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CONTENTS

Where Have All the Flowers Gone? High-Mountain Wildflower Season Reduced, Affecting Pollinators Like Bees, Hummingbirds

A female broadtailed hummingbird collects nectar from the flowers of tall larkspur. (Credit: David Inouye)

ScienceDaily (June 17, 2011) — It's summer wildflower season in the Rocky Mountains, a time when high-peaks meadows are dotted with riotous color. But for how long? Once, wildflower season in montane meadow ecosystems extended throughout the summer months. But now scientists have found a fall-off in wildflowers at mid-season.

They published their results, funded by the National Science Foundation (NSF), in the current issue of the *Journal of Ecology.*

"Shifts in flowering in mountain meadows could in turn affect the resources available to pollinators like bees," says David Inouye of the University of Maryland, currently on leave in NSF's Division of Environmental Biology.

Inouye and colleagues George Aldridge and William Barr of the Rocky Mountain Biological Laboratory, Jessica Forrest of the University of California at Davis, and Abraham Miller-Rushing of the USA National Phenology Network in Tucson, Ariz., found that such changes could become more common as climate change progresses.

"Some pollinators with short periods of activity may require only a single flower species," write the ecologists in their paper, "but pollinators active all season must have flowers available in sufficient numbers through the season."

For example, bumblebees, important pollinators in many regions, need a pollen and nectar supply throughout the growing season to allow the queen bee to produce a colony.

As mid-summer temperatures have warmed in places like the Elk Mountains of Colorado, the researchers have found that the mid-season decline in flowering totals is ecosystem-wide.

"These meadows are heavily affected by snowmelt and temperature," says Inouye. "Wildflowers use information from these natural cues to 'know' when it's time to unfurl their petals."

The early-season climate is becoming warmer and drier in the high altitudes of the southern Rocky Mountains.

These changing conditions are altering moisture availability and hence flowering timing in sub-alpine meadows, says Inouye. The result is a mid-season decline in number of wildflowers in bloom.

Such changes in seasonal flower availability across large areas, or in individual habitats, could have serious consequences for entire pollinator populations, says Inouye, which include not only bees, but hummingbirds and others that feed on pollen and nectar.

Over the long term, he and colleagues believe, the changes could affect animal-pollinated plants.

If bees and hummingbirds need flowers, flowers need hummingbirds and bees.

And they all need a high-meadow ecosystem that changes at its own pace, say the scientists, not one moving in fast-forward in tandem with warmer temperatures.

Otherwise those sultry days and nights, especially in high summer, may leave Colorado mountain meadows empty, along with their wildflowers, and the pollinators that depend on them, vanished in the shimmering heat.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Science Foundation**.

Journal Reference:

1. George Aldridge, David W. Inouye, Jessica R. K. Forrest, William A. Barr, Abraham J. Miller-Rushing. **Emergence of a mid-season period of low floral resources in a montane meadow ecosystem associated with climate change**. *Journal of Ecology*, 2011; 99 (4): 905 DOI: 10.1111/j.1365-2745.2011.01826.x

http://www.sciencedaily.com/releases/2011/06/110616193751.htm

Mercury: Messenger Orbital Data Confirm Theories, Reveal Surprises

On March 18, 2011, the MESSENGER spacecraft entered orbit around Mercury to become that planet's first orbiter. (Credit: Image courtesy of Carnegie Institution)

ScienceDaily (June 17, 2011) — On March 18, 2011, the MESSENGER spacecraft entered orbit around Mercury to become that planet's first orbiter. The spacecraft's instruments are making a complete reconnaissance of the planet's geochemistry, geophysics, geologic history, atmosphere, magnetosphere, and plasma environment. MESSENGER is providing a wealth of new information and some surprises. For instance, Mercury's surface composition differs from that expected for the innermost of the terrestrial planets, and Mercury's magnetic field has a north-south asymmetry that affects interaction of the planet's surface with charged particles from the solar wind.

Tens of thousands of images reveal major features on the planet in high resolution for the first time. Measurements of the chemical composition of the planet's surface are providing important clues to the origin of the planet and its geological history. Maps of the planet's topography and magnetic field are offering new evidence on Mercury's interior dynamical processes. And scientists now know that bursts of energetic particles in Mercury's magnetosphere are a continuing product of the interaction of Mercury's magnetic field with the solar wind.

"MESSENGER has passed a number of milestones just this week," offers MESSENGER principal investigator Sean Solomon of the Carnegie Institution. "We completed our first perihelion passage from orbit on Sunday, our first Mercury year in orbit on Monday, our first superior solar conjunction from orbit on Tuesday, and our first orbit-correction maneuver on Wednesday. Those milestones provide important context to the continuing feast of new observations that MESSENGER has been sending home on nearly a daily basis."

The Surface in Detail

Images obtained with MESSENGER's Mercury Dual Imaging System (MDIS) are being combined into maps for the first global look at the planet under optimal viewing conditions. New images of areas near Mercury's north pole orbital show that region hosts one of the largest expanses of volcanic plains deposits on the planet, with thicknesses of up to several kilometers. The broad expanses of plains confirm that volcanism shaped much of Mercury's crust and continued through much of Mercury's history, despite an overall contractional stress state that tended to inhibit the extrusion of volcanic material onto the surface.

Among the fascinating features seen in flyby images of Mercury were bright, patchy deposits on some crater floors, but they remained a curiosity. New targeted MDIS observations reveal these patchy deposits to be

clusters of rimless, irregular pits with horizontal dimension from hundreds of meters to several kilometers. These pits are often surrounded by diffuse halos of higher-reflectance material, and they are found associated with central peaks, peak rings, and rims of craters.

"The etched appearance of these landforms is unlike anything we've seen before on Mercury or the Moon," says Brett Denevi, a staff scientist at the Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, Md., and a member of the MESSENGER imaging team. "We are still debating their origin, but they appear to have a relatively young age and may suggest a more abundant than expected volatile component in Mercury's crust."

The Surface Composition

The X-Ray Spectrometer (XRS) has made several important discoveries since orbit insertion. The magnesium/silicon, aluminum/silicon, and calcium/silicon ratios averaged over large areas of the planet's surface show that, unlike the surface of the Moon, Mercury's surface is not dominated by feldspar-rich rocks. XRS observations have also revealed substantial amounts of sulfur at Mercury's surface, lending support to suggestions from ground-based observations that sulfide minerals are present. This discovery suggests that Mercury's original building blocks may have been less oxidized than those that formed the other terrestrial planets and could be key to understanding the nature of volcanism on Mercury.

MESSENGER's Gamma-Ray and Neutron Spectrometer detected the decay of radioactive isotopes of potassium and thorium, and researchers have determined the bulk abundances of these elements. "The abundance of potassium rules out some prior theories for Mercury's composition and origin," says Larry Nittler, a staff scientist at the Carnegie Institution. "Moreover, the inferred ratio of potassium to thorium is similar to that of other terrestrial planets, suggesting that Mercury is not highly depleted in volatiles, contrary to some prior ideas about its origin."

Mercury's Topography and Magnetic Field

MESSENGER's Mercury Laser Altimeter has been mapping the topography of Mercury's northern hemisphere in detail. The north polar region, for instance, is a broad area of low elevations. The overall topographic height range seen to date exceeds 9 kilometers (5.5 miles).

Previous Earth-based radar images showed that around Mercury's north and south poles are deposits thought to consist of water ice and perhaps other ices preserved on cold, permanently shadowed floors of high-latitude impact craters. MESSENGER's altimeter is measuring the floor depths of craters near the north pole. The depths of craters with polar deposits support the idea that these areas are in permanent shadow.

The geometry of Mercury's internal magnetic field can potentially allow the rejection of some theories for how the field is generated. The spacecraft found that Mercury's magnetic equator is well north of the planet's geographic equator. The best-fitting internal dipole magnetic field is located about 0.2 Mercury radii, or 480 km (298 miles), northward of the planet's center. The dynamo mechanism responsible for generating the planet's magnetic field therefore has a strong north-south asymmetry.

As a result of this north-south asymmetry, the geometry of magnetic field lines is different in Mercury's north and south polar regions. In particular, the magnetic "polar cap" where field lines are open to the interplanetary medium is much larger near the south pole. This geometry implies that the south polar region is much more exposed than the north to charged particles heated and accelerated by the solar wind. The impact of those charged particles onto Mercury's surface contributes both to the generation of the planet's tenuous atmosphere and to the "space weathering" of surface materials, both of which should have a north-south asymmetry.

Energetic Particles at Mercury

One of the major discoveries made by Mariner 10 flybys of Mercury in 1974 were bursts of energetic particles in Mercury's Earth-like magnetosphere. Four bursts of particles were observed on the first flyby, so it was puzzling that no such events were detected by MESSENGER during any of its three flybys.

With MESSENGER now in near-polar orbit about Mercury, energetic events are being seen almost like clockwork, remarked MESSENGER Project Scientist Ralph McNutt, of APL. "While varying in strength and distribution, bursts of energetic electrons -- with energies from 10 kiloelectron volts (keV) to more than 200 keV -- have been seen in most orbits since orbit insertion," McNutt said. "The Energetic Particle Spectrometer has shown these events to be electrons rather than energetic ions, and to occur at moderate latitudes. The latitudinal location is entirely consistent with the events seen by Mariner 10."

With Mercury's smaller magnetosphere and with the lack of a substantial atmosphere, the generation and distribution of energetic electrons differ from those at Earth. One candidate mechanism for their generation is

the formation of a "double layer," a plasma structure with large electric fields along the local magnetic field. Another is induction brought about by rapid changes in the magnetic field, a process that follows the principle used in generators on Earth to produce electric power. The mechanisms at work will be the studied over the coming months.
"We are assembling a global overview of the nature and workings of Mercury for the first time," remarked Solomon, "and many of our earlier ideas are being cast aside as new observations lead to new insights. Our primary mission has another three Mercury years to run, and we can expect more surprises as our Solar System's innermost planet reveals its long-held secrets."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Carnegie Institution**.

http://www.sciencedaily.com/releases/2011/06/110616142729.htm

Scientists Develop a Fatty 'Kryptonite' to Defeat Multidrug-Resistant 'Super Bugs'

Escherichia coli. (Credit: © Tomasz Niewęgłowski / Fotolia)

ScienceDaily (June 17, 2011) — "Super bugs," which can cause wide-spread disease and may be resistant to most, if not all, conventional antibiotics, still have their weaknesses. A team of Canadian scientists discovered that specific mixtures of antimicrobial agents presented in lipid (fatty) mixtures can significantly boost the effectiveness of those agents to kill the resistant bacteria.

This discovery was published online in *The FASEB Journal*.

According to a researcher involved in the study, Richard Epand, Ph.D. from the Department of Biochemistry and Biomedical Science at McMaster University in Hamilton, Ontario, Canada, "This study may contribute to overcoming the lethal effects of drug resistant bacteria that is becoming an increasing clinical problem, particularly in hospitals."

To make their discovery, Epand and colleagues conducted experiments using groups of mice infected with lethal doses of multidrug-resistant *Escherichia coli* (*E. coli*). Researchers then treated the mice with conventional drug combinations or drug combinations encapsulated in lipid mixtures. They found that certain lipid mixtures caused the drugs to act together in a synergistic manner. In this form, the drugs were much more effective in increasing the survival rate of the mice because they overcame the cellular mechanisms used by these bacteria to defeat therapeutic agents.

This study also demonstrated a novel use of a new family of antimicrobial agents called oligo-acyl-lysyls, which have the potential to be combined with other drugs and lipid mixtures with similar properties to yield a platform for other specific applications.

"As we've seen in the recent *E. coli* outbreak in Germany, bacteria can mutate to become super bugs that resist antibiotics," said Gerald Weissmann, M.D., Editor-in-Chief of *The FASEB Journal*. "Thanks to this new, lipid-based antibiotic therapy, multidrug-resistant bacteria may begin to look more like Jimmy Olsen and a lot less like Superman."

Story Source:

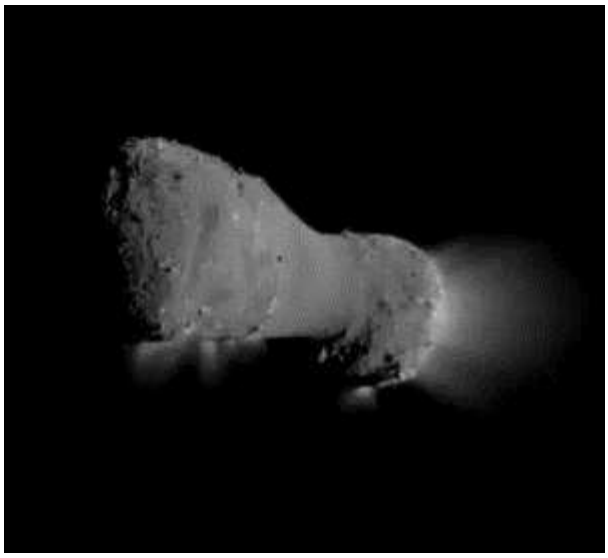
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Federation of American Societies for Experimental Biology**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. H. Sarig, D. Ohana, R. F. Epand, A. Mor, R. M. Epand. **Functional studies of cochleate assemblies of an oligo-acyl-lysyl with lipid mixtures for combating bacterial multidrug resistance**. *The FASEB Journal*, 2011; DOI: 10.1096/fj.11-183764

http://www.sciencedaily.com/releases/2011/06/110616193740.htm

Comet Hartley 2 in Hyperactive Class of Its Own: CO_2 Jets Confirmed, New Insight Into Composition, 'Excited' Rotation



This image from the flyby was taken from the spacecraft's Medium-Resolution Instrument during the encounter. The spacecraft was able to image nearly 50 percent of the comet's illuminated surface in detail. (Credit: NASA/JPL-Caltech/UMD/Brown University)

ScienceDaily (June 16, 2011) — Comet Hartley 2, is in a hyperactive class of its own compared to other comets visited by spacecraft, says a University of Maryland-led study published in the June 17 issue of the journal *Science*.

The comet was visited last fall by NASA's Deep Impact spacecraft during its EPOXI mission. The EPOXI science team's new, in-depth analysis of the images and data taken during the flyby confirms its earlier finding that carbon dioxide is the volatile fuel for Hartley 2's ice-spewing jets.

