theory models predict (*Physical Review D*, DOI: [10.1103/PhysRevD.78.055002](https://doi.org/10.1103/PhysRevD.78.055002)).

<http://www.newscientist.com/article/mg20727774.300-exotic-matter-could-show-up-in-the-lhc-this-year.html>

## Ancient Greeks spotted Halley's comet

- 09 September 2010 by **Jo Marchant**

Magazine issue 2777.



The comet was considered a bad omen in 1066 (Image: Mary Evans/Alamy)

A CELESTIAL event in the 5th century BC could be the earliest documented sighting of Halley's comet - and it marked a turning point in the history of astronomy.

According to ancient authors, from Aristotle onwards, a meteorite the size of a "wagonload" crashed into northern Greece sometime between 466 and 468 BC. The impact shocked the local population and the rock became a tourist attraction for 500 years.

The accounts describe a comet in the sky when the meteorite fell. This has received little attention, but the timing corresponds to an expected pass of Halley's comet, which is visible from Earth every 75 years or so.

Philosopher Daniel Graham and astronomer Eric Hintz of Brigham Young University in Provo, Utah, modelled the path that Halley's comet would have taken, and compared this with ancient descriptions of the comet (*Journal of Cosmology*, vol 9, p 3030). For example, the comet was said to be visible for 75 days, accompanied by winds and shooting stars, and in the western sky when the meteorite fell.

The researchers show that Halley's comet would have been visible for a maximum of 82 days between 4 June and 25 August 466 BC. From 18 July onwards, a time of year characterised in this region by strong winds, it was in the western sky. At around this time, the Earth was moving under the comet's tail, so its debris field would have made shooting stars.

None of this proves the comet's identity, but Graham says such major comet sightings are rare, so Halley must be a "strong contender". Previously, the earliest known sighting of Halley was made by Chinese astronomers in 240 BC. If Graham and Hintz are correct, the Greeks saw it three orbits and more than two centuries earlier.





The researchers' analysis reveals this moment to be a crucial turning point in the history of astronomy. Plutarch wrote in the 1st century AD that a young astronomer called Anaxagoras predicted the meteorite's fall to Earth, which has puzzled historians because such events are essentially random occurrences.

After studying what was said about Anaxagoras, Graham concludes that he should be recognised as "the star of early Greek astronomy". Rather than predicting a particular meteorite, he reckons Anaxagoras made a general statement that rocks might fall from the sky.

At this time, says Graham, everyone thought that celestial bodies such as the moon and planets were fiery, lighter-than-air objects. But after observing a solar eclipse in 478 BC, Anaxagoras concluded that they were heavy, rocky lumps, held aloft by a centrifugal force. This implied that solar eclipses occurred when the moon blocked the light from the sun. It also meant that if knocked from position, such a rock might crash to Earth.

"When the meteorite fell, no one could deny it," says Graham. "The headline was 'Anaxagoras was right'."

Did Halley's comet play a role? It is always possible that the comet might have nudged a near-Earth asteroid from its course and sent it hurtling towards northern Greece. From that point on, the idea of rocks in the sky was accepted, and the Greeks had a new understanding of the cosmos.

<http://www.newscientist.com/article/mg20727774.400-ancient-greeks-spotted-halleys-comet.html>

## Laws of physics may change across the universe

- Updated 12:49 09 September 2010 by Michael Brooks



Do the laws of physics change from one region of space to another? (Image: NASA/ESA/R. Thompson/U of Arizona)

New evidence supports the idea that we live in an area of the universe that is "just right" for our existence. The controversial finding comes from an observation that one of the constants of nature appears to be different in different parts of the cosmos.

If correct, this result stands against Einstein's equivalence principle, which states that the laws of physics are the same everywhere. "This finding was a real surprise to everyone," says John Webb of the University of New South Wales in Sydney, Australia. Webb is lead author on the new paper, which has been submitted to *Physical Review Letters*.

Even more surprising is the fact that the change in the constant appears to have an orientation, creating a "preferred direction", or axis, across the cosmos. That idea was dismissed more than 100 years ago with the creation of Einstein's special theory of relativity.

### Sections of sky

At the centre of the new study is the fine structure constant, also known as alpha. This number determines the strength of interactions between light and matter.

A decade ago, Webb used observations from the Keck telescope in Hawaii to analyse the light from distant galaxies called quasars. The data suggested that the value of alpha was very slightly smaller when the quasar light was emitted 12 billion years ago than it appears in laboratories on Earth today.

Now Webb's colleague Julian King, also of the University of New South Wales, has analysed data from the Very Large Telescope (VLT) in Chile, which looks at a different region of the sky. The VLT data suggests that the value of alpha elsewhere in the universe is very slightly bigger than on Earth.

The difference in both cases is around a millionth of the value alpha has in our region of space, and suggests that alpha varies in space rather than time. "I'd quietly hoped we'd simply find the same thing that Keck found," King says. "This was a real shock."

### Bar magnet

Moreover, the team's analysis of around 300 measurements of alpha in light coming from various points in the sky suggests the variation is not random but structured, like a bar magnet. The universe seems to have a large alpha on one side and a smaller alpha on the other.

This "dipole" alignment nearly matches that of a stream of galaxies mysteriously moving towards the edge of the universe. It does not, however, line up with another unexplained dipole, dubbed the axis of evil, in the afterglow of the big bang.

Earth sits somewhere in the middle of the extremes for alpha. If correct, the result would explain why alpha seems to have the finely tuned value that allows chemistry – and thus life – to occur. Grow alpha by 4 per cent, for instance, and the stars would be unable to produce carbon, making our biochemistry impossible.

### Extraordinary claim

Even if the result is accepted for publication, it is going to be hard to convince other scientists that the laws of physics might need a rewrite. A spatial variation in the fine-structure constant would be "truly transformative", according to Lennox Cowie, who works at the Institute for Astronomy in Hawaii. But, he adds, extraordinary claims require extraordinary evidence: "That's way beyond what we have here." He says the statistical significance of the new observations is too small to prove that alpha is changing.

If the interpretation of the light is correct, it is "a huge deal", agrees Craig Hogan, head of the Fermilab Center for Particle Astrophysics in Batavia, Illinois. But like Cowie, he suspects there is a flaw somewhere in the analysis. "I think the result is not real," he says.

Another author on the paper, Michael Murphy of Swinburne University in Australia, understands the caution. But he says the evidence for changing constants is piling up. "We just report what we find, and no one has been able to explain away these results in a decade of trying," Murphy told *New Scientist*. "The fundamental constants being constant is an assumption. We're here to test physics, not to assume it."

*When this article was first posted, the paragraphs beginning: "Now Webb's colleague..." and "The difference in both cases..." read:*

*"Now, thanks to data from the Very Large Telescope (VLT) in Chile, which looks at a different region of the sky, Webb thinks that alpha varies in space rather than time.*

*"The VLT data suggests that, elsewhere in the universe, the value of alpha is very slightly bigger than on Earth. The difference in both cases is around a millionth of the value alpha has in our region of space."*

<http://www.newscientist.com/article/dn19429-laws-of-physics-may-change-across-the-universe.html>



### Tilting stars may explain backwards planets

- 05 September 2010
- Magazine issue 2776.

SOMERSAULTING stars could explain why some planets orbit backwards.

Planets tend to form in a disc that surrounds their star's equator, and orbit the star in the same direction as its spin. But recently, astronomers have found about 10 stars that host planets in tilted orbits - some so extreme that the planets travel backwards. Some researchers suspected that gravitational encounters with other planets or a distant star were to blame.

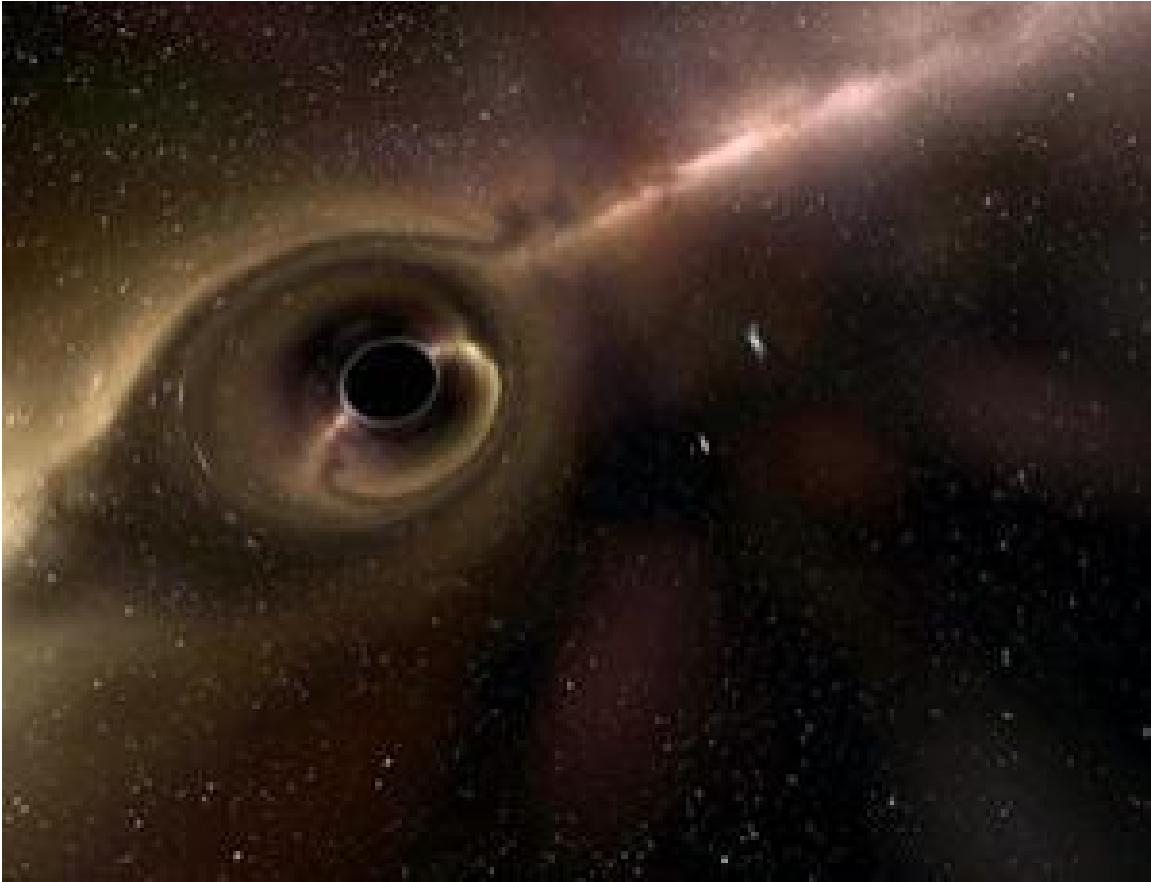
Now Dong Lai at Cornell University in Ithaca, New York, and his colleagues say there is no need to invoke such violence. The researchers calculate that a newborn star's magnetic field interacts with its planet-forming disc, which is electrically conducting, causing the star to tilt and in some cases flip over ([arxiv.org/abs/1008.3148](http://arxiv.org/abs/1008.3148)).

It is not clear how common the process might be, or how many of the unusual orbits it could explain. But it "might have happened in our solar system", says Lai. Earth's orbit is at an angle of 7.2 degrees to the solar equator, suggesting that the young sun may have tipped a bit.

<http://www.newscientist.com/article/mg20727765.200-tilting-stars-may-explain-backwards-planets.html>

## Eternal black holes are the ultimate cosmic safes

- 18:59 03 September 2010 by Stephen Battersby



There may be a way to create black holes that do not evaporate over time (Image: Copyright Denver Museum of Nature and Science)

If you wanted to hide something away for all eternity, where could you put it? Black holes might seem like a safe bet, but Stephen Hawking famously calculated that they leak radiation, and most physicists now think that this radiation contains information about their contents. Now, there may be a way to make an "eternal" black hole that would act as the ultimate cosmic lockbox.

The recipe for this unlikely object was discovered by looking at an even more abstruse entity, the white hole. White holes are black holes that run backwards in time, throwing out matter instead of sucking it in. Where a black hole might form from a collapsing star, a white hole would explode and leave a star in its place. White holes have never been observed, though general relativity predicts they could exist in principle.

Stephen Hsu of the University of Oregon in Eugene wanted to calculate whether a white hole would emit radiation like a black hole. He considered the special case of a white hole sitting in a perfect vacuum, and

calculated that when it spits out its contents, there is a burst of radiation essentially identical to a black hole's Hawking radiation ([arxiv.org/abs/1007.2934](http://arxiv.org/abs/1007.2934)).

### 'Exquisitely difficult'

Hsu realised that running the process backwards would be equivalent to a black hole forming and then existing in a perfect vacuum, with no Hawking radiation. "It becomes a black hole that's not radiating, which is a very weird thing," Hsu says.