In-depth analysis of the images and data taken during the flyby of the comet last fall by NASA's Deep Impact spacecraft confirms that carbon dioxide is the volatile fuel for Hartley 2's spectacular ice-spewing jets.

The study also provides several new twists in the unfolding story of this small cometary dynamo including that: (1) the smooth, relatively inactive waist of the peanut shaped comet is likely re-deposited, and thus evolutionary rather than primordial material; (2) Hartley 2 has an 'excited state of rotation' because it spins around one axis, but also tumbles around a different axis; and (3) on its larger, rougher ends, the comet's surface is dotted with glittering, blocky objects that can reach approximately 165 feet (50 meters) high and 260 feet (80 meters) wide.

"Hartley 2 is a hyperactive little comet, spewing out more water than other comets its size," said University of Maryland Astronomer Michael A'Hearn, who is lead author on the *Science* paper and principal investigator for the EPOXI and Deep Impact missions."When warmed by the sun, dry ice [frozen carbon dioxide] deep in the comet's body turns to gas jetting off the comet and dragging water ice with it.

"Although, Hartley 2 is the only such hyperactive comet visited by a spacecraft, we know of at least a dozen other comets that also are relatively high in activity for their size and which are probably driven by carbon dioxide or carbon monoxide," said A'Hearn, who won the 2008 Kuiper astronomy prize for seminal contributions over his career to the study of comets. "These could represent a separate class of hyperactive comets or just a continuum in comet activity extending from Hartley 2-like comets all the way to the much less active, 'normal' comets that we are more used to seeing."

The EPOXI mission found that the strong activity in water release and carbon dioxide-powered jets did not occur equally in the different regions of the comet. During the spacecraft's flyby of the comet -- with closest approach of 431 miles (694 km) on November 4, 2011 -- carbon dioxide driven jets were seen at the ends of the comet with most occurring at the small end. The water ice particles driven out by these jets created a "snowstorm" through which the spacecraft flew. In the middle region or waist of the comet, water was

released as vapor with very little carbon dioxide or ice. The latter findings indicate that material in the waist is likely a product of the activity at the ends of the comet, the researchers say.
"We think the waist is a deposit of material from other parts of the comet, our first evidence of redistribution on a comet," said University of Maryland Astronomy Professor Jessica Sunshine, who is deputy principal investigator for the EPOXI mission. "The most likely mechanism is that some fraction of the dust, icy chunks, and other material coming off the ends of the comet are moving slowly enough to be captured by even the very weak gravity of this small comet. This material then falls back into the lowest point, the middle," said Sunshine, who is principal investigator for Comet Hopper, a mission proposal that is a finalist for selection by NASA as a new planetary mission in the agency's Discovery Program.
The researchers also say that their EPOXI findings indicate the small end of the comet appears to release about twice as much carbon dioxide relative to the amount of water released than does the large end. If true, they write, this difference almost certainly indicates a primordial difference in composition between the two ends, a difference present since this comet's formation.
However, they note that for now this is still a tenuous conclusion. The complex rotation and tumble of Hartley 2 makes it hard to definitively correlate differences in carbon dioxide to water ratios with compositional differences for the two ends of the comet.
"Not only does the total brightness of Hartley 2 vary, but the dust and gas structures in its coma show occasional 'hiccups' over the course of several rotations, phenomena characteristic of a complex rotation state," said study coauthor Tony Farnham, an associate research scientist at the University of Maryland. "These observations suggest that there is something unique about the activity on Hartley 2 that has a major influence on its dynamical state."
In comets, the release of dust and water vapor and the activation of carbon dioxide (and other volatiles) jets are the result of solar heating on the sunward side of a comet. Thus, a complete understanding of how the dual axis rotations affect the amount solar heating that each end of the comet receives is needed in order to determine how much solar heating versus true primordial compositional differences influenced the type and amount of material that is observed streaming out of the comet at both ends.
"Ground based observations can measure, over a much longer period of time, the rotational behavior of Hartley 2, as well as the compositional variations in the extended coma, the cloud of dust and gas surrounding the body of the comet," said coauthor Lori Feaga, an assistant research scientist at the University of Maryland. "Several other research groups have made such observations of the comet, and their finding will assist us in jointly disentangling the underlying cause of Hartley 2's heterogeneity."
The study notes that another EPOXI discovery is that on the knobby ends of Hartley 2, particularly the smaller end, the surface terrain is dotted with block-like, shiny objects, some as big as a block-long, 16-story-tall building -- tops of 165 feet (50 meters) high and 260 feet (80 meters) wide. The study says the objects appear to be two to three times more reflective than the surface average.
"These are spectacular features, but at this point we don't know whether these are deposits or growths, or something else," said Sunshine.

Deep Impact on Comet Science

Comets are fundamental building blocks of the giant planets and may have been an important source by which water and organics -- the essentials of life as we know it -- came to Earth.
On its EPOXI mission the Deep Impact spacecraft flew by Hartley 2 on Nov. 4, 2010, just a few weeks after the comet had passed within 11 million miles of Earth. Equipped with two telescopes with digital color cameras and a near-infrared spectrometer, the spacecraft beamed back more than a million images and spectra of Hartley 2 during an imaging period encompassing 2 months on approach of the comet and 3 weeks on departure.
With its EPOXI mission data, the Deep Impact spacecraft added to its extensive scientific legacy. Launched in January 2005, the spacecraft made history and world-wide headlines when it smashed a probe into comet Tempel 1 on July 4th of that year. Following the conclusion of that mission, a Maryland-led team of scientists won approval from NASA to fly the Deep Impact spacecraft to a second comet as part of an extended mission named EPOXI (Extrasolar Planet Observation and Deep Impact Extended Investigation).

The spacecraft remains in excellent condition, but has no fuel for future travels. Use of the spacecraft as an orbiting observatory remains possible.

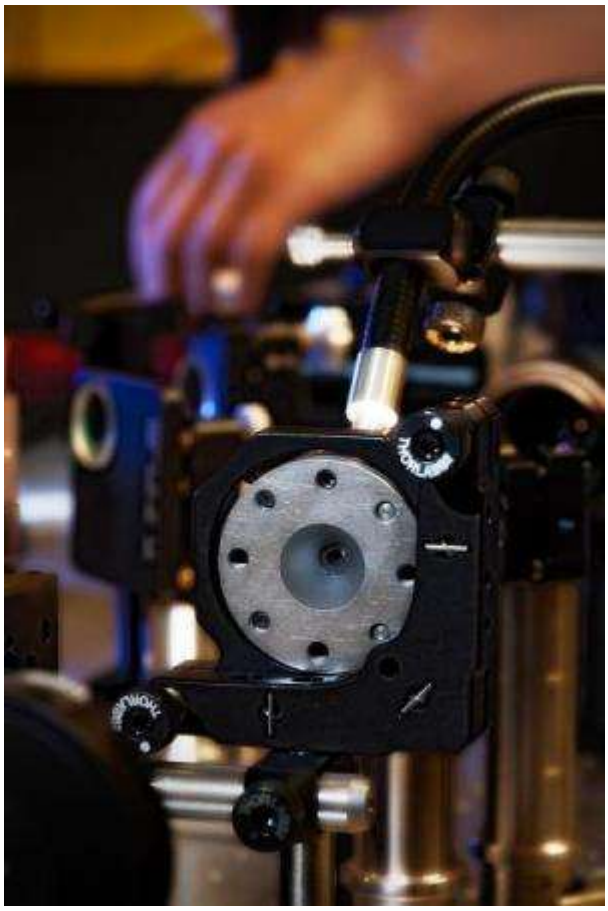
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Maryland**.

Journal Reference:

1. A'Hearn et al. **EPOXI at Comet Hartley 2**. *Science*, 2011; 332 (6036): 1396-1400 DOI: 10.1126/science.1204054

http://www.sciencedaily.com/releases/2011/06/110616142706.htm

Metallic Glass: A Crystal at Heart



Scientists recently used a diamond anvil like this one to squeeze tiny samples of metallic glass. Under very high pressure, the samples switched from their amorphous, glassy state to form a single crystal -- the first time this behavior has been seen in a glass. The discovery. published in the June 17 issue of Science, could help scientists design better metallic glasses, which are widely used in power transformers, anti-theft tags and other products, and it may help explain why these materials are so tough. (Credit: Image courtesy Brad Plummer/SLAC.)

ScienceDaily (June 16, 2011) — Glass, by definition, is amorphous; its atoms lack order and are arranged every which way. But when scientists squeezed tiny samples of a metallic glass under high pressure, they got a surprise: The atoms lined up in a regular pattern to form a single crystal.

It's the first time researchers have glimpsed this hidden property in a glass. The discovery, reported June 17th in *Science*, offers a new window into the atomic structure and behavior of metallic glasses, which have been used for decades in products such as anti-theft tags and power transformers but are still poorly understood. The more scientists learn about the structure of these commercially important materials, the more effectively they can design new metallic glasses and tinker with old ones to improve their performance.

"Maybe a lot of glasses have this underlying structure, but we just didn't know how to look for it," said paper co-author Wendy Mao, a mineral physicist at the Department of Energy's (DOE) SLAC National Accelerator Laboratory and Stanford University.

Daniel Miracle, a metallurgist at the Air Force Research Laboratory in Ohio who was not involved in the research, called the discovery "a really, really neat, important finding." Not only will it help researchers design better metallic glasses, he said, but it may help explain why these materials can be so tough: If each piece of glass is a single crystal at heart, it doesn't have any of the weak spots at the boundaries between crystals where fractures and corrosion tend to start.

Unlike familiar window glass, metallic glasses are alloys made of metals -- in this case cerium and aluminum. They resist wear and corrosion and they have useful magnetic properties. If you took apart the plastic anti-theft tag on a DVD case, you'd find a thin piece of metallic glass that looks like aluminum foil. When you rent or buy a DVD, the checkout clerk rubs it across a pad to demagnetize the metallic glass so it won't trigger an alarm when you leave.

Scientists have been investigating metallic glasses for half a century, and in 1982 turned up the surprising discovery that these glasses do have some atomic structure, forming patterns over distances spanning just a few atoms. But no long-range patterns were apparent.

"The structure of glass is still mysterious. We know little about it, even though we use glass a lot," said Qiaoshi (Charles) Zeng of Zhejiang University in China, who led a research team of scientists from SLAC, Stanford, the Carnegie Institution of Washington, George Mason University and China's Jilin University. "And it's not easy investigating the structure of glass by traditional methods."

Zeng, Mao and their colleagues were not looking for order when they squeezed samples of the metallic glass between the tips of two diamonds at Argonne National Laboratory's Advanced Photon Source, applying 250,000 bars of pressure (250,000 times the pressure of Earth's atmosphere at sea level). They were simply doing a series of experiments on how materials behave in extreme conditions.

All the samples were taken from a centimeter-long, extremely thin ribbon of the metallic glass. Under intense pressure, all of the samples "devitrified," abruptly switching out of their glassy state to form a face-centered cubic crystal -- one whose atoms are arranged like ping-pong balls packed into a box.

What's more, all the atoms in the crystallized samples lined up in the same direction -- an indication, the researchers wrote, that this underlying structure ran throughout the whole ribbon of glass, and was put there when the glass formed.

Zeng, who will be joining Mao's group at Stanford in July, said the high-pressure technique may offer a new approach for making single-crystal materials from glasses. In addition, he said, it provides a unified understanding of the atomic structures of materials by directly linking the two most extreme examples: highly ordered single crystals and highly disorganized glass.

This work was supported in part by DOE's Office of Science through the Center for Energy Frontier Research in Extreme Environments, a DOE Energy Frontier Research Center led by the Carnegie Institute of Washington.

Story Source:

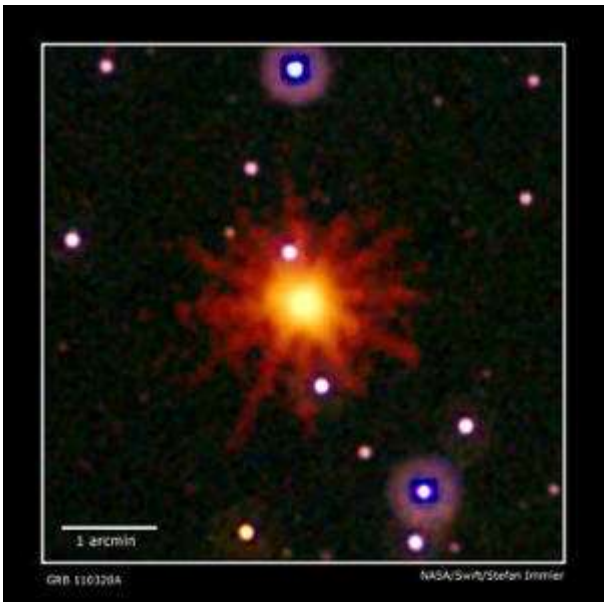
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/SLAC National Accelerator Laboratory**.

Journal Reference:

1. Qiaoshi Zeng, Hongwei Sheng, Yang Ding, Lin Wang, Wenge Yang, Jian-Zhong Jiang, Wendy L. Mao, and Ho-Kwang Mao. **Long-Range Topological Order in Metallic Glass**. *Science*, 2011; 332 (6036): 1404-1406 DOI: 10.1126/science.1200324

http://www.sciencedaily.com/releases/2011/06/110616142724.htm

Gamma-Ray Flash Came from Star Being Eaten by Massive Black Hole



Images from Swift's Ultraviolet/Optical (white, purple) and X-ray telescopes (yellow and red) were combined in this view of the gamma-ray flare, catalogued as GRB 110328A. The blast was detected only in X-rays, which were collected over a 3.4-hour period on March 28, 2011. (Credit: NASA/Swift/Stefan Immler)

ScienceDaily (June 16, 2011) — A bright flash of gamma rays observed March 28 by the Swift satellite may have been the death rattle of a star falling into a massive black hole and being ripped apart, according to a team of astronomers led by the University of California, Berkeley.

When the Swift Gamma Burst Mission spacecraft first detected the flash within the constellation Draco, astronomers thought it was a gamma-ray burst from a collapsing star. On March 31, however, UC Berkeley's Joshua Bloom sent out an email circular suggesting that it wasn't a typical gamma-ray burst at all, but a high-energy jet produced as a star about the size of our sun was shredded by a black hole a million times more massive.

Careful analysis of the Swift data and subsequent observations by the Hubble Space Telescope and the Chandra X-ray Observatory confirmed Bloom's initial insight. The details are published online on June 16 in *Science* Express, a rapid publication arm of the journal *Science*.

"This is truly different from any explosive event we have seen before," Bloom said.

What made this gamma-ray flare, called Sw 1644+57, stand out from a typical burst were its long duration and the fact that it appeared to come from the center of a galaxy nearly 4 billion light years away. Since most, if not all, galaxies are thought to contain a massive black hole at the center, a long-duration burst could conceivably come from the relatively slow tidal disruption of an infalling star, the astronomers said.

"This burst produced a tremendous amount of energy over a fairly long period of time, and the event is still going on more than two and a half months later," said Bloom, an associate professor of astronomy at UC Berkeley. "That's because as the black hole rips the star apart, the mass swirls around like water going down a drain, and this swirling process releases a lot of energy."

Bloom and his colleagues propose in their *Science* Express paper that some 10 percent of the infalling star's mass is turned into energy and irradiated as X-rays from the swirling accretion disk or as X-rays and higher energy gamma rays from a relativistic jet that punches out along the rotation axis. Earth just happened to be in the eye of the gamma-ray beam.

Bloom draws an analogy with a quasar, which is a distant galaxy that emits bright, high-energy light because of the massive black hole at its center gobbling up stars and sending out a jet of X-rays along its rotation axis. Observed from an angle, these bright emissions are called active galactic nuclei, but when observed down the axis of the jet, they're referred to as blazars.

"We argue that this must be jetted material and we're looking down the barrel," he said. "Jetting is a common phenomenon when you have accretion disks, and black holes actually prefer to make jets."
Looking back at previous observations of this region of the cosmos, Bloom and his team could find no evidence of X-ray or gamma-ray emissions, leading them to conclude that this is a "one-off event," Bloom said.
"Here, you have a black hole sitting quiescently, not gobbling up matter, and all of a sudden something sets it off," Bloom said. "This could happen in our own galaxy, where a black hole sits at the center living in quiescence, and occasionally burbles or hiccups as it swallows a little bit of gas. From a distance, it would appear dormant, until a star randomly wanders too close and is shredded."
Probable tidal disruptions of a star by a massive black hole have previously been seen at X-ray, ultraviolet and optical wavelengths, but never before at gamma-ray energies. Such random events, especially looking down the barrel of a jet, are incredibly rare, "probably once in 100 million years in any given galaxy," said Bloom. "I would be surprised if we saw another one of these anywhere in the sky in the next decade."
The astronomers suspect that the gamma-ray emissions began March 24 or 25 in the uncatalogued galaxy at a redshift of 0.3534, putting it at a distance of about 3.8 billion light years. Bloom and his colleagues estimate that the emissions will fade over the next year.
"We think this event was detected around the time it was as bright as it will ever be, and if it's really a star being ripped apart by a massive black hole, we predict that it will never happen again in this galaxy," he said.
Bloom's colleagues include UC Berkeley theoretical physicist Elliot Quataert, who models the production of jets from accretion disks, and UC Berkeley astronomers S. Bradley Cenko, Daniel A. Perley, Nathaniel R. Butler, Linda E. Strubbe, Antonino Cucchiara, Geoffrey C. Bower and Adam N. Morgan; Dimitrios Giannios and Brian D. Metzger of Princeton University; Andrew J. Levan of the University of Warwick, Coventry, United Kingdom; Nial R. Tanvir, Paul T. O' Brien, Andrew R. King and Sergei Nayakshin of the University of Leicester in the U.K.; Fabio De Colle, Enrico Ramirez-Ruiz and James Guillochon of UC Santa Cruz; William H. Lee of the Universidad Nacional Autonoma de México in Mexico City; Andrew S. Fruchter of the Space Telescope Science Institute in Baltimore, Md.; and Alexander J. van der Horst of the Universities Space Research Association in Huntsville, Ala.
Levan is first author of the companion *Science* Express paper, and leader of the Chandra and Hubble Space Telescope observation team.
Bloom and his laboratory are supported by grants from NASA and the National Science Foundation.

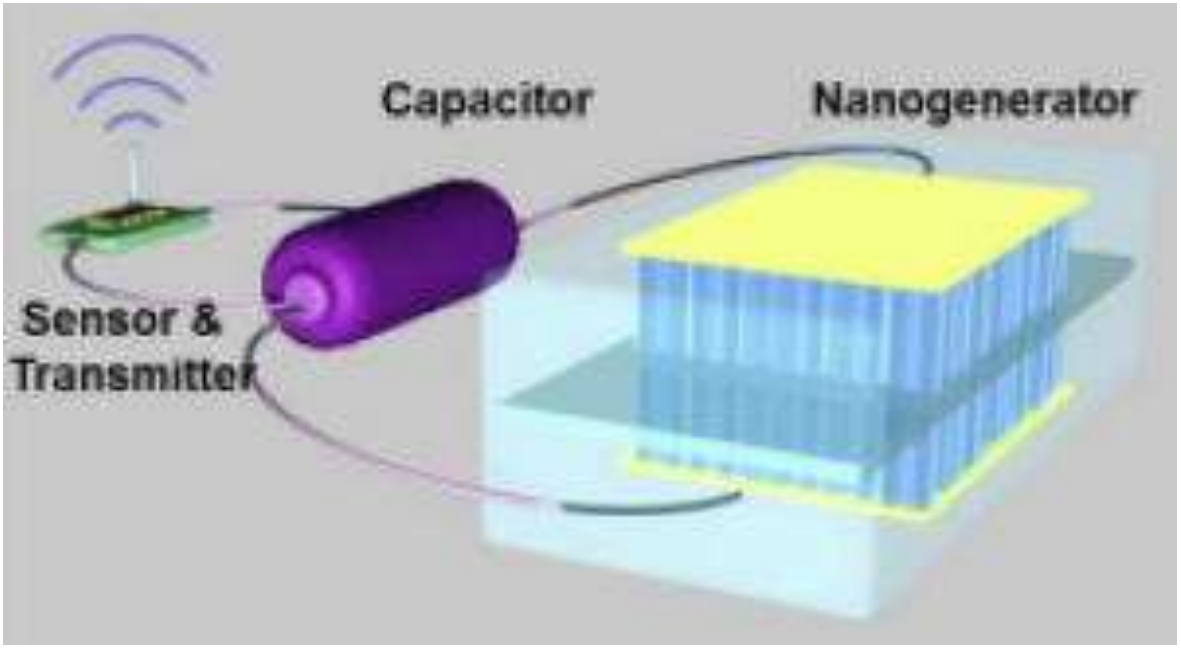
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Berkeley**.

Journal Reference:

1. Joshua S. Bloom, Dimitrios Giannios, Brian D. Metzger, S. Bradley Cenko, Daniel A. Perley, Nathaniel R. Butler, Nial R. Tanvir, Andrew J. Levan, Paul T. O' Brien, Linda E. Strubbe, Fabio De Colle, Enrico Ramirez-Ruiz, William H. Lee, Sergei Nayakshin, Eliot Quataert, Andrew R. King, Antonino Cucchiara, James Guillochon, Geoffrey C. Bower, Andrew S. Fruchter, Adam N. Morgan, Alexander J. Van Der Horst. **A Possible Relativistic Jetted Outburst from a Massive Black Hole Fed by a Tidally Disrupted Star**. *Science*, 16 June 2011 DOI: 10.1126/science.1207150

http://www.sciencedaily.com/releases/2011/06/110616142709.htm

First Self-Powered Device With Wireless Data Transmission



Scientists are reporting development of the first self-powered nano-device that can transmit data wirelessly over long distances. (Credit: ACS)

ScienceDaily (June 16, 2011) — Scientists are reporting development of the first self-powered nano-device that can transmit data wirelessly over long distances. In a study in ACS's journal *Nano Letters*, they say it proves the feasibility of a futuristic genre of tiny implantable medical sensors, airborne and stationary surveillance cameras and sensors, wearable personal electronics, and other devices that operate independently without batteries on energy collected from the environment.

Zhong Lin Wang and colleagues explain that advances in electronics have opened the door to developing tiny devices that operate battery-free on minute amounts of electricity that can be harvested from the pulse of a blood vessel, a gentle breeze, or the motions of a person walking. "It is entirely possible to drive the devices by scavenging energy from sources in the environment such as gentle airflow, vibration, sonic wave, solar, chemical, and/or thermal energy," the scientists explain.

The device consists of a nanogenerator that produces electricity from mechanical vibration/triggering, a capacitor to store the energy, and electronics that include a sensor and a radio transmitter similar to those in Bluetooth mobile phone headsets. Their device transmitted wireless signals that could be detected by an ordinary commercial radio at distances of more than 30 feet.

The authors acknowledge funding from DARPA and the U.S. Department of Energy, Basic Energy Sciences.

Story Source:

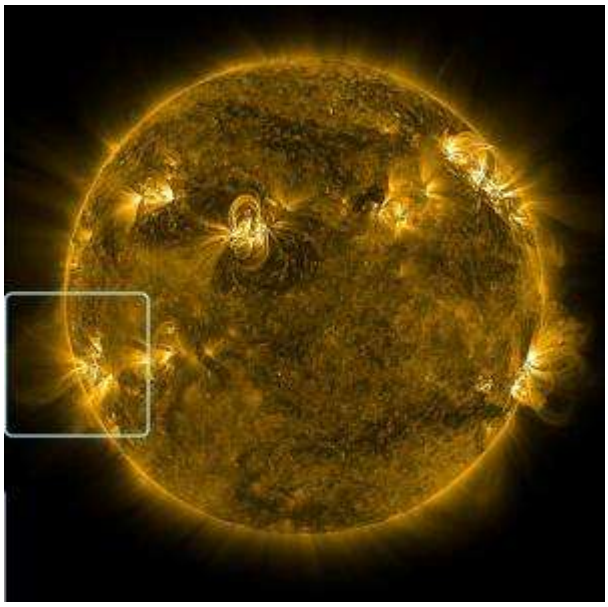
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Chemical Society**.

Journal Reference:

1. Youfan Hu, Yan Zhang, Chen Xu, Long Lin, Robert L. Snyder, Zhong Lin Wang. **Self-Powered System with Wireless Data Transmission**. *Nano Letters*, 2011; : 110523140742088 DOI: 10.1021/nl201505c

http://www.sciencedaily.com/releases/2011/06/110615103042.htm

Scientists Prove Existence of 'Magnetic Ropes' That Cause Solar Storms



Sun's image taken at 03:41 UT on March 8, 2011, showing numerous loops of magnetic fields emanating from multiple island-like active regions across the surface of the Sun. The white box encloses the particular active region where the giant magnetic rope was discovered. The image, taken by the Atmospheric Imaging Assembly (AIA) telescope on board SDO at the Extreme Ultraviolet wavelength of 171 Angstrom, maps the highly-charge corona gas material at temperature about 1 million degree Celsius. (Credit: NASA and George Mason University)

ScienceDaily (June 16, 2011) — George Mason University scientists discovered recently that a phenomenon called a giant magnetic rope is the cause of solar storms. Confirming the existence of this formation is a key first step in helping to mitigate the adverse effects that solar storm eruptions can have on satellite communications on Earth.

The discovery was made by associate professor Jie Zhang and his graduate student Xin Cheng using images from the NASA Solar Dynamic Observatory (SDO) spacecraft.

Though the magnetic rope was believed to be the cause of these giant eruptions on the Sun, scientists had previously not been able to prove this phenomenon existed because of how quickly the rope moves.

However, through close examination of images taken by the Atmospheric Imaging Assembly (AIA) telescope on board the SDO, Zhang was able to pinpoint an area of the sun where a magnetic rope was forming. The AIA telescope suite is able to capture images of the Sun every 10 seconds, 24 hours a day. This unprecedented cadence in time helped the discovery.

"The magnetic rope triggers a solar eruption. Scientists have been debating whether or not this magnetic rope exists before a solar eruption. I believe that the result of this excellent observation helps finally solve this controversial issue," says Zhang.

A solar storm is a violent eruption from the Sun, sending billions of tons of charged material, also called plasma, into space at a speed of more than one million miles per hour. The cloud of plasma carries with it a strong magnetic field. When the magnetized cloud reaches Earth one to three days later, a huge amount of energy is deposited into the magnetosphere of Earth.

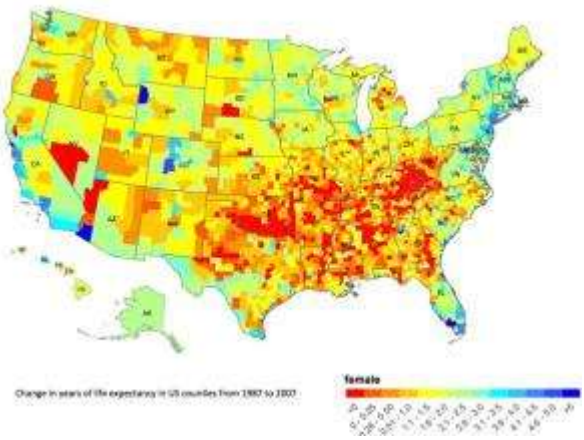
Normally Earth's magnetosphere shields this harmful solar wind and protects the environment. However, a solar storm has the potential to disrupt the shielding effect and produce severe space weather, which can have harmful effects on a wide array of technological systems, including satellite operation, communication and navigation and electric power grids.