The snag is that to run this process backwards and make the eternal black hole, you would need to send in a precisely crafted burst of radiation as the hole forms. The radiation would have to be "exactly tuned to interfere with the Hawking radiation that would otherwise come out", says Hsu.

"Maybe in a highly advanced civilisation, physicists could create a black hole that didn't evaporate," he told *New Scientist*. "It would be exquisitely difficult, but mathematically you can do it."

### Encoded information

If one did build an eternal black hole, it would be the perfect place to store sensitive information.

Normal black holes are thought to gradually release information about their contents through Hawking radiation. "Most theorists have come to the conclusion that black hole evaporation is analogous to the burning of a book," says Martin Einhorn of the University of California, Santa Barbara. "All the information in the book must be encoded in special properties of the outgoing radiation." In principle, it would be possible to recreate the original book – if you could collect all the outgoing radiation and understood the quantum properties of gravity.

But with eternal black holes, "it's as if you just put the information inside a box and at the end you still have the box", says Hsu.

<http://www.newscientist.com/article/dn19402-eternal-black-holes-are-the-ultimate-cosmic-safes.html>

### Trojan asteroids make planetary scientist lose sleep

- 03 September 2010
- Magazine issue 2776.

A FAMILY of asteroids that travels in lockstep with Jupiter appears to be different in one important respect from their purported kin in the outer solar system. The mismatch could spell trouble for the leading theory of how our solar system evolved.

This theory, called the Nice model, suggests that as Jupiter and Saturn moved to their current orbits, they wreaked gravitational havoc in the early solar system, scattering lumps of rock in their vicinity. Some of these ended up on tilted orbits in the distant Kuiper belt, beyond the orbit of Neptune. Others were hurled inwards, with more than 4000 getting trapped on Jupiter's orbital path as "Trojan" asteroids.

Now Wesley Fraser at the California Institute of Technology in Pasadena, and colleagues, say that the Trojans have a different size distribution to tilted Kuiper belt objects (*Icarus*, DOI: [10.1016/j.icarus.2010.08.001](https://doi.org/10.1016/j.icarus.2010.08.001)). That suggests that the Trojans have a different origin, but if so, the Nice model cannot say where they formed. All it can say is that they could not have formed where they are now, as they would have ended up being shunted elsewhere.

Fraser says he has "lost a lot of sleep" over the puzzle. Alessandro Morbidelli of the Côte d'Azur Observatory in France, who helped develop the Nice model, says he "cannot imagine any scenario that has a chance to explain this result". But he says there is still some disagreement over the sizes of tilted objects in the Kuiper belt, so it may be premature for "modellers to bang their head against the wall".

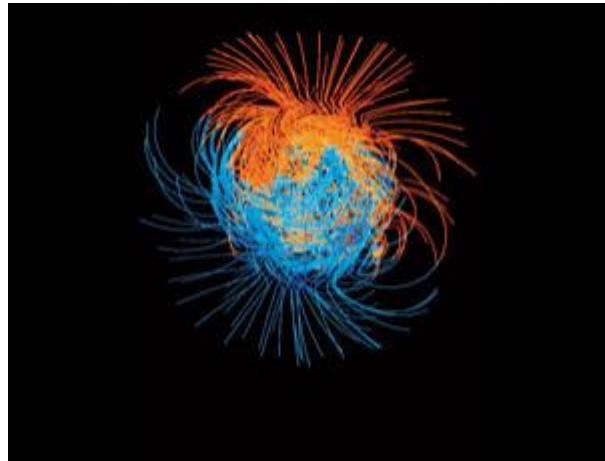
<http://www.newscientist.com/article/mg20727765.100-trojan-asteroids-make-planetary-scientist-lose-sleep.html>



## Second super-fast flip of Earth's poles found

- Updated 12:04 03 September 2010

Magazine issue 2776.



On the flip, in record time (Image: G.Glatzmaier/Los Alamos National Laboratory/P.Roberts/UCLA/SPL)

SOME 16 million years ago, north became south in a matter of years. Such fast flips are impossible, according to models of the Earth's core, but this is now the second time that evidence has been found.

The magnetic poles swap every 300,000 years, a process that normally takes up to 5000 years. In 1995 an ancient lava flow with an unusual magnetic pattern was discovered in Oregon. It suggested that the field at the time was moving by 6 degrees a day - at least 10,000 times faster than usual. "Not many people believed it," says Scott Bogue of Occidental College in Los Angeles.

Now Bogue and his colleague Jonathan Glen of the United States Geological Survey in Menlo Park, California, say they have found a second example in Nevada. The lava rock suggests that in one year, Earth's magnetic field shifted by 53 degrees (*Geophysical Research Letters*, DOI: 10.1029/2010GL044286). At that rate, a full flip would take less than four years, but there could be another interpretation. "It may have been a burst of rapid acceleration that punctuated the steady movement of the field," says Bogue.

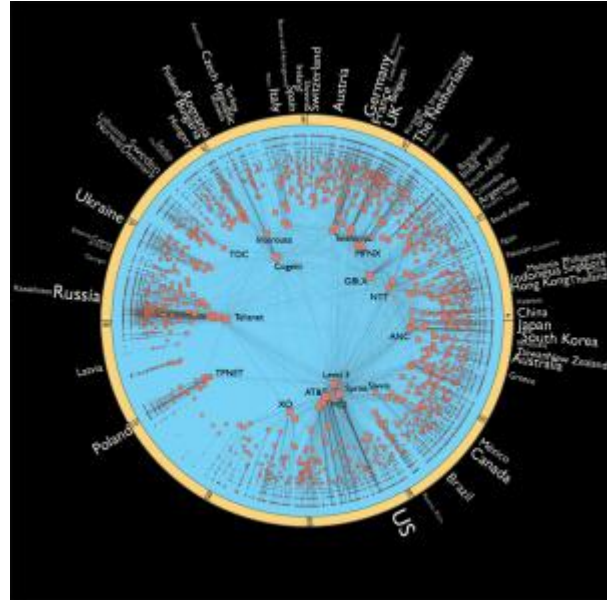
Peter Olson of Johns Hopkins University in Baltimore, Maryland, remains sceptical and points out that the effects could have been local rather than global.

Earth is overdue for a reversal, and rapid shifts would cause widespread chaos - for navigation and migratory birds for instance.

<http://www.newscientist.com/article/mg20727765.000-second-superfast-flip-of-earths-poles-found.html>

## Escher-like internet map could speed online traffic

- 15:34 08 September 2010 by **Jacob Aron**



This hyperbolic map of the internet captures connections between systems on the network (Image: Marián Boguñá)

A novel map of the internet created by [Marián Boguñá](#) and colleagues at the University of Barcelona, Spain, could help make network glitches a thing of the past.

Boguñá squeezed the entire network into a disc using hyperbolic geometry, more familiar to us through the circular mosaic-like artworks of [M. C. Escher](#).

Each square on the map is an "autonomous system" – a section of the network managed by a single body such as a national government or a service provider. The most well-connected systems are close to the centre, while the least connected are at the edges. The area of the hyperbolic plane grows exponentially with distance from the centre, so the edges of the map are "roomier" than the middle.

Like all good cartographers, Boguñá's team hopes their map will help speed up navigation. At present each system routes traffic by referring to a table of all available network paths, but keeping this up to date is difficult as new paths keep coming on stream while others shut down.

### Network coordinates

Boguñá's map could do away with all this by providing "coordinates" for every system on the network. This turns routing traffic into a game of "pass the parcel". Each system calculates in which "direction" the final destination of a packet of information lies, and simply relays each packet to the neighbour which lies closest to that direction – an approach called "greedy forwarding".



Although the map simply shows the number of connections between each autonomous system, the geography of the hyperbolic internet map often reflects that of the real world – for example, a number of western European nations are clustered in one sector.

It might be assumed that Boguñá's greedy-forwarding approach would route packets as effectively if applied to a map of the internet based on actual geographical relationships between systems rather than the hyperbolic map, which is based on the number of connections. However, the team's simulations showed that applying the technique to a purely geographical map resulted in up to 86 per cent of traffic becoming trapped within the network. When using the hyperbolic map, just 3 per cent of traffic suffered this fate.

This trapping can happen when, for example, a packet reaches a point that is geographically close to its destination, but that lacks a direct link. If this happens, and the packet is forced to retrace its steps and visit the same autonomous system twice, the routing fails.

Journal reference: *Nature Communications*, DOI: 10.1038/ncomms1063)

<http://www.newscientist.com/article/dn19420-escherlike-internet-map-could-speed-online-traffic.html>

## Japan to begin drilling for methane in undersea slush

- 17:01 09 September 2010 by **Michael Fitzpatrick**

Determined to keep Japan's lights burning despite scarce natural resources and uncertain energy security, the country's government says it is to begin commercial test drilling of methane hydrates as early as the first half of next year.

The coastal waters around Japan contain an estimated 7.4 trillion cubic metres of methane, which equates to around 100 years' worth of natural gas at today's rate of usage. But it is only recently that an economically feasible way to extract the stuff has been developed.

The gas is locked beneath the ocean bed in methane hydrates, a sorbet-like substance consisting of methane trapped in ice. In 2002, a team of geologists from Japan and Canada investigated whether it was possible to release the gas using hot water to melt the ice. The demonstration was successful, but used too much energy to be practical.

Further experiments by the team in 2008 found a more economical approach. Holes were drilled into the methane deposits, decreasing the pressure on the ice and so raising its melting temperature. This allows the methane to separate out from the ice-like material and flow up to the wellhead.

It is this approach which will now be further tested in Japan's coastal waters by a consortium led by the government and the Japan Oil, Gas and Metals National Corporation. According to a government statement, the main area of study is the coastal region stretching 400 kilometres from Tokyo to the western tip of Honshu Island – a region thought to hold enough reserves to supply Japan with natural gas for nearly 14 years.

<http://www.newscientist.com/article/dn19433-japan-to-begin-drilling-for-methane-in-undersea-slush.html>

## New formula shows who's really top of the tweeters

- 12:41 09 September 2010 by [Justin Mullins](#)

The most influential Twitter feeds don't necessarily have the most followers. That's the insight given by a new technique for ranking twitterers, which has been used to create a chart of the top 100 news-media Twitter feeds. The new system is different from conventional web page rankings, which rely on the PageRank algorithm developed by Larry Page at Google. This judges that a page is important if other important pages link to it, so a website's rank mostly comes from analysis of the pattern of links to and from other websites.

A similar approach has been tried for ranking Twitter feeds, but with limited success. This is because PageRank doesn't look at "retweeting" – forwarding a tweet to other users, which is an important measure of a tweet's importance. "That's an active process that the structure of links in the network does not capture," says [Daniel Romero](#) at Cornell University in Ithaca, New York, who together with colleagues has come up with a [better way to rank Twitter feeds](#).

### Tweeters and followers

Romero and colleagues use two different factors to determine how influential twitterers are: the total number of people who follow them, and how likely these followers are to retweet their messages. The team describes this second measure as a follower's "passivity". Some users routinely retweet many messages, however, most followers are passive and rarely or never retweet.

In the new approach, the most influential tweets are those that change this status quo, persuading followers who rarely retweet to forward the message. That ability to change the behaviour of passive followers is the crucial factor that defines influential Twitter feeds, says [Wojciech Galuba](#) of the Swiss Federal Institute of Technology in Lausanne, a co-author of the study. "Our algorithm measures this ability to change people's behaviour." The new method of ranking throws up some surprises. For example, the team found that the most popular twitterers are not necessarily the most influential. Popular feeds may reach many followers, but if tweets are rarely passed on they do not spread. The most influential Twitter feeds, on the other hand, are the ones with followers who retweet the messages and persuade passive followers to become active.

### Hot news

Last week, Romero released a list of the top 100 most influential news-media Twitter feeds. Top of the list is [@mashable](#), from the social-media news blog Mashable, followed by [@cnbrk](#), breaking news from the CNN network. However, the team were surprised to find [@big\\_picture](#) at number 3, a feed with only 23,000 followers (compared with over 3 million for [@cnbrk](#)). [@big\\_picture](#) provides links to [top-quality photojournalism](#) selected by *The Boston Globe* newspaper. "[@big\\_picture](#) proves that a large number of followers is not necessary to be influential," says Romero. [The full list is here](#): [@newscientist](#) is ranked at 28.

Galuba is currently building a website that will allow people to analyse the influence of their feeds and how it is changing in real time. As well as ranking Twitter feeds, the technique allows the team to rank individual tweets themselves by measuring how far they have spread through the network. "So we can show them tweets ranked by influence rather than chronology," says Galuba. He says the new site should be live within the next two or three months.