Zhang's research will help in giving early warning about solar storms and help to minimize the damage done by space weather here on Earth.
"Understanding the eruption process of these storms will definitely help us better predict them," says Zhang. "We cannot prevent solar storms, just like we cannot prevent earthquakes or volcanoes. But the development of prediction capacity can help mitigate adverse effects. For instance, satellite operators can power-down key systems to prevent the possible damage to the systems."
It is widely believed that magnetic fields in the Sun play an essential role in storing energy and powering solar storms. However, the exact form that magnetic field lines take prior to the eruption are highly controversial. Most field lines are semi-circular loops with their foot-points rooted on the surface of the Sun. They cannot erupt easily, and in fact, they often play the role of preventing the eruption.
Scientists suspected that the magnetic rope, if it indeed existed, was the phenomenon that powered the eruption. A magnetic rope contains many magnetic field lines wrapping around a center axis and possibly twisting around each other. Because of the twisting, a strong electric current can be carried by the magnetic rope. Theoretically, the electric current could produce a sufficient electro-magnetic force to overcome the overlying constraining force from other field lines and power the magnetic rope to move outward.
AIA images now reveal that, before an eruption, there is a long and low-lying channel running through the entire active region, which heats to a temperature as high as 10 million degrees, and slowly rises. When it reaches a critical point, it starts to erupt quickly. It is a feature distinctly different from the surrounding magnetic field lines. This particular hot channel is now believed to be the magnetic rope that scientists have been looking for.
Zhang is an associate professor in the School of Physics, Astronomy and Computational Sciences and works with the Space Weather Lab at George Mason University. His results were reported at the American Astronomical Society Solar Physics Division Meeting, held in Las Cruces, New Mexico on June 12-16, 2011.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **George Mason University**.

http://www.sciencedaily.com/releases/2011/06/110615103218.htm

Life Expectancy in Most US Counties Falls Behind World's Healthiest Nations



U.S. women's life expectancy. The most current county-level analysis finds large disparities nationwide. Women fare worse than men, and people in Appalachia, the Deep South, and Northern Texas live the shortest lives. (Credit: Image courtesy of Institute for Health Metrics and Evaluation)

ScienceDaily (June 16, 2011) — While people in Japan, Canada, and other nations are enjoying significant gains in life expectancy every year, most counties within the United States are falling behind, according to a new study by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington.

IHME researchers, in collaboration with researchers at Imperial College London, found that between 2000 and 2007, more than 80% of counties fell in standing against the average of the 10 nations with the best life expectancies in the world, known as the international frontier.

"We are finally able to answer the question of how the US fares in comparison to its peers globally," said Dr. Christopher Murray, IHME Director and one of the paper's co-authors. "Despite the fact that the US spends more per capita than any other nation on health, eight out of every 10 counties are not keeping pace in terms of health outcomes. That's a staggering statistic."

The new study, Falling behind: life expectancy in US counties from 2000 to 2007 in an international context, is published June 15 in Biomed Central's open-access journal *Population Health Metrics*. In conjunction with the study, IHME is releasing a complete time series for life expectancy from 1987 to 2007 for 3,138 counties and 10 cities, the most up-to-date analysis available.

"When compared to the international frontier for life expectancy, US counties range from being 16 calendar years ahead to more than 50 behind for women. For men the range is from 15 calendar years ahead to more than 50 calendar years behind. This means that some counties have a life expectancy today that nations with the best health outcomes had in 1957."

Hopefully it's not too late to fix it. Thanks in advance.

The researchers suggest that the relatively low life expectancies in the US cannot be explained by the size of the nation, racial diversity, or economics. Instead, the authors point to high rates of obesity, tobacco use, and other preventable risk factors for an early death as the leading drivers of the gap between the US and other nations.

Five counties in Mississippi have the lowest life expectancies for women, all below 74.5 years, putting them behind nations such as Honduras, El Salvador, and Peru. Four of those counties, along with Humphreys County, MS, have the lowest life expectancies for men, all below 67 years, meaning they are behind Brazil, Latvia, and the Philippines.

Women live the longest in Collier, FL, at 86 years on average, better than France, Switzerland, and Spain. Men live the longest in Fairfax County, VA, at 81.1 years, which is higher than life expectancies in Japan and Australia. Women are also living long lives in Teton, Wyoming; San Mateo and Marin, California; and Montgomery, Maryland. For men, long life spans also can be found in Marin, California; Montgomery, Maryland; Santa Clara, California; and Douglas, Colorado.

Nationwide, women fare more poorly than men. The researchers found that women in 1,373 counties -- about 40% of US counties -- fell more than five years behind the nations with the best life expectancies. Men in about half as many counties -- 661 total -- fell that far.

Black men and women have lower life expectancies than white men and women in all counties. Life expectancy for black women ranges from 69.6 to 82.6 years, and for black men, from 59.4 to 77.2 years. In both cases, no counties are ahead of the international frontier, and some are more than 50 years behind. The researchers were not able to analyze other race categories because of low population levels in many counties.

Change in life expectancy is so uneven that within some states there is now a decade difference between the counties with the longest lives and those with the shortest. States such as Arizona, Florida, Virginia, and Georgia have seen counties leap forward more than five years from 1987 to 2007 while nearby counties stagnate or even lose years of life expectancy. In Arizona, Yuma County's average life expectancy for men increased 8.5 years, nearly twice the national average, while neighboring La Paz County, lost a full year of life expectancy, the steepest drop nationwide. Nationally, life expectancy increased 4.3 years for men and 2.4 years for women between 1987 and 2007.

"By creating this time series, which has never been available at the county level, we hope states and counties will be able to take targeted action," Dr. Sandeep Kulkarni, an IHME research fellow and the paper's lead author, said. "Counties in one part of the state should not be benefiting from big increases in life expectancy while other counties are actually seeing life spans shrink."

The authors propose that state and local policymakers use the life expectancy data and the county comparisons to tailor strategies that will fit the dynamics of their communities. This resonates with local policymakers, such as Dr. David Fleming, Director of Public Health -- Seattle & King County.

"It's not the health care system that's having the biggest impact on health; it's the community," Dr. Fleming said. "The average person in the US spends one hour annually in a physician's office unless they are really sick. So until we start moving our interventions out into the communities where people live, we are not going to get ahead of these problems."

The Seattle & King County health department is collaborating with IHME on an ambitious analysis of health in King County, one of the largest studies of its kind. Called the Monitoring Disparities in Chronic Conditions (MDCC) Study, researchers are integrating data from emergency medical services, hospital discharge databases, pharmacy records, and other sources to identify the biggest health challenges in King County. They are surveying 9,000 people and taking blood samples to analyze for a range of risk factors and diseases.

"We are building the evidence for focused interventions that will make an impact locally," said Dr. Ali Mokdad, Professor of Global Health at IHME, who is leading the MDCC Study. "If we as a society are going to fund programs to improve health, we must ensure that we are measuring the impact, because these life expectancy numbers show that what we have been doing up until now clearly is not working."

Story Source:

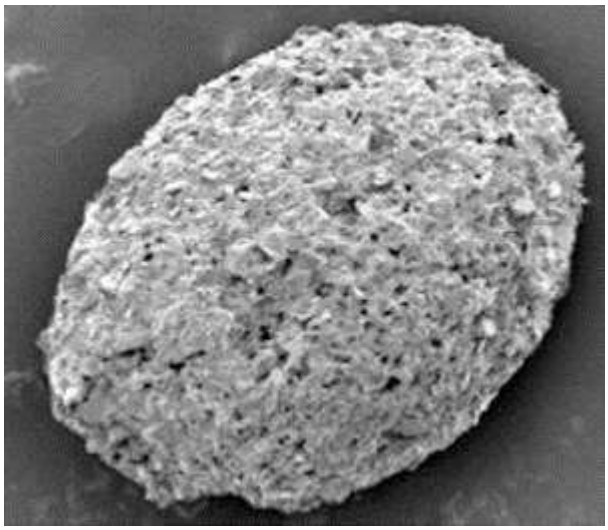
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Institute for Health Metrics and Evaluation**.

Journal Reference:

1. Sandeep C Kulkarni, Alison Levin-Rector, Majid Ezzati, Christopher JL Murray. **Falling behind: life expectancy in US counties from 2000 to 2007 in an international context**. *Population Health Metrics*, 2011; 9 (1): 16 DOI: 10.1186/1478-7954-9-16

http://www.sciencedaily.com/releases/2011/06/110615061958.htm

Life After 'Snowball Earth': New Fossils Suggest Rapid Recovery of Life After Global Freeze



Scanning electron microscopy images reveal an microscopic, oval-shaped shell with tapered ends, from which an organism's feet may have extended. The surface of the shell are made up of tiny bits of silica, aluminum and potassium, which the organism likely collected from the environment and glued to form armor. (Credit: Tanja Bosak)

ScienceDaily (June 16, 2011) — The first organisms to emerge after an ancient worldwide glaciation likely evolved hardy survival skills, arming themselves with tough exteriors to weather a frozen climate.

Researchers at MIT, Harvard University and Smith College have discovered hundreds of microscopic fossils in rocks dating back nearly 710 million years, around the time when the planet emerged from a global glaciation, or "Snowball Earth," event. The fossils are remnants of tiny, amoeba-like organisms that likely survived the harsh post-glacial environment by building armor and reaching out with microscopic "feet" to grab minerals from the environment, cobbling particles together to make protective shells.

The discovery is the earliest evidence of shell building, or agglutination, in the fossil record. The team found a diversity of fossils, suggesting life may have recovered relatively quickly following the first major Snowball Earth event. The researchers report their findings in an upcoming issue of *Earth and Planetary Science Letters*.

The widely held Snowball Earth theory maintains that massive ice sheets covered the planet from pole to pole hundreds of millions of years ago. Geologists have found evidence of two major snowball periods -- at 710 and 635 million years ago -- in glacial deposits that formed close to the modern equator. Fossil records illustrate an explosion of complex, multicellular life following the more recent ice age. However, not much is known about life between the two major glaciations -- a period of about 75 million years that, until now, exhibited few signs of life.

"We know quite well what happened before the first Snowball, but we have no idea what happened in between," says Tanja Bosak, assistant professor of geobiology at MIT, and the paper's lead author. "Now we're really starting to realize there's a lot of unexpected life here."

Ice Age armor

Bosak's colleagues, Francis Macdonald of Harvard and Sara Pruss of Smith, trekked to northern Namibia and Mongolia to sample cap-carbonate rocks -- the very first layers of sediment deposited after the first ice age. The team hauled the samples back to Cambridge, where Bosak dissolved the rocks in acid. She plated the residue on slides and looked for signs of fossilized life. "It's a little bit like looking at clouds, trying to pick out shapes and seeing if anything's consistent," Bosak says.

Peering at the sludge through a microscope, she discovered a sea of tiny dark ovals, each with a single notch at its edge. To get a closer look, Bosak used scanning electron microscopy to create high-resolution, three-dimensional images, revealing hollow, 10-micron-thick shells. Fossils from Namibia were mostly round;

those from Mongolia, more tube-like. Most fossils contained a slit or neck at one end, from which the organism's pseudopodia, or feet, may have protruded.
Bosak analyzed the shells' composition using X-ray spectroscopy, finding a rough patchwork of silica, aluminum and potassium particles that the organism likely plucked from the environment and glued to its surface.
Bosak says these single-celled microbes may have evolved the ability to build shells to protect against an extreme deep-ocean environment, as well as a potentially growing population of single-celled species, some of which may have preyed on other organisms.

A Snowball window

"We can now say there really were these robust organisms immediately after the first glaciation," Bosak says. "Having opened this kind of window, we're finding all kinds of organisms related to modern organisms."
The closest modern relative may be testate amoebae, single-celled microbes found in forests, lakes and peat bogs. These tiny organisms have been known to collect particles of silica, clay minerals, fungi and pollen, cementing them into a hard cloak or shell. Bosak says testate amoebae were extremely abundant before the first Snowball Earth, although there is no robust evidence that the plentiful protist evolved its shell-building mechanism until after that ice age.
Bosak's guess is that the post-glacial environment was a "brine" teeming with organisms and newly evolved traits. She says the group plans to return to Mongolia to sample more rocks from the same time period, and hopes other researchers will start to investigate rates of evolutionary change in similar rocks.
Andrew Knoll, the Fisher Professor of Natural History and professor of earth and planetary sciences at Harvard, says the group's findings point to a potentially rich source of information about the kinds of life able to persist between glacial periods.
"To date, we've known very little about life between the two large ice ages," Knoll says. "With this in mind, the new discoveries are truly welcome."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Massachusetts Institute of Technology**. The original article was written by Jennifer Chu.

Journal Reference:

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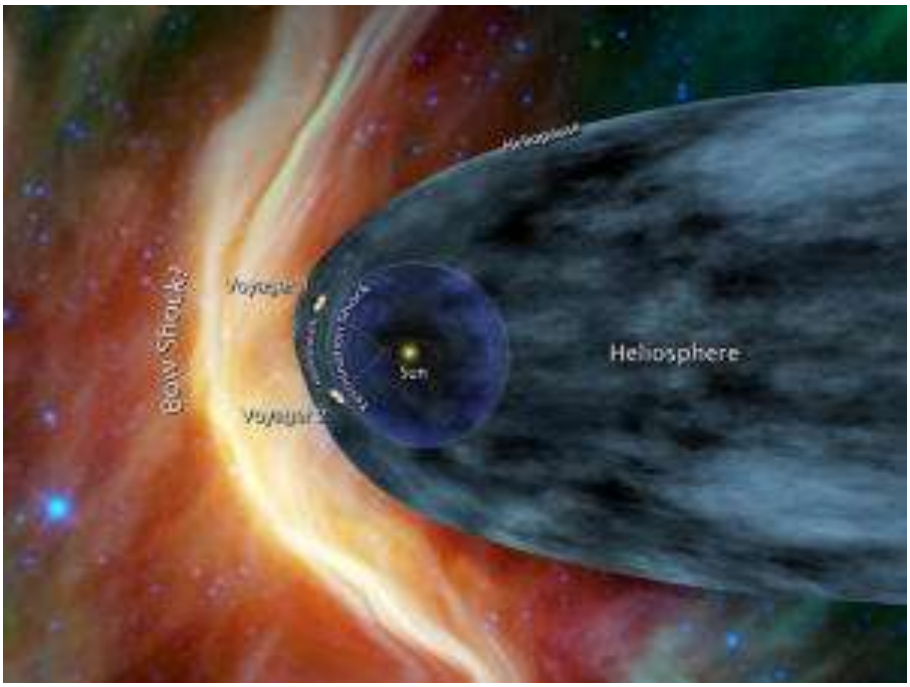
http://www.sciencedaily.com/releases/2011/06/110615132027.htm

Recalculating the Distance to Interstellar Space



This artist's concept shows NASA's two Voyager spacecraft exploring a turbulent region of space known as the heliosheath, the outer shell of the bubble of charged particles around our sun. (Credit: NASA/JPL-Caltech)

ScienceDaily (June 15, 2011) — Scientists analyzing recent data from NASA's Voyager and Cassini spacecraft have calculated that Voyager 1 could cross over into the frontier of interstellar space at any time and much earlier than previously thought.