<http://www.newscientist.com/article/dn19432-new-formula-shows-whos-really-top-of-the-tweeters.html>

**Robot car passenger: On the road to China, no driver**

- 08 September 2010 by Alison George
- Magazine issue 2776

Driverless cars are safer and they are the future, says **Alberto Broggi**, leader of an autonomous-vehicle expedition from Italy to China

**Tell me about your expedition.**

We are making a three-month journey, travelling 13,000 kilometres from Parma, Italy, to Shanghai, China, using autonomous vehicles - a world first. We've just left Moscow and are heading to Siberia.

**Why are you making this journey?**

I work on driver assistance systems - systems to take control of a vehicle when the driver falls asleep, for example. We wanted to push these technologies to the limit and see if we could remove the driver altogether. We had participated in some autonomous vehicle races, but these take place in a structured environment. We wanted to be in the real world with real challenges. We're aiming to reach Shanghai for the World Expo.

**Tell me about your autonomous vehicles.**

They are normal vehicles, made by Piaggio, but with sensors to perceive the environment, to detect whether a vehicle or pedestrian is ahead. Inside there are computers to analyse this data to determine whether to brake or steer.

**Designing software to make decisions about driving must be a huge challenge.**

Yes, it's the most difficult part. Take pedestrians, for example. They can appear in hundreds of different ways but the system needs to understand that all are definitely pedestrians.

**Do you trust your vehicles to do this?**

Yes, I've stood in front of them when they are heading straight at me. In this field you need to test real situations, not just carry out simulations.

**How autonomous are your vehicles? Are they really driving themselves to Shanghai?**

Even when they are moving autonomously, there is always someone in the vehicles who can intervene. This journey is a test, not a demonstration. We want to test our systems and learn from the failures.

**How does your convoy work?**

It consists of two autonomous vehicles, plus back-up transport. The lead vehicle can drive itself, but is mostly driven by humans, mainly because we don't have maps for many of the places we are going so need someone to decide which way to go. This vehicle sends GPS data to the second vehicle directly behind, which drives itself.

**What's the biggest challenge you've faced on this expedition?**

Entering Moscow. We had to turn to manual mode because the traffic was really crazy. Our autopilot system looks at road markings to determine where to drive, but the drivers in Moscow were not obeying these markings. There were three or four lanes of cars where only two lanes were marked, and the autonomous pilot could not deal with it.

**Do you think that autonomous vehicles are safer than ones driven by humans?**

Yes, because human drivers can be distracted. An autonomous pilot will always be in charge, ready to react. The majority of vehicles on our roads will definitely be autonomous within my lifetime.

**Profile**

Alberto Broggi is director of the Artificial Vision and Intelligent Systems Laboratory at the University of Parma, Italy. He has competed in several autonomous vehicle races

<http://www.newscientist.com/article/mg20727760.200-robot-car-passenger-on-the-road-to-china-no-driver.html>



## Acoustic trick gives 'dumbphones' touchscreen feel

- 13:45 08 September 2010 by **Paul Marks**



The latest touchscreen? (Image: Niall Macpherson/iStock)

Embarrassed by your "ancient" push-button cellphone? Touchscreen envy eating you up inside? Fear not. New software could offer users of cheaper push-button phones access to some of the features usually found only on the more pricey smartphones.

Called TouchDevice, the program renders the entire casing and LCD display of a standard phone sensitive to touch – or, rather, the sounds of touch. And it needs no new hardware, so can be applied to most existing phones, its creators claim.

The TouchDevice software, developed by Input Dynamics of Cambridge, UK, will let users scroll through menus, browse or zoom; all by swiping, tapping or scratching a fingertip, touchscreen-style, along the side of the phone.

Instead of selecting onscreen icons with a joypad, they can tap the icons as if the traditional display was an iPhone-style capacitive touchscreen. Tapping the phone casing a number of times activates pre-selected functions like the address book, texting service or camera.

### Telltale taps

So how does it do work? Through smart use of the phone's built-in microphone, says inventor Giovanni Bisutti. Every tap on the phone's screen or its casing produces a telltale sound that resonates through the device. Careful analysis of the sound patterns can identify where and how the phone was touched.

"The built-in mic picks up these 'acoustic fingerprints' and the TouchDevice software algorithms work out which spot on the phone was tapped or swiped," says Bisutti. For every make of "dumbphone" that TouchDevice runs on, the algorithms must be trained to recognise the device's acoustic properties, but he says it's easy to do and won't add significantly to the costs.

The software can identify the point of contact to within about 1 square centimetre. At the Meerkats and Avatars conference in Cambridge, UK, today the firm demonstrated a version able to identify single crisp taps from a finger nail or stylus. The firm says that it is refining its algorithms to interpret the acoustically distinct signatures made by scratching the device with a fingernail, tapping it with a softer finger tip, and swiping the device with a finger. In future they say that the algorithms will be able to handle taps from multiple finger tips at once, turning old phones into multi-touch devices.

### **Nail-biting challenge**

As yet, no phone-maker is building the software into its entry-level phones. However, Bisutti says he is in talks with "tier-one handset manufacturers, the big ones" about licensing the software. "They see the advantages. It lets them build a touchscreen phone without the need for expensive hardware – and the software can be uploaded into existing phone designs," he says.

Commentators like the idea. "If it works it sounds like a neat way to expand fairly limited devices," says Peter Bentley, a software engineer at University College London and author of an acoustics-based iPhone app, iStethoscope, which recently topped Apple's App Store charts. "But I wonder how it will cope with people who bite their fingernails as that will change the acoustics."

The notion of acoustic fingerprinting hit the headlines earlier this year when Chris Harrison at Carnegie Mellon University in Pittsburgh, Pennsylvania, developed a human-skin-based cellphone control system called Skinput. Skinput uses compact projectors, dubbed picoprojectors, to turn skin into a 'touchscreen' that, for instance, allowed people to tap an icon projected on their forearm to answer a call. The tap's acoustic signature – a resonant ricochet through the arm's bone, muscle and fat – activated the phone's answering mechanism.

"Acoustics fingerprinting is really neat in that you can turn a totally passive item like a table or, in this case, a cellphone, into an interactive surface," says Harrison.

<http://www.newscientist.com/article/dn19417-acoustic-trick-gives-dumbphones-touchscreen-feel.html>

## Squeezing solar juice from jellyfish

- 18:01 07 September 2010 by **Helen Knight**



Sea power (Image: Denise Allen/CorruptKitten/Flickr)

Silicon solar cells are so, well, dead. Dollops of green goo made of living cells – from jellyfish to algae - are now being recruited to produce cheaper solar power.