The findings are detailed in this week's issue of the journal *Nature*.

Data from Voyager's low-energy charged particle instrument, first reported in December 2010, have indicated that the outward speed of the charged particles streaming from the sun has slowed to zero. The stagnation of this solar wind has continued through at least February 2011, marking a thick, previously unpredicted "transition zone" at the edge of our solar system.

"There is one time we are going to cross that frontier, and this is the first sign it is upon us," said Tom Krimigis, prinicipal investigator for Voyager's low-energy charged particle instrument and Cassini's magnetospheric imaging instrument, based at the Johns Hopkins University Applied Physics Laboratory in Laurel, Md.

Krimigis and colleagues combined the new Voyager data with previously unpublished measurements from the ion and neutral camera on Cassini's magnetospheric imaging instrument. The Cassini instrument collects data on neutral atoms streaming into our solar system from the outside.

The analysis indicates that the boundary between interstellar space and the bubble of charged particles the sun blows around itself is likely between 10 and 14 billion miles (16 to 23 kilometers) from the sun, with a best estimate of approximately 11 billion miles (18 billion kilometers). Since Voyager 1 is already nearly 11 billion miles (18 billion kilometers) out, it could cross into interstellar space at any time.

"These calculations show we're getting close, but how close? That's what we don't know, but Voyager 1 speeds outward a billion miles every three years, so we may not have long to wait," said Ed Stone, Voyager project scientist, based at the California Institute of Technology in Pasadena.

Scientists intend to keep analyzing the Voyager 1 data, looking for confirmation. They will also be studying the Voyager 2 data, but Voyager 2 is not as close to the edge of the solar system as Voyager 1. Voyager 2 is about 9 billion miles (14 billion kilometers) away from the sun.

Launched in 1977, the Voyager twin spacecraft have been on a 33-year journey. They are humanity's farthest working deep space sentinels enroute to reach the edge of interstellar space. The Voyagers were built by NASA's Jet Propulsion Laboratory in Pasadena, Calif., which continues to operate both spacecraft. The Voyager missions are a part of the NASA Heliophysics System Observatory, sponsored by the Heliophysics Division of NASA's Science Mission Directorate in Washington. JPL is managed for NASA by Caltech. More information about Voyager is available at: http://www.nasa.gov/voyager and http://voyager.jpl.nasa.gov .

Story Source:
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Low-Carbohydrate, High-Protein Diets May Reduce Both Tumor Growth Rates and Cancer Risk

A new study in mice suggests that eating a low-carbohydrate, high-protein diet may reduce the risk of cancer and slow the growth of tumors already present. (Credit: © Emilia Stasiak / Fotolia)

ScienceDaily (June 15, 2011) — Eating a low-carbohydrate, high-protein diet may reduce the risk of cancer and slow the growth of tumors already present, according to a study published in *Cancer Research*, a journal of the American Association for Cancer Research.

The study was conducted in mice, but the scientists involved agree that the strong biological findings are definitive enough that an effect in humans can be considered.

"This shows that something as simple as a change in diet can have an impact on cancer risk," said lead researcher Gerald Krystal, Ph.D., a distinguished scientist at the British Columbia Cancer Research Centre. Cancer Research editor-in-chief George Prendergast, Ph.D., CEO of the Lankenau Institute for Medical Research, agreed. "Many cancer patients are interested in making changes in areas that they can control, and this study definitely lends credence to the idea that a change in diet can be beneficial," said Prendergast, who was not involved with the study.

Krystal and his colleagues implanted various strains of mice with human tumor cells or with mouse tumor cells and assigned them to one of two diets. The first diet, a typical Western diet, contained about 55 percent carbohydrate, 23 percent protein and 22 percent fat. The second, which is somewhat like a South Beach diet but higher in protein, contained 15 percent carbohydrate, 58 percent protein and 26 percent fat. They found that the tumor cells grew consistently slower on the second diet.

As well, mice genetically predisposed to breast cancer were put on these two diets and almost half of them on the Western diet developed breast cancer within their first year of life while none on the low-carbohydrate, high-protein diet did. Interestingly, only one on the Western diet reached a normal life span (approximately 2 years), with 70 percent of them dying from cancer while only 30 percent of those on the low-carbohydrate diet developed cancer and more than half these mice reached or exceeded their normal life span.

Krystal and colleagues also tested the effect of an mTOR inhibitor, which inhibits cell growth, and a COX-2 inhibitor, which reduces inflammation, on tumor development, and found these agents had an additive effect in the mice fed the low-carbohydrate, high-protein diet.

When asked to speculate on the biological mechanism, Krystal said that tumor cells, unlike normal cells, need significantly more glucose to grow and thrive. Restricting carbohydrate intake can significantly limit blood glucose and insulin, a hormone that has been shown in many independent studies to promote tumor growth in both humans and mice.

Furthermore, a low-carbohydrate, high-protein diet has the potential to both boost the ability of the immune system to kill cancer cells and prevent obesity, which leads to chronic inflammation and cancer.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Association for Cancer Research**, via EurekAlert!, a service of AAAS.

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http://www.sciencedaily.com/releases/2011/06/110614115037.htm

The smell of a meat-eater

Chemical in urine alerts prey species to a nearby predator.
Nicola Nosengo

A chemical found in the urine of carnivores such as bobcats could shed light on the control of instinctive behaviour.Paul Sawer/FLPA

If you are a small animal, it is useful to know whether there is anything around that might want to eat you. Stephen Liberles from Harvard Medical School in Cambridge, Massachusetts, and his colleagues have analysed urine samples from a variety of zoo inhabitants, including lions and bears, and discovered how rodents can use smell to do just that.

In a research published today in the Proceedings of the National Academy of Science, the team identifies a chemical found in high concentrations in the urine of carnivores that makes mice and rats run for cover[1]. Chemicals have already been identified that allow prey to recognize a known predator. But this is the first example of a generic clue that allows an animal to detect any potential predator, irrespective of whether the two species have ever come into contact.

The researchers started by analysing an engimatic group of olfactory receptors discovered in 2001 called trace amine-associated receptors (TAARs)[2]. They are found in most vertebrates, in varying numbers. Mice, for example, have 15, rats 17 and humans have just 6. Very little is known about what chemicals bind to them.

"A giraffe had to be trained to urinate in a cup."

Liberles and his colleagues found that one member of the receptor family, TAAR4, is strongly activated by bobcat urine, which is sold online and used by gardeners to keep rodents and rabbits away. They managed to extract the molecule responsible for activating the receptor, called 2-phenylethylamine.

They then wondered whether the molecule was specific to the bobcat. But the urine from other animals cannot always be bought as easily. "Also, commercial products may be contaminated, whereas we wanted to be sure we were studying only natural substances," says David Ferrero, a graduate student in Liberles's lab and first author of the study.

So the researchers collected urine samples from a range of sources, including zoos in New England and South Dakota. Their collection covered 38 species from predators such as lions, snow leopards and servals to herbivores including cows, giraffes and zebra. They also tested humans, cats and various rodents.

The operation was not trivial. A giraffe had to be trained to urinate in a cup, and Ferrero had a nose-to-nose encounter with an uncooperative jaguar when the animal jumped against the bars as he approached its cage.

Top of the list

Carnivores had by far the greatest concentration of 2-phenylethylamine in their urine, with the highest levels in lion, serval and tiger. Levels in the herbivores' urine were up to 3,000 times lower. The chemical might be a by-product of digesting meat proteins, although the researchers have yet to confirm this idea.

Liberles and his team double-checked the role of 2-phenylethylamine by placing a few drops of it - on its own, or within lion urine - in a cage. They found that mice and rats stayed away from that part of the cage. But when they used an enzyme to remove the chemical from lion urine, the drops no longer caused any reaction.

"The role of TAAR receptors is still a bit of a mystery," says Anna Menini, a physiologist at the International School for Advanced Studies in Trieste, Italy, and president-elect of the European Chemoreception Research Organization in Paris. "Here we have the first convincing evidence that they might control instinctive behaviour."

She adds that the study questions a dogma in olfactory studies: that the olfactory receptors that trigger instinctive responses are found only in the vomeronasal organ, a part of the olfactory system that humans have lost. TAARs are in the olfactory epithelium — specialized tissue on the roof of the nasal cavity — which humans have, although they do not have an active gene for TAAR4 itself.

The researchers are still missing the smoking gun for proving that TAAR4 directly controls the animal's behaviour: a mouse in which this receptor has been knocked out should be fearless when faced with a carnivore's urine. Liberles says he is working on this, as well as studying what brain circuits are activated by the receptor.

"That is the big black box in neuroscience" he says. "We know a lot about perception and we can observe behaviour, but we need to find the circuits in the brain that bridge the two. TAAR4 offers a way to do that."

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Gale Crater on target to become next Mars landing site

Scientists recommend destination for roving science laboratory 'Curiosity'.

A black ellipse in Gale crater shows the recommended landing site for NASA's Mars Science Laboratory.NASA

Gale Crater, a 150-kilometre wide depression named after an Australian banker-turned-amateur astronomer, has emerged as the preferred destination for the next spacecraft to set wheels on Mars.

The proposed landing site, which includes a tantalizing 5-kilometre-high mound of ancient sediments, may have once been flooded by water. Nature has learned that it rose to the top last month following a secret ranking of four candidate sites by co-investigators working with NASA's Mars Science Laboratory, a 900-kilogram rover dubbed 'Curiosity' set to launch later this year.

The scientists' endorsement of Gale Crater does not ensure that it will be selected by NASA management. Another site, Eberswalde Crater, which contains a relic river delta and — perhaps — buried evidence of organics in the lakebed deposits into which the river flowed, was ranked a very close second. The other two sites under consideration include Mawrth Vallis, which records complex mineralogy in the oldest and longest sequence of rocks among the four sites, and Holden Crater, another site with an ancient lakebed.

NASA Associate Administrator Ed Weiler is expected to make the final decision on Friday with a formal announcement of the site to follow next week. His imprimatur will bring to a close the most elaborate selection process yet for a Mars lander, in which dozens of candidate sites were winnowed down to the four

finalists. At a fifth and final site selection workshop last month, engineers told scientists that they were comfortable landing the rover safely in any of the four candidates sites. NASA engineers for the first time will use a 'sky crane' technology, in which a floating, rocket-powered platform will gently lower the rover to a boulder-free spot somewhere within a landing ellipse 20 kilometres by 25 kilometres.

The Mars Science Laboratory, 'Curiosity', will search for signs of past habitability.NASA

That vote of confidence from engineers means that the final site selection has come down to science. After the workshop, project scientist John Grotzinger of the California Institute of Technology in Pasadena gathered more than 50 principal and co-investigators from the science team for the closed-door ranking. "It was a very fair process," says one scientist involved.On Friday, Grotzinger will present Weiler with the science team's preferences. In the past weeks, an external panel, headed by Gentry Lee, an engineer with the Jet Propulsion Laboratory in Pasadena, has conducted a independent review of the site selection process.

Lucky number seven?

If successful, Curiosity will be the seventh spacecraft to soft-land on Mars. However, this time the stakes for the $2.5 billion mission are especially high. The mission's key objective, to study the past habitability of Mars, is even more crucially tied to the selection of a worthy landing site than previous missions have been. Earlier landings, such as the Viking missions of the 1970s, were bound to reveal exciting details no matter what they found, simply by getting there first. More recently, during the Mars Exploration Rover mission, two camps of Mars scientists were placated by the selection of two very different landing sites for the mission's twin rovers. Spirit went to Gusev Crater, which appealed to geologists interested in its stratigraphy and sedimentology, while Opportunity touched down on Meridiani Planum, where remote sensing showed a concentration of the water-related mineral haematite.

This time, three of the four sites are craters and all three appeal more to the sedimentologists, whereas only the fourth site, Mawrth Vallis, holds much allure for the mineralogists. And there is only one rover. Some mineralogists are already frustrated that Mawrth Vallis has been ruled out, even as they acknowledge that its lack of scenic vistas — important in drawing the public into a mission — could be a major failing.

Ross Irwin, a geomorphologist who works for the Planetary Science Institute in Tucson, Arizona, says that the friction between sedimentologists and mineralogists doesn't just represent two different camps of Mars scientists, but two classes of geological activities on Mars: one with mechanisms that make and erode layers of rock and another with interesting geochemical mechanisms. "It's not just telling us something about ourselves," says Irwin, who has advocated for Holden Crater. "It's telling us something about Mars as well."

The selection also throws a posthumous spotlight on Walter Frederick Gale, an Australian banker who was an avid amateur astronomer and comet discoverer at the turn of the twentieth century. The crater that bears his name, with its finely layered mound of sediment, was also one of the sites considered by the Mars Exploration Rover science team.

http://www.nature.com/news/2011/110623/full/news.2011.380.html

City living marks the brain

Neuroscientists study social risk factor for mental illness.
Alison Abbott

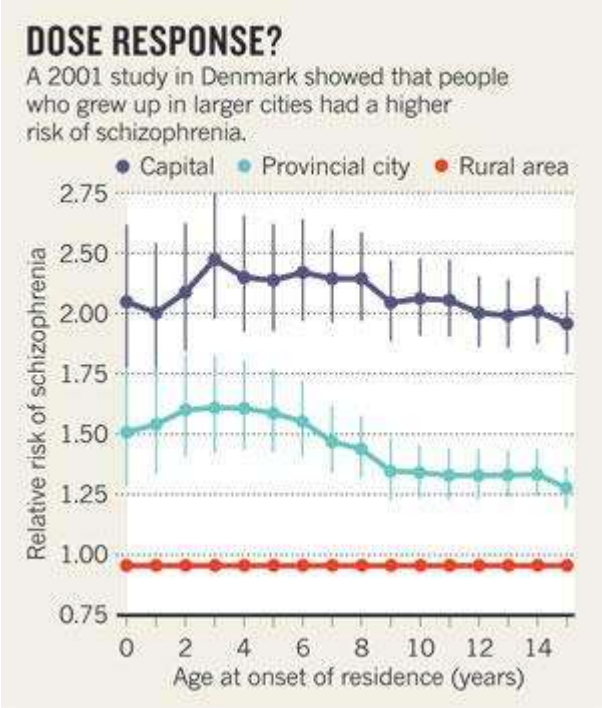
At a research institute in Mannheim, Leila Haddad scolds subjects to stress them while imaging their brains.S. WOLFF

Epidemiologists showed decades ago that people raised in cities are more prone to mental disorders than those raised in the countryside. But neuroscientists have avoided studying the connection, preferring to leave the disorderly realm of the social environment to social scientists. A paper in this issue of Nature represents a pioneering foray across that divide.

Using functional brain imaging, a group led by Andreas Meyer-Lindenberg of the University of Heidelberg's Central Institute of Mental Health in Mannheim, Germany, showed that specific brain structures in people from the city and the countryside respond differently to social stress (see pages 452 and 498). Stress is a major factor in precipitating psychotic disorders such as schizophrenia.

The work is a first step towards defining how urban life can affect brain biology in a way that has a potentially major impact on society — schizophrenia affects one in 100 people. It may also open the way for greater cooperation between neuroscientists and social scientists. "There has been a long history of mutual antipathy, particularly in psychiatry," says sociologist Craig Morgan at the Institute of Psychiatry in London. "But this is the sort of study that can prove to both sides that they can gain from each others' insights."

Meyer-Lindenberg works on risk mechanisms in schizophrenia, and previously focused on the role of genes. But although a dozen or so genes have been linked to the disorder, "even the most powerful of these genes conveys only a 20% increased risk", he says. Yet schizophrenia is twice as common in those who are city-born and raised as in those from the countryside, and the bigger the city, the higher the risk (see 'Dose response?').



SOURCE: C. B. PEDERSEN & P. B. MORTENSEN ARCH. GEN. PSYCHIATRY **58,** 1039–1046 (2001)

So Meyer-Lindenberg set out to study how city life might increase the risk of mental illness. The team scanned the brains of 32 student volunteers while they performed arithmetic tests. At the same time, the students received negative feedback through headphones. "We'd tell individuals they were performing below average, and suggest impatiently they hurry up a bit, so they'd feel they were failing," he explains.

This 'social stress' activated many brain areas, two of them specifically correlated with the volunteers' history of urban living. The amygdala, which processes emotion, was activated only in people currently living in a city. And the cingulate cortex, which helps to regulate the amygdala and processes negative emotions, responded more strongly in those brought up in cities than in those who grew up in towns or rural areas.

The initial experiment showed such clear associations that Meyer-Lindenberg didn't think anyone would believe them. So he did a similar experiment on another 23 subjects, this time adding visual feedback that allowed participants to see the investigators' frowns. He found the same sturdy associations.

He now plans to repeat the work in the general population, where urban–rural differences are likely to be even stronger than in students. He also plans to study how other risk factors identified by social scientists — such as being an immigrant — affect stress processing. "We will use tools from social scientists to help us quantify things like perceived discrimination, social support networks, or stigma," he says.

Yet he has had trouble interesting his social-science colleagues in setting up joint projects. Such lack of sympathy across the cultural divide is common, says Ernst Fehr, an economist at the University of Zurich, Switzerland, and a pioneer in the field of neuroeconomics, which studies the neurological basis of economic decisions. "But social problems have neurobiological effects, which, in turn, may exacerbate the social problems," he says.

The social sciences have as much to gain from crossing disciplinary boundaries as the biological sciences, says Morgan. "Sociologists and epidemiologists establish associations that are plausible — like immigrants may suffer more mental illness because of social isolation — but they are validated when neuroscientists demonstrate a robust biological mechanism."

For his future investigations, Meyer-Lindenberg is seeking urban planners who can help him to tease out how variables such as green space and population density contribute to the neurobiological impact of city living. Hans Wirz of the urban planning office in Basel, Switzerland, says that it took decades to integrate knowledge about the biomedical effects of the cityscape into his profession. "But when it comes to mental health we haven't a clue."

http://www.nature.com/news/2011/110622/full/474429a.html

Vaccine trial's ethics criticized

Collapsed trial fuels unfounded vaccine fears.
Priya Shetty

A schoolgirl receives human papillomavirus vaccine as part of a feasibility study in India.PATH/AMYNAH JANMOHAMED

A clinical trial that came under fire in India threatens to have a dual legacy: inflaming unfounded fears about a lifesaving vaccine and raising new questions about the management of medical research in the country. After four teenage girls taking part in a test of human papillomavirus (HPV) vaccines died last year, the Indian government faced accusations that its citizens were being used as guinea pigs to test dangerous vaccines. A scientific investigation has exonerated the vaccines but uncovered a more familiar problem in India: ethical irregularities.

The study, funded by the Bill & Melinda Gates Foundation and run by the international health charity PATH and the Indian Council of Medical Research (ICMR), vaccinated more than 23,000 girls aged 10–14 against HPV, which can cause cervical cancer. The vaccines — Merck's Gardasil and GlaxoSmithKline's Cervarix — are already in widespread use in the developed world, and the study was designed to assess the feasibility of launching an HPV-immunization programme in the Indian health system. The researchers hoped to gauge public acceptance of the vaccines and assess the costs of administering it in different parts of the country.

A committee of three scientists from the All India Institute of Medical Sciences (AIIMS) in New Delhi, commissioned by the government to look into the trial, confirmed that the deaths were not linked to the vaccines — two of the girls died of poisoning, one of drowning and the fourth of a fever. But its report, leaked to India's media last month, said that the study involved several serious ethical violations. According to media reports, participants were recruited from vulnerable tribal populations, consent was improperly obtained — headmasters of the girls' schools signed the forms — and adverse events were poorly recorded. The scientists also criticized Indian regulators for classifying the HPV study as an observational rather than a clinical trial, which meant that it was subject to different regulations, including looser reporting of side

effects. The expert committee deemed it to be a clinical trial because it was a "study of a pharmaceutical product carried out on human participants" and "4 of 5 primary outcome measures proposed related to evaluation of the safety of the vaccine".
Vivien Tsu, director of PATH's HPV vaccines project, says that the procedures criticized in the report had all been approved by state ethics boards in India and an independent review board in the United States. "The problems the report raises, over the poor reporting of adverse events, for instance, were the sorts of issues that the study was intended to tease out," she says. Vishwa Katoch, director-general of the ICMR, says that his organization "had advised on ethical issues when the study was being planned. All necessary ethical approvals were there; the problem was how different individuals or teams implemented it."
Still, the verdict could pose a setback to the country's ambitions to become a hub for international clinical trials, luring drug developers with its large patient population and low costs. Rani Kumar, dean of the AIIMS, who assisted the investigating committee, declined to speak to Nature. But India's weak ethical infrastructure has been heavily criticized in the past for having few well-trained ethicists, and poorly run ethics boards. A clinical-trials registry was introduced in 2007 in a bid to better regulate clinical research, but "India still needs clear national guidelines on the ethical conduct of clinical trials", says Ramanan Laxminarayan, vice-president of policy and research at the Public Health Foundation of India in New Delhi. Shortly after the HPV report hit the headlines, the Drugs Controller General of India produced, for the first time, draft guidelines on the reporting of adverse events in clinical trials.
Heidi Larson, an anthropologist at the London School of Hygiene & Tropical Medicine who studies the social acceptance of vaccines, says that the collapse of the HPV trial highlights one of the key problems in research collaborations between developed and developing countries. Ultimately, she says, international researchers are obliged to work within the ethics capacity of the host country, regardless of whether or not it is robust. Trying to align different expectations over research ethics can be especially tricky, Larson adds. "How do you negotiate local versus national versus international tensions?"
Meanwhile, India's vaccination plans could suffer collateral damage from the controversy. India decided in 2008 to roll out a new pentavalent vaccine against diphtheria, pertussis, tetanus, Haemophilus influenzae type b (Hib) and hepatitis B. Public objections over fears of dangerous side effects reported in Sri Lanka and the vaccine's high cost delayed the programme. Vaccination is finally due to start next month, but only in Tamil Nadu and Kerala, southern states chosen because their routine immunization coverage is already high, says Ajay Khera, deputy commissioner of India's Universal Immunisation Programme.
Vaccination fears that have made headlines in the West are now taking hold in countries such as India, says Larson (H. J. Larson et al. Lancet doi:10.1016/S0140-6736(11)60678-8; 2011). Because most of the vaccines now in development are aimed at diseases common in the developing world, such as malaria, tuberculosis, leishmaniasis and helminth infections, anti-vaccination movements in such countries could have a major impact on public health, adds Richard Moxon, a paediatrician at the John Radcliffe Hospital in Oxford, UK.

Jacob Puliyel, head of paediatrics at St Stephen's Hospital in Delhi, has been a vocal opponent of both the HPV vaccines and the pentavalent vaccine. He does not endorse the vaccine fears that gripped the public after the four girls' deaths, but he told Nature that too little is known about the prevalence of Hib and HPV-related cervical cancer in India to justify the new vaccines. At a time when India is already struggling to achieve universal coverage with existing vaccines — coverage for basic childhood immunizations is just 63%, according to Khera — the country simply cannot afford them, Puliyel says

http://www.nature.com/news/2011/110622/full/474427a.html

Indian generics giants set sights on Japan

Country's drug industry looks to exploit growing Japanese market while fending off tougher European patents.

Priya Shetty

Regulatory hurdles and doctors' resistance have limited Indian opportunities in the Japanese drug market.P. Mastrovito/Corbis

India's generic drugs industry, which has boomed since the country abandoned patent protection in 1970, has long been a lifeline to poor countries, supplying HIV drugs that have saved millions of lives, for example. Now India is aiming to become a drugs factory for rich countries such as Japan.

But at the same time as India's drug companies look East, health advocates are concerned that the European Union's (EU's) demand for stricter patent rules on generics will hamper the country's ability to act as a pharmacy for the developing world.

Japan is keen to use more generic drugs as a way of curbing its skyrocketing health-care costs: the country spends some 36 trillion yen (US$450 billion) a year on health care, and this could rise to 93 trillion yen by 2035. This April, Japan signed a free-trade agreement with India that should make it easier for Indian companies to reach the Japanese market.

Generics account for just 18% of Japan's $97-billion drug market, compared with 70% in the United States. Japanese doctors are mainly responsible for this, says Ludwig Kanzler, a partner at the Tokyo office of consultancy firm McKinsey, as they have "resisted any significant changes to the health-care system, and certainly all changes that restricted the freedom of doctors".

In a bid to raise the share of generics to 30% by 2013, the Japanese government brought in reforms last year, including encouraging hospitals to prescribe generics and promoting the use of the drugs among patients. Now, several blockbuster drugs, such as the anticholesterol agent Lipitor (atorvastatin) and the antidepressant Paxil (paroxetine), are about to go off-patent in Japan, says Kanzler.

"That becomes quite a compelling market for generics, and obviously Indian companies will be eyeing it up," says Kiran Mazumdar-Shaw, head of Biocon, an Indian biotechnology firm in Bangalore.

Generics direct

Several Indian companies already supply active pharmaceutical ingredients (APIs) – the key components of generics — rather than the finished product, to Japanese companies. Ind-Swift, headquartered in Chandigarh, has just received approval from the Japanese regulator, the Pharmaceuticals and Medical Devices Agency, to supply APIs for risedronate sodium (for osteoporosis) and pioglitazone (an antidiabetic). The company has five other applications for APIs for cholesterol-lowering and Alzheimer's drugs in the pipeline.

But Japan's notoriously fussy data requirements and slow review process have stymied Indian companies, says Mazumdar-Shaw. The free-trade agreement should ease this, she adds. Import duties should also drop, from 4-10% to zero.

Anurag Chaturvedi, Ind-Swift's associate vice-president of international marketing, says the company is keen to go beyond APIs and provide generics direct to Japan's health system.

The agreement may also lead to more deals between Japanese and Indian companies. In 2008, the pharmaceutical company Daiichi Sankyo bought the Indian drug firm Ranbaxy with a view to expanding generics production in Japan. And another leading Indian generics manufacturer, Hyderabad-based Dr. Reddy's, is currently scouting for a Japanese partner.

Poorest at risk

Meanwhile, in trade negotiations, the EU had sought to allow European drug companies to own the copyright on data from their clinical trials. This would have meant that Indian firms would have had to conduct duplicate trials of off-patent drugs before making generics.

The EU has now backed down on this, but the problem remains, says Katrien Vervoort, policy officer at Oxfam's Brussels office, as India is itself likely to introduce data exclusivity for its own companies at some point. "In that case, it would also apply to European industry," she says.

Aid organizations say that other aspects of the agreement to protect drug companies' investments threaten the health of the poor. If patent restrictions squeeze too hard, India is likely to want to issue compulsory licences to force the generic production of patented drugs in order to meet public-health needs. But a clause in the agreement that treats intellectual property as an investment may threaten India's ability to lift patent barriers in this way, says Michelle Childs, director of policy and advocacy at the campaign for access to essential medicines run by the medical charity Doctors Without Borders.

http://www.nature.com/news/2011/110621/full/news.2011.377.html

Worth a dam?

Voluntary agreement enables rating of hydroelectric impacts.
Jeff Tollefson

Indigenous communities turned out in Lima to protest the proposed Inambari Dam in October 2010.E. Castro-Mendivil/Reuters

Hydropower is booming in the developing world, but one megaproject faltered last week. On 13 June, after years of community protests, Peru announced that it was revoking an agreement with a Brazilian consortium to build the 2,000-megawatt Inambari Dam, which would have flooded 400 square kilometres of Amazonian forest.

Now, to foster a less confrontational way of advancing projects, the hydropower industry, environmental and human-rights organizations, and representatives from banks and governments have negotiated a mechanism for evaluating, and perhaps mitigating, the impact of dams before they are built.

Released on 16 June in Iguaçu Falls, Brazil, the Hydropower Sustainability Assessment Protocol provides a method for assessing dams in all phases, from development to operation. Projects would be ranked on a scale of one to five according to their likely effects on biodiversity, ecology, hydrology and erosion as well as on broader issues regarding regional planning, cultural heritage and effect on local inhabitants.