Zackary Chiragwandi at Chalmers University of Technology in Gothenburg, Sweden, and colleagues are developing a photovoltaic device based on green fluorescent protein (GFP) from the jellyfish *Aequorea victoria*.

The team deposit two aluminium electrodes with a tiny gap between them onto a silicon dioxide substrate. A droplet of green fluorescent protein is then added on top, whereupon the protein assembles itself into strands between the electrodes.

When exposed to ultraviolet light, the GFP absorbs photons and emits electrons, which travel around a circuit to produce electricity.

### Cheap goo

The green goo acts like the dye used in current "dye-sensitised" solar cells, called Grätzel cells.

However, unlike such cells, the GFP does not require the addition of expensive materials, such as titanium dioxide particles. Instead, the GFP can be placed directly on top of the electrode, simplifying the design and reducing overall cost.

The team have also used the proteins to create a biological fuel cell that generates electricity without the need for an external source of light.



Instead, they used light emitted from a mixture of chemicals such as magnesium and the luciferase enzymes found in fireflies (*Lampyridae*) and sea pansies (*Renilla reniformis*) to generate electricity from the jellyfish biophotovoltaic device.

Such a fuel cell could be used to power nano-devices embedded in living organisms, says Chiragwandi, for example to diagnose disease.

### **Algaelectricity**

Jellyfish are not the only sea creatures that can be exploited to generate energy: algae could power floating devices on the ocean wave. Adrian Fisher and Paolo Bombelli at the University of Cambridge and colleagues are developing biophotovoltaic devices based on algae and photosynthetic bacteria.

The team deposit a film of photosynthetic cells on top of a transparent conductive electrode, which faces a carbon cathode seeded with platinum nanoparticles.

When exposed to sunlight the algal cells begin splitting water and producing oxygen, electrons and protons. These would usually be used by the algae to convert carbon dioxide into organic compounds, but instead the device siphons them off to generate electricity, says Fisher. "The algal cells produce electrons very generously," he says.

The team has so far used a proof-of-concept device to power a clock. The sunlight-to-electricity efficiency of the device is only 0.1 per cent at present, compared with between 10 and 15 per cent for existing dye-sensitised solar cells, however. Screening different algae species to find the most productive electron donor might be one way to produce more juice.

Eventually, algal cells could float out at sea, generating electricity from sunlight and seawater. "We might end up with less efficiency than [conventional] photovoltaics, but we think we can win on cost, and we don't require space where people want to live," says Bombelli.

Journal reference: *Energy and Environmental Science*, in press

<http://www.newscientist.com/article/dn19416-green-machine-squeezing-solar-juice-from-jellyfish.html>



### Immortal signals promise perfect web video

- 10:52 07 September 2010 by **Colin Barras**
- Magazine issue 2777.



Light that never fades (Image: John Rensten/Corbis)

A perfect stream of video delivered down your broadband connection without irritating blips may seem as likely as uncovering the elixir of youth. Now a team of optical engineers think they have discovered the secret to both. They've devised a way to revitalise light signals being sent down optical fibres, enabling them to send more information down the wires.

Bandwidth-hungry video streaming applications are prompting changes in the way that information is sent across the internet via its network of optical fibres. Conventionally, data is sent as a series of on-off light pulses, where each pulse encodes a single bit of information. More data can potentially be squeezed onto a stream of light by modifying the phase of each light pulse in a measurable way. Even greater carrying capacity can be achieved using light at several intensity levels, potentially "an order of magnitude" higher than now, says David Richardson at the University of Southampton, UK.

However, light signals are gradually distorted by interacting with the fibre – a process known as attenuation. The more complex the signal, the harder it becomes to resolve after attenuation. What is needed is a way to reverse the degradation process and recreate the original signal, says Richardson, and his team has now developed one.

#### Mix it up

Their device makes a copy of the attenuated incoming signal, and "mixes" it with a laser beam in a length of specially designed optical fibre. This generates two additional strong signals that are perfectly in phase with the data signal, one with a frequency just higher than the original and one with a frequency just lower. These signals can then act as a scaffold that, after interaction with a second copy of the data signal in a second fibre, removes the noise and generates a pristine version.



The team has demonstrated the technique on signals at 40 gigabits per second, but Richardson says it should handle higher data rates too.

Similar systems have been demonstrated before, but only in a "very controlled way where the phase and carrier frequency of the incoming signal are known", says Richardson. The new device can reconstruct an incoming signal without this information – a more likely scenario in the real world.

### **Phased approach**

The current version works with relatively simple signals where the information is encoded into one of two light phases – so called "binary phase-shifted keys" (PSK).

"Our primary interest is in extending the approach to work with more complex signals such as quadrature PSK", which can encode more data in the phase, says Richardson.

A team led by Guifang Li at the University of Central Florida in Orlando has demonstrated components of the device separately, but not combined them into a fully functioning system. "The results they demonstrated are quite impressive," he says.

Journal reference: Nature Photonics, DOI: 10.1038/nphoton.2010.203

<http://www.newscientist.com/article/dn19410-immortal-signals-promise-perfect-web-video.html>



## Tech heavyweights set to move music to the cloud

- Updated 12:27 06 September 2010 by **MacGregor Campbell**
- Magazine issue 2776.



I'm moving on (Image: Louis Quail/Photonic/Getty)

FROM the sagging shelf of vinyl, through teetering stacks of CDs to a hard drive stuffed with MP3s, personal music collections have adapted to, even thrived on, the technological changes of the last few decades. But actually owning music could soon become a thing of the past - because of the cloud.

Cloud music services, which enable you to stream music from the internet to your computer or phone, have been around for a few years. But so far, services such as Pandora, Last FM and Spotify, have had little discernible effect on music lovers' appetite for owning songs. But the number of sites is growing, along with the range of services they offer, and with Apple and Google gearing up to offer their own services, could the era of the digital download be coming to an end?

Typically, such services offer unlimited access to a music store of millions of songs, either interspersed with advertisements or for a subscription. The latest versions also promise to give people access to their own music collection from anywhere with an internet connection. The extra bandwidth and data transmission speeds of next-generation (4G) mobile networks mean it could soon be possible to listen to music streaming straight from the internet anywhere where there's reception. When that happens, music ownership might start to look unappealing. Who would choose to own music when every song is available to stream wirelessly, on demand?