The protocol is voluntary, and a poor rating may not prevent a project from going ahead. Yet quantifying anticipated effects could generate pressure for managers to rethink plans to improve the outcome. "If we have some good results in a few test cases around the world, I think it will take off," says Pedro Bara, who works for WWF, one of the environmental groups that helped to develop the protocol. "It's very useful to have an international standard, especially for countries that don't have much experience in hydropower development."

The document has its roots in the World Commission on Dams, which produced comprehensive international guidelines in 2000. The International Hydropower Association (IHA), a trade group based in London, followed up with its own sustainability protocol in 2006, but continued criticism that the protocol was weak led the IHA to establish a formal dialogue with environmentalists and human-rights groups in 2008. Since then, the process has brought groups such as the WWF, Oxfam and Transparency International together with industry officials to hammer out a compromise.

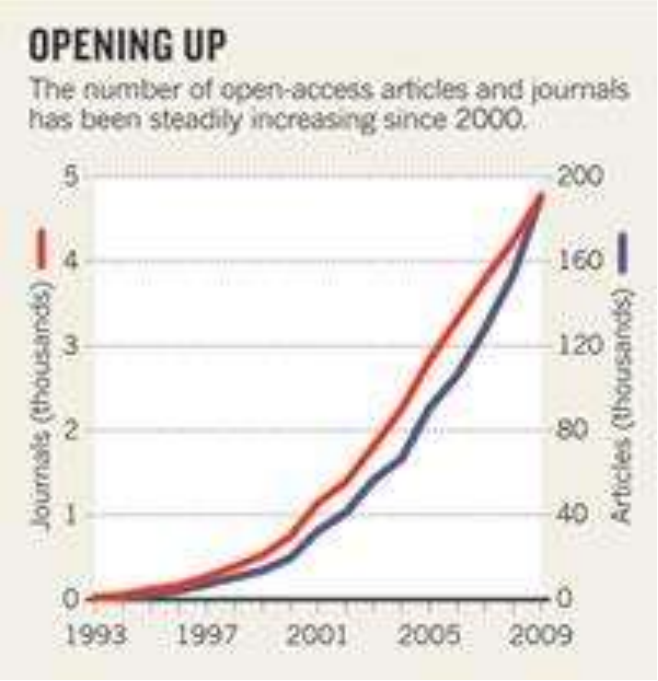
Advocacy groups, governments and companies can use the protocol informally, but a governance council representing the stakeholder groups will oversee a more formal assessment carried out by trained auditors. Companies would pay for this assessment and would be required to publicly release the results.
How the protocol will be applied remains to be seen. Companies that sign it are not required to use it, or to alter their projects if the assessment identifies problems. This has split environmental groups, many of which called the protocol a dangerous public-relations tool that will allow companies to 'greenwash' their projects and will weaken existing standards.
The protocol is designed to be applied one dam at a time, missing cumulative impacts of development as well as opportunities to identify the best sites and coordinate energy production across an entire river system, such as the Amazon. "Where you have a cascade of dams, you really need a broader assessment," says Mathias Kondolf, a fluvial geomorphologist at the University of California, Berkeley.
Nonetheless, advocates hope that governments will require formal evaluations under the protocol and apply minimum standards to the projects that they support. "The aspirational end point would be some kind of independent certification system," says David Harrison, a senior adviser at the Nature Conservancy based in Salem, Oregon, who worked on the protocol.

Within industry, many see the protocol as a way to head off the kind of public opposition that can stall or quash a project after years of investment, says Cameron Ironside, a programme director at the IHA. "Everybody would be very happy if industry were able to apply the protocol early on," he says, "because that would solve a lot of the issues that people are running into downstream."
At least 140 major companies have signed on, including representatives of utility companies such as the China Three Gorges Dam Corporation in Yichang, Paris-based EDF and Eletrobras in Rio de Janeiro, Brazil. WWF officials have noted that many Chinese companies that are building dams around the world are not yet parties to the protocol. Yet companies on the sidelines may ultimately have to act in accordance with the protocol, says Bara, if it becomes standard practice. "If the banks get involved, it will be difficult not to jump in."

http://www.nature.com/news/2011/110621/full/474430a.html

Open access comes of age

Publishing model enters phase of slower but steady growth.
John Whitfield
A study of open-access publishing — published last week in the open-access journal PLoS ONE — has found that the number of papers in freely accessible journals is growing at a steady 20% per year (M. Laakso et al. PLoS ONE **6,** e20961; 2011). To many, the growth confirms the health of the free-access, author-pays model. But to a few it is a discouraging sign that open access is not about to take over the world of scholarly publishing.



The analysis, by information scientist Mikael Laakso of the Hanken School of Economics in Helsinki and his colleagues, also found that the number of fully open-access journals is growing at around 15% every year as new journals are founded and subscription journals switch to the open-access model (see 'Opening up'). By contrast, subscription journals are growing at about 3.5%. "Most indicators suggest growth is not slowing," says Laakso. "The open-access publishing model has proven itself to work."
Laakso divides the history of open access into three phases. First came the pioneering years of 1993–99, during which most open-access journals were, he says, "home-brew" efforts, set up by individuals and hosted on university servers. Next were the innovation years, which saw the birth of publishers such as the Public Library of Science and of software infrastructure that makes it much easier to launch a digital journal.
Since 2005, Laakso says, innovation has slowed but growth continues — the consolidation phase. Following this trend, last week Nature Publishing Group (NPG) launched Scientific Reports , an author-pays, open-access, online-only journal, which reviews papers on technical soundness rather than impact.
NPG's acknowledged inspiration is PLoS ONE, which in 2010 published 6,749 papers, making it the world's largest journal. It has been a "phenomenal success", says Jason Wilde, business development director at NPG. "It shows that authors and readers like the model of a broad-based journal with light peer review." Scientific Reports will provide PLoS ONE with a rival and help drive up standards, says Wilde. "In any market there should be competition."
The trends "show the success of open access", says Peter Suber, director of the Open Access project at the non-profit lobby group Public Knowledge in Washington DC. So far, he adds, the open-access movement has not imperilled commercial publishers. "The predictions of harm are being proven to be false."

But not all advocates of open access are satisfied with its progress. "The growth rate is portrayed as dramatic, but it's not dramatic at all if the goal is 100% open access," says Stevan Harnad, a cognition researcher at the University of Southampton, UK. Other ways to make papers freely accessible, such as self-archiving and hybrid journals, which allow authors to choose whether to pay for open access, are also growing only linearly, he says. "The rate is much too low for the needs of research."

What is not known is whether open-access journals are competing with subscription journals, or whether they have opened up a publishing niche. Harnad believes that most open-access journals are new ventures. Because nearly all the must-have journals still charge subscription fees, the rise of the author-pays model actually imposes an extra expense on research funders, he says.
To escape this catch-22, says Harnad, institutions and funders — who have led the demand for open access — must mandate grantees to deposit papers published in subscription journals in open repositories. This would free up resources to support author-pays open access. "Publishers won't convert until the money is available to pay them," he says.

http://www.nature.com/news/2011/110621/full/474428a.html

Wing hairs help to keep bats in the air

Receptors in the wing membrane sense aerodynamic conditions.
Marian Turner

It takes more than echolocation to do aerobatics in the dark.photolibrary.com

Bats use tiny hairs to sense the speed and direction of air flowing over their wings. This may alert them to the danger of stalling and enable them to perform impressive aerobatic tricks, according to a report published today in the Proceedings of the National Academy of Sciences[1].

Bats are the only mammals capable of powered flight; their wings are made of a membrane covered with microscopic hairs. Scientists once thought that bats use these hairs to sense their surroundings when flying in the dark, but studies on them were put aside 70 years ago, after the discovery that bats navigate by echolocation[2]. Susanne Sterbing-D'Angelo, a neuroscientist from the University of Maryland in College Park, and her colleagues took up the study of the hairs, and found that they are crucial for bat flight control.

To discover what information bats glean from their wing hairs, the researchers implanted electrodes into the animals' brains and fixed their heads and wings to a vibration-isolation table. Then they directed puffs of air at the hairs and monitored the resulting brain activity.

"It takes months to train a bat to fly through an obstacle course."

The air activated neurons in the primary somatosensory cortex — part of the brain that is triggered by the sense of touch. The air puffs were not strong enough to activate touch receptors in the wing membrane, so the scientists think that other receptors, called Merkel cells, are triggered by the movement of the hairs. When the researchers removed the wing hairs using depilatory cream, the neurons no longer responded to the air puffs. The neurons fired most strongly when the air puffs hit the rear part of the wing. Airflow from behind can be a sign of turbulent conditions, so the team suggests that information from the hairs might signal to the bat that it needs to stabilize.

Flight control

The hairs are also important during normal bat flight, the researchers showed. They built artificial forests from nets and tree trunks and trained the animals to seek a banana or mealworm as a reward. "It takes months to train a bat to fly through an obstacle course," says Sterbing-D'Angelo. When the animals were used to the task, the researchers filmed them flying through the maze. They then removed the bats' wing hairs, and filmed them again. Without the hairs, the bats sped up, and their turns were wider and more cautious.

The authors suspect that the hairless bats change their flight patterns because they think they are at risk of stalling. In aerodynamics, stalling occurs when an aircraft is flying too slowly, which causes the lift forces to drop. In the bats, hair receptors sensitive to reverse airflow should pick up swirling vortices at higher speeds. Lack of signal from these receptors might make the bats think they were flying dangerously slowly, prompting them to speed up.

So it seems that evolution of the hairs may be a key feature of bats' impressive ability for aerial acrobatics, including tight turns, hovering and perching upside down. "Hairs with Merkel receptors might have evolved uniquely to bats," says Sterbing-D'Angelo. Her team tested fast-flying big brown bats (Eptesicus fuscus) as well as slower, hovering short-tailed fruit bats (Carollia perspicillata). Both species showed the same types of flight change when their wing hairs were removed.

Ideas are already springing up for how humans might copy the bats' tactics to help prevent plane crashes, among other things. "Stall is a major problem for aircraft," says Geoffrey Spedding, a zoologist studying aerodynamics at the University of Southern California in Los Angeles. He says that Pitot tubes, the devices currently used for aircraft stall detection, don't work particularly well, so any improvement that could be garnered from the bats would be welcome. "But features of animal flapping wings can't always be applied to fixed-winged aircraft," he cautions.

Belinda Batten, a mechanical engineer at Oregon State University in Corvallis, hopes to use the findings to make autonomous flying objects, or drones, more manoeuvrable. Drones are used by the military, but also have civilian applications. "We can fly them into buildings to search for people trapped after earthquakes, or over forest canopies to count bird populations," says Batten.
She envisages making artificial versions of bat wing hairs using flexible polymers with ceramic bases that respond to strain, mimicking the Merkel receptors. Planes with hairy wings? Maybe not such a batty idea.

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http://www.nature.com/news/2011/110620/full/news.2011.376.html

Researchers tweet technical talk

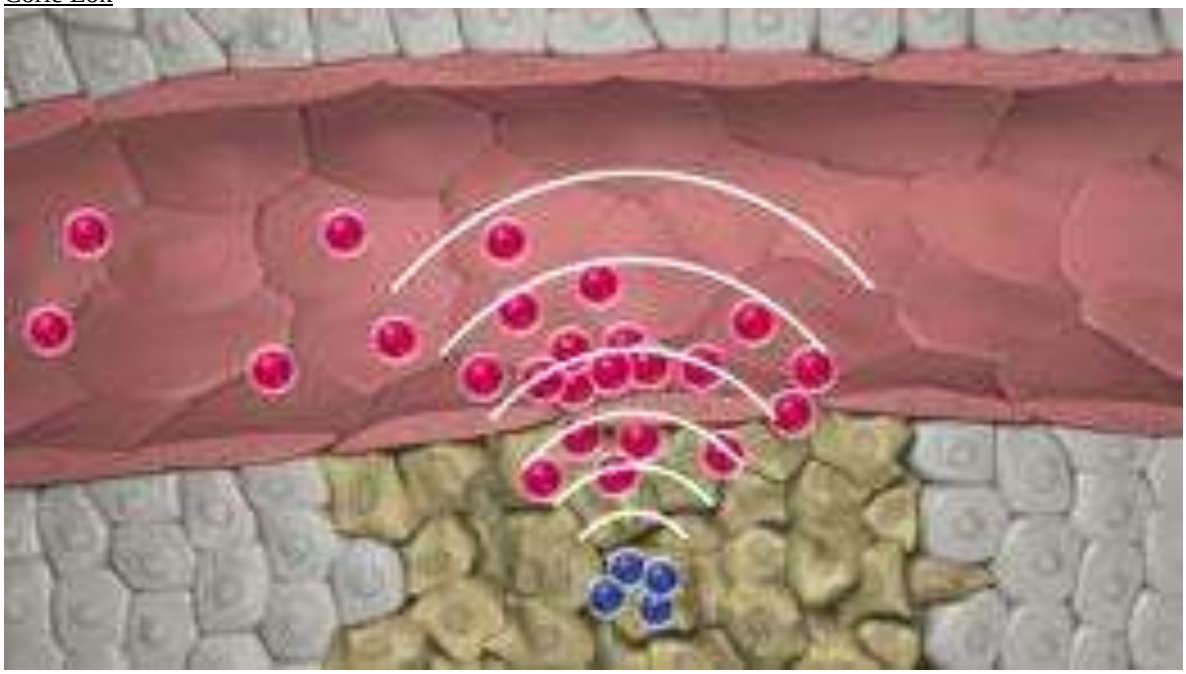
In the latest trend in scientific discourse, journal clubs and data disclosures move to Twitter.
Eugenie Samuel Reich
Robert Boyle would not have approved. The famously verbose seventeenth- century natural philosopher and pioneer of the scientific method argued that technical communication demands detail, not brevity. But there is no room for Boyle-like excess within the confines of the social-networking site Twitter, where users converse in 140-character posts, or 'tweets'. Researchers are now using the site's abbreviated messages to discuss papers in journal clubs and to share data in real time.
Scientists were among the early adopters when Twitter was launched five years ago, and many now use the site to tweet updates from conferences, promote links to papers, network and gossip. But using Twitter to engage in technical discussions with remote colleagues "is a novel thing", says Cornelius Puschmann, a linguist and information scientist at the University of Düsseldorf in Germany, who has tracked scientists' use of social media. Proponents say that Twitter enables fast-moving conversations, and allows users to post links pointing to more detail where required.
A medical-journal club started by Fiona Douglas, a medical student at the University of Cambridge, UK, and Natalie Silvey, a doctor at University Hospitals Coventry and Warwickshire in Coventry, UK, has held three weekly meetings since it began this month. A group for astronomers met for the first time last week.
In the inaugral session of the medical club on 5 June, around 60 participants discussed an influential paper on the treatment of acute sepsis and septic shock (E. Rivers et al. N. Engl. J. Med. **345,** 1368–1377; 2001). Silvey says that the participants encompassed a wider range of expertise and career stages than would be seen at a conventional journal club, and that the technical quality of the discussion was high. Some participants used data in the paper to calculate the 'number needed to treat' (NNT), a measure of the effectiveness of an intervention based on the average number of patients who have to be treated for one to benefit (see 'Medical chatter').
The format confounded some potential participants. Ves Dimov, an allergy doctor at the University of Chicago in Illinois, found the conversation hard to follow. "Only people who can wrap their minds around this somewhat chaotic environment will find Twitter journal clubs useful," he says.