Last December, Apple acquired Lala, a music-streaming service launched in 2006 that could scan a user's hard drive for music files and replicate them in the cloud. This technology is expected to form the basis of a cloud-based update to iTunes, although Apple gave few clues over its cloud intentions at its recent music



event. But the event did show how the company has been investing in streaming technology, transmitting a live broadcast using its own HTTP-based streaming protocol. And Apple is building a huge data centre in North Carolina that is set to be one of the largest in the world - handy if you were planning to host a lot of music files.

Some services scan a user's hard drive and replicate their own music collection in the cloud

Google appears to be taking a different approach. In May it acquired Simplify Media, a California-based start-up whose technology enables people to access media files, such as photos and music, across multiple devices without having to synchronise them. So instead of having to wait while files are transferred from your hard drive to your mobile music player, the technology will send the files into the cloud and let you access them from there. The app will run on Google's Android smartphone operating system.

Being able to connect people with their desired song is only one aspect of the process, however. Perhaps the greater challenges are persuading the music companies that own the rights to the songs to get on board, and devising a workable royalty system.

Difficulties with this have scuppered many earlier attempts at delivering cloud music. For example, Swedish music service Spotify, while popular in Europe, has been unable to agree with the major record labels how much their artists would receive each time a user accesses their song. As a result it has been unable expand into the US. An early cloud service from Yahoo left many users disgruntled when changes to its digital rights management technology meant they could no longer access songs they had paid for.

### **Seamless stream**

Seamless transmission of the music also needs perfecting. One of the primary means of accessing music over the internet is via streaming, which allows users to start playing the music before the entire file has been transmitted. Typically, streaming files do not get written permanently to the hard drive, so each time a user wants to listen to a song they have to start a new stream. It can also be a slow process when a lot of users are online at the same time, and such bandwidth issues are only magnified when it comes to mobile phones.

Spotify has built its service on blending streaming with peer-to-peer (P2P) networking. P2P technology pulls together chunks of a file from multiple sources to create the whole. Songs can get started quickly from the company's servers, while the rest of the data is gathered via P2P, says Gunnar Kreitz, an engineer with Spotify. This decreases the amount of server space and bandwidth used, making it feasible to deliver a cloud-based music streaming service. "By combining peer-to-peer and server streaming, we can get the best of both worlds," Kreitz says.

California-based mSpot keeps bandwidth down in a different way. Its application scans a user's own music library and enables them to access it via the cloud. By letting users dictate which songs are hosted in the cloud and which are stored on their mobile device, it even promises to allow users to access their music when they have no mobile reception, says mSpot's chief technology officer, Ed Ho. The software "pre-fetches" a user's most listened-to songs when the web connection is good, ensuring they can be played if the connection drops.

Its charges also vary with how much bandwidth a user consumes - giving the company more control over how much is taken up. One potential drawback is that mSpot uses data compression technology to squeeze down the size of the files being transmitted, thereby losing some of the sound quality.



Corynne McSherry, a staff attorney with the Electronic Frontier Foundation, a digital-rights pressure group in San Francisco, sounds a note of caution over cloud music services. She believes licensing problems like those with Yahoo will be difficult to overcome. "Downloading the MP3, having the actual file, gives you more control over how you use the music," she says.

Ho thinks that while some people will continue to want to own recordings, the culture of music ownership could eventually die out. "You might have a next generation of people who say: 'I don't want to bother with having my own collection of music.' I don't know when that date will come."

*When this article was first posted, the passage, "This technology is expected to form the basis of a cloud-based update to iTunes, although Apple gave few clues over its cloud intentions at its recent music event. But the event did show how the company has been investing in streaming technology, transmitting a live broadcast using its own HTTP-based streaming protocol. And Apple is building a huge data centre in North Carolina that is set to be one of the largest in the world - handy if you were planning to host a lot of music files," read as follows: "This technology is expected to form the basis of a cloud-based update to iTunes, and although Apple's intentions were not clear as New Scientist went to press, the company is building a huge data centre in North Carolina that is set to be one of the largest in the world - handy if you were planning to host a lot of music files."*

<http://www.newscientist.com/article/mg20727765.700-tech-heavyweights-set-to-move-music-to-the-cloud.html>



## Bird flu jumps to pigs

- 15:38 07 September 2010 by **Deborah MacKenzie**



Sharing more than just a pen (Image: Romeo Gacad/AFP/Getty)

The H5N1 bird flu virus may be evolving the ability to spread from mammal to mammal, says a team who have discovered that pigs in Indonesia have been infected with the disease since 2005. It's one step in the frightening chain of events that could lead to human transmission and a pandemic.

The H5N1 bird flu kills 60 per cent of the people it infects. However, most infections occur after direct contact with an infected bird and the disease does not appear to spread well between humans. As long as human to human transmission remains rare, the virus cannot cause a flu pandemic.

This could change. One way the virus could develop the ability to spread among humans is to first infect pigs, which have many biochemical similarities to humans. Flu viruses adapted to pigs have less trouble adapting to humans than do bird flu viruses – one pig-adapted virus caused the swine flu pandemic in 2009.

Chairul Nidom of Airlangga University in Surabaya, Indonesia, and colleagues in Japan, have been tracking H5N1 in pigs since 2005 in Indonesia, the country hardest hit by the avian flu virus. They now report that between 2005 to 2007 when the avian flu peaked, 7.4 per cent of 700 pigs they tested also carried H5N1. There have been sporadic reports of H5N1 in pigs, but this is the first time the extent of the problem has been measured.

### Poultry to pig

In each case, the virus in pigs closely resembled H5N1 from nearby outbreaks in poultry, suggesting it has jumped from the bird to the pig population. That and the small proportion of pigs infected suggests the virus cannot yet spread between pigs. "If the virus was better adapted to pigs it would have spread like wildfire," says Ab Osterhaus of the University of Rotterdam in the Netherlands, a flu expert not involved in the research.



Since 2007, avian flu outbreaks have diminished in poultry and in people in Indonesia and the investigators found that the the rate of infection in pigs has similarly dropped. Although pigs are still carrying signs of recent infection.

This means the virus could still be spreading and evolving because the team discovered, to their surprise, that infected pigs show no symptoms. "H5N1 viruses could easily evade detection as they spread through Indonesia in asymptomatic pigs," warn Nidom and colleagues.

And there are worrying indications that H5N1 is already evolving. Nidom says that in one pig, the virus had developed the ability to bind to a molecule present in the noses of both pigs and humans. That's exactly the kind of change that could allow it to spread between people.

"This shows we should keep a close watch on pig flu, as it can change rapidly," warns Osterhaus. The European Union is heeding the call and is funding a scientific collaboration called FLUPIG, to study how bird flu adapts to pigs and how pig flu spreads to people. It will meet for the first time later this month.

Journal reference: *Emerging Infectious Diseases* , DOI:10.3201/eid1610.100508

<http://www.newscientist.com/article/dn19414-bird-flu-jumps-to-pigs.html>



## The natural selection of leaders

- 07 September 2010 by **Anjana Ahuja**

Magazine issue 2776.



Was he born for the job? (Image: David Brown/Polaris/Eyevine)

*Are leaders born or made? Evolution may be throwing us a curve ball when it comes to picking them in the modern world, says **Anjana Ahuja***

IMAGINE this. You and your colleagues are gathered round a conference table, with coffee and biscuits. You open the door and greet the first sharp-suited candidate of the day. Before evening falls, one lucky applicant will hear the unlikely phrase: "We would like to offer you the job of being our boss."

The idea of subordinates selecting their superiors might seem fantastical, but not to our ancestors. In our new book, Mark van Vugt at VU University in Amsterdam, the Netherlands, and I propose that leadership and followership behaviours can be traced to the earliest days of our species. Given that all human groupings - be they nations, gangs or cults - have leaders and followers, and that these behaviours appear spontaneous, our thesis is that leadership and followership are adaptive behaviours.

In other words, they are behaviours that evolved to give our ancestors a survival advantage (our book's title, *Selected*, reflects the role natural selection plays in leadership). In fact, this arrangement proves so beneficial that other species, from fish to birds to chimpanzees, also show forms of leadership and followership, rudimentary in the cases of fish and birds, but surprisingly sophisticated in the case of our coalition-building cousins.

But what's the link between our theory that leadership and followership are evolved behaviours and you and your colleagues picking your own line manager? Studies of some hunter-gatherer communities show that gifted individuals are picked in a bottom-up, not top-down, way. Leadership is fluid rather than fixed, and assigned by peers to whoever is recognised as adept in a specific domain, from herbalism to hunting. We argue that some modern companies are unwittingly still practising this ancestral style of promotion, with great success. For example, the CEO of W. L. Gore & Associates, which makes Gore-Tex, is chosen by the rank

and file of the company, not shoehorned in by management. The firm has an unusually high retention rate for "associates" (never called "employees").

Studies of hunter-gatherer societies also show that hierarchies are relatively flat and wealth disparities minimal. One tribe is documented as having no concept of personal property and, correspondingly, theft, an outlook which led its members into persistent conflict with sheep-owning incomers. A Martian alighting upon one of these societies and asking to be taken to their leader would be met with bewilderment. There are no presidential elections or prime ministerial hustings in those isolated communities: overly domineering characters are more likely to be assassinated than obeyed. Unlike in the glass-and-steel corporate empires of the developed world, there are strong norms against pushy individuals who thrust themselves forward, or whose self-interest is too clearly displayed.

When you view leadership and followership through the prism of evolutionary psychology, many peculiarities about the way we choose our leaders look less odd. For example, political scientists have no convincing rational explanation of why taller candidates almost always beat shorter rivals. But hundreds of thousands of years ago, when tribal conflicts were resolved physically, lofty tribesmen would have enjoyed an edge over opponents of modest stature. Our societies continue to insist leaders should look "statesmanlike" without spelling out what this means, which suggests that we have some innate concept of what a leader should look like. Such an internal template of a good leader would have been reinforced over evolutionary history - though the template would vary in different circumstances, letting us opt for a different kind of leader in war or peacetime.

The modern vestiges of these templates can be detected by psychologists today. Take the startling finding that people can distinguish high-ranking CEOs from their lower-ranked peers purely on facial appearance (the key is in the squareness of the jawline). Tallness is also overrepresented in both CEOs and politicians. In another study, naïve children shown photographs of election candidates typically pick the same winner as the electorate.

These studies back up our theory that many leaders owe their position not to calculated, rational decisions on the part of the electorate or interview board, but to their ability to push a "leader button" in the human psyche. Whether it's Barack Obama hitting the gym or a bare-chested Vladimir Putin posing in Siberia, politicians like us to know that they're tough guys, as if we still need musclemen to protect us in an age when governing tends to be a cerebral, rather than an aerobic, activity.

Leaders owe their position to the ability to push a leader button in people's psyches

In fact we know from experiments in the laboratory that the way we pick our leaders often defies easy, conscious explanation. In one experiment using university students, van Vugt showed that groups entrusted with performing task X were more likely to select leader A, who had previously failed at that task, instead of leader B, who had previously succeeded. The reason? Leader A came from the same university as the rest of the group, while leader B was from another institution. So the deeply ingrained idea of "us" and "them" lingers, even in cosmopolitan university students. Evolutionarily, there is much to be said for sticking to the fiercely loyal devil you know rather than the potentially disloyal angel you don't.

That is not to say that workplaces should become havens of primitivism. Evolution might have bestowed on us an instinctive suspicion of leaders who are short, female or who belong to a different tribe (skin colour is an obvious badge of belonging), but we need to ask whether such prejudices belong in today's interconnected world, in which citizens of all colours and religions need to rub along. The election of America's first black



president offers encouraging evidence that we can overcome these ancestral biases, although Obama's success was undoubtedly aided by his physical stature.

Perhaps the most important take-home message in our book is that there is a mismatch between the way we lead and follow today, and the way our ancestors operated. Where our forebears clustered in small groups on the African savannah, half of the world's population now lives in cities. Where leadership was dispersed among the many, it is now concentrated in the hands of a corporate and political elite. Could this be why we feel disconnected from our leaders?

The good news is that insights into our recent past may help improve things. People in small companies (think small tribe) are happier than those in big ones. Good bosses and adept politicians know that the personal touch goes a long way (think extended family, or at least the feeling of one) - as does roughing it sometimes on the shopfloor to show solidarity with subordinates and to earn their endorsement (think nights hunting in the forest). These working practices feel right for a reason: your ancestors thrived on them. So, the next time your line manager announces that it's time for your performance review, just smile and ask them to bring examples of their work along to it.

### **Profile**

This article is based on *Selected* (Profile Books) by Mark van Vugt, professor of psychology at VU University in Amsterdam, the Netherlands, and research fellow at the University of Oxford, and Anjana Ahuja, writer and former science columnist for *The Times* of London

<http://www.newscientist.com/article/mg20727761.400-the-natural-selection-of-leaders.html>