On 11 June, Mike Brown, an astronomer at the California Institute of Technology in Pasadena, pioneered another use of Twitter when he 'live-tweeted' plots of observations he was making of the transit of the dwarf planet Haumea by its moon, Namaka, from the William Herschel Telescope on La Palma in the Canary Islands, Spain (see go.nature.com/me9trl). "There is an interest in getting discoveries out there quickly," he says.
Simon Schaffer, a historian of science at the University of Cambridge, says that Twitter is not as different from traditional scientific communication as it may seem. Journals began as letters between scientists, and were only later collated and published. "The idea of the person-to-person message is the essence of communication in the sciences," says Schaffer. And although Boyle's published reports were long-winded, he and other early scientists also kept notebooks in which they succinctly listed facts and observations that they had heard from others in coffee shops and elsewhere. "In a sense, Boyle was already tweeting," says Schaffer.

http://www.nature.com/news/2011/110620/full/474431a.html

Nanoparticles hit tumours with one-two punch

Using scout particles to pave the way makes drug delivery more effective.
Corie Lok



'Signalling' particles enter the tumour and trigger a blood clot that attracts drug-delivering 'receiver' particles.G. Carlson

By harnessing the body's blood-clotting system, researchers have designed nanoparticles that scout out tumours and then call in a second type of nanoparticle to deliver cancer-killing drugs.

Sangeeta Bhatia, a bioengineer at the Massachusetts Institute of Technology in Cambridge, and her colleagues found that using the two nanoparticles in tandem in mice increased the amount of drug delivered to a tumour by 40-fold relative to controls. Tumours in these mice stopped growing, whereas those in mice that received only one type of nanoparticle did not.

Bhatia's team was inspired by the ability of the body's clotting system to mount a huge response at an injured site. A clot forms thanks to a cascade of reactions that leads to the cross-linking of a large amount of a protein called fibrin.

The researchers designed their nanoparticles to piggyback on this cascade. "We use the body's natural amplification processes to get more drug to the target," says Bhatia. The study is published in Nature Materials[1].

Division of labour

Several targeted, drug-delivering nanoparticles are already in use, and more are in clinical trials. Some of these particles have molecules on their surface that bind to receptors on the target tissue.

Bhatia's team decided to allocate each job — finding the tumour and delivering the drug — to a different particle.

The 'scout' nanoparticle, a gold nanorod, is designed to fit through the abnormally large pores of the tumour's blood vessels. When near-infrared light is shone on the nanorods, they heat up just enough to damage the tumour and trigger the clotting cascade.

At the end of the cascade, an enzyme called Factor XIII cross-links fibrin to grow the clot. The drug-bearing nanoparticle, called the receiver, has a protein fragment on its surface that is a substrate for Factor XIII. The particles are attracted as the clotting process occurs at the tumour.

Factor XIII then cross-links the receivers' protein coating to the fibrin in the clot, where the receivers unload their drug cargo. The Factor XIII and fibrin generated during the clotting process produce additional binding

sites at the tumour for the receiver nanoparticle, which leads to the 40-fold increase in the amount of drug delivered.
This is a big improvement on other nanoparticles, which typically deliver 2–7 times the dose of conventional drug delivery methods, says Omid Farokhzad at the Brigham and Women's Hospital in Boston, Massachusetts. "What's new here is that the system triggers the body to create an environment that favours the accumulation of nanoparticles," he says.

Clotting complexity

"This is on the right path," says Farokhzad. "But given the level of innovation, a lot of work will be needed to translate this to the clinic."

One challenge will be to ensure that the particles trigger and target blood clots only in tumours, as cancer patients are susceptible to blood clots elsewhere in the body, says Anil Sood, an oncologist at the MD Anderson Cancer Center in Houston, Texas. "If you're going to trigger coagulation, you want to be very selective, so that you don't cause damage in other parts of the body."
Bhatia admits that her system is complex; her group is working on ways to simplify it. But cancer is a complex disease, says Dan Peer, a nanotechnologist at Tel Aviv University in Israel. "Maybe the solutions won't be so simple."

- **References**

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http://www.nature.com/news/2011/110619/full/news.2011.374.html

Voyager at the edge

Spacecraft finds unexpected calm at the boundary of Sun's bubble.
Geoff Brumfiel

The Voyager 1 spacecraft, and its partner, Voyager 2, are approaching the edge of the Sun's protective bubble.NASA/JPL-Caltech

Seventeen and a half billion kilometres from Earth, mankind's most distant probe seems to be on the edge of interstellar space.

The Voyager 1 spacecraft is at the limit of the 'heliosheath', where particles streaming from the Sun clash with the gases of the galaxy. Contrary to scientists' expectation of a sharp, violent edge, the boundary seems to be a tepid place, where the solar wind mingles with extrasolar particles.

"We're in this mixed-up region where the Sun still has some influence," says Stamatios Krimigis, a physicist at the Applied Physics Laboratory of Johns Hopkins University in Laurel, Maryland. "It's certainly not what we thought."

"We may have crossed into interstellar space and don't know it."

The new findings, reported by Krimigis and his colleagues this week in Nature, are the latest of many during the spacecraft's long journey[1]. Launched in 1977, Voyager 1 photographed active volcanoes on the moon Io on its way past Jupiter in 1979. The following year, it confirmed the existence of three new moons orbiting Saturn. In one of its final photographs, transmitted in 1990, Earth appears as a grainy speck bathed in the rainbow rays of the Sun.

Crossing the unknown

Since then, NASA scientists have shut down six of its ten instruments, and it is so far away that transmissions now take more than 16 hours to reach Earth. But Voyager's work continues. It is now travelling out of the heliosphere, the bubble of space filled by the Sun's wind. In late 2004, Voyager 1 crossed the 'termination shock', the boundary beyond which the solar wind's influence begins to wane. And this year researchers were expecting it to meet another boundary — one at which the solar wind sharply reverses direction, signalling the beginning of interstellar space.

Instead, Krimigis says, measurements of low-energy charged particles show that the solar wind has gradually slowed to zero and is mingling with interstellar gases. Theories failed to predict this mixed-up environment, and Krimigis says it may even be possible that this is, in fact, what interstellar space looks like. "We may have crossed and don't know it, because nobody has a model that describes what we're seeing," he says.

The blowing of far-flung interstellar gases may seem inconsequential to those of us closer to the Sun, but the details do matter, says Voyager's chief scientist Ed Stone at the California Institute of Technology in Pasadena. The Sun is currently flying through debris from several nearby supernovae. Streams of particles and the magnetic fields produced by our star are shielding us from the some of the interstellar radiation from the blasts, he says. "The size of this bubble is important."
Voyager should be able to provide more answers in the coming years. The spacecraft's plutonium power plant will allow it to operate smoothly until at least 2020, and "we will continue to be taking data", says Krimigis. Even after its signal fades, the spacecraft's journey will continue; it should pass the constellation Camelopardalis in around 40,000 years.

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http://www.nature.com/news/2011/110615/full/news.2011.370.html

Misconceptions about forest-dwellers overturned

Study rejects claims that poor residents cause most deforestation.
Natasha Gilbert

For many, such as these Ugandan Pygmies in Semliki National Park, Bundibugyo, forests are the main source of food.REUTERS/J. Akena

Forests are vital to the livelihoods of millions of people in developing countries, providing on average more than one-fifth of their annual income, according to data presented today at a meeting in London.

The study provides much-needed solid evidence for the importance of forests to the world's rural poor. It also overturns some existing assumptions, showing, for example, that forests provide vital income to whole communities, not just the poorest, and that richer households are most likely to contribute to deforestation.

Income from forests has been largely "undervalued", particularly in assessments of poverty and income such as the World Bank's Living Standard Measurement Survey, says Arild Angelsen, an environmental economist at the Norwegian University of Life Sciences in Aas and a lead author of the study by the Center for International Forestry Research (CIFOR) based in Bogor, Indonesia. He presented the findings at the Royal Society, the United Kingdom's national academy of science.

Part of the problem, adds Frances Seymour, CIFOR's director-general, has been that most previous studies looked at anecdotal evidence from single sites. The lack of solid evidence has led to questions over claims that forests are important to the livelihoods of poor people.

Robust data

Angelsen's team collected data from 8,000 households across 24 countries, including China, Zambia and Indonesia, four times a year over a period of six years. This makes the study the largest and most robust so far on the links between forests and poverty.

The researchers found that firewood accounts for around a fifth of the income that comes from forests, with timber coming in second at 10%.

One unexpected discovery was that the poorest forest-dwelling people do not cause the bulk of deforestation. In fact, the richest 20% of households at each study site caused 30% more deforestation than the poorest 20%.

The work also showed that although the poorest households are reliant on forests for their daily needs, they also look elsewhere — for example, travelling to urban areas — when drastic action is needed to feed

themselves or urgently acquire income. "I was surprised that poor people did not rely on forests as a safety net," says Angelsen.

Not just carbon

Researchers hope that the data will inform policies that aim to conserve forests at the same time as reducing poverty. Mike Speirs, an environment and climate-change adviser to the Danish government who was present at the Royal Society meeting, welcomed the study's contribution to ensuring that forests are not seen by governments and the international community as "just stocks of carbon".

But Bill Adams, a conservation and development scientist at the University of Cambridge, UK, says that despite the new data, it will be "difficult to achieve win–win outcomes for forest conservation and poverty reduction".

Attempts to protect forests can be bad news for the poor, particularly if locals are evicted and banned from protected areas, he told the meeting. Moreover, projects attempting to address both conservation and poverty reduction are often expensive, complex to plan and slow to deliver results — and their success is difficult to predict.

Adams argues that forest-conservation and poverty-reduction initiatives, including the United Nations' extended Reducing Emissions from Deforestation and Forest Degradation (REDD+) scheme, will work only if they are implemented from the bottom up, with locals involved in decision-making and their access and land rights recognized. "But this does not occur in most places," he says.

The CIFOR study does show examples of how forest conservation and livelihoods can be integrated, but Adams cautions that it suggests "no overarching strategy" for conserving biodiversity while reducing poverty.

http://www.nature.com/news/2011/110615/full/news.2011.371.html

'Statins' for cancer could prevent many breast cancers

- 22:00 22 June 2011 by **Andy Coghlan**

Exemestane, a drug already used to treat breast cancer, can more than halve the chances of healthy, post-menopausal women getting the disease in the first place. So concludes a three-year study in 4560 women in the US and Europe.

Only 11 breast cancers arose in women taking the drug, compared with 32 in those given a placebo, a 65 per cent reduction in risk. Crucially, there were no reports of serious side effects such as other cancers or heart disease in the treated women.

Although researchers demonstrated in the 1990s that the breast cancer drugs tamoxifen and raloxifene also prevent, as well as cure, breast cancers, women have avoided taking them prophylactically because of rare, life-threatening side effects including cancer of the womb lining and heart attacks caused by blood clots.

The team reporting the new results say that the lack of side effects with exemestane could make it far more attractive as a preventative treatment.

Strong and safe

"Our hope is that our trial results turn up the volume on the debate around breast cancer prevention," says Paul Goss of the Massachusetts General Hospital Cancer Center in Boston, head of the research team.

"Exemestane is substantially more effective than the other drugs against early breast cancer, and our data suggest it is better at protection too," says Goss. "It is also very safe, and that makes it more appealing."

The results were so impressive that at the end of the trial, all the participants were offered ongoing treatment with the drug.

Goss says that women might do well to take the drug for five years or so when they reach menopause, an age when the risk of breast cancer rises because of increases in the hormone oestrogen. The trial results suggest that over three years, for every 94 women taking exemestane, a single case of breast cancer would be prevented.

"Probably thousands or tens of thousands of women [worldwide] could avoid death from breast cancer by using effective risk reduction in the same way that men and women have reduced their risk of heart disease by reducing high blood pressure or cholesterol levels by taking statins," says Goss.

Source blocked

Side effects may be fewer because of the mechanism by which the drug works. All three major preventive breast cancer drugs work by reducing the body's exposure to oestrogen, but whereas tamoxifen and raloxifene compete with oestrogen for receptors on breast and other cells, exemestane suppresses production of oestrogen by neutralising aromatase, the enzyme that makes it.

Enthusiasts for preventive therapy have hailed the results in an editorial accompanying the study in the *New England Journal of Medicine*, concluding that with breast cancer the second most common fatal cancer in the US, "we have run out of excuses… What are we waiting for?"

"We have studied this area of breast cancer risk reduction intensively, and it's now time to put the results of our clinical trials into practice," says Nancy Davidson of the University of Pittsburgh Cancer Institute in Pennsylvania, a co-author of the editorial.

"About 200,000 women are diagnosed with breast cancer each year, and about 40,000 die," she told *New Scientist*. "Exemestane offers women and physicians another choice in addition to tamoxifen and raloxifene, so having multiple options is good,"

Goss says that another attraction is that the cost of exemestane – currently $600 per year – is falling dramatically around the world because the patents for it are running out, allowing cheap versions to be made and sold instead.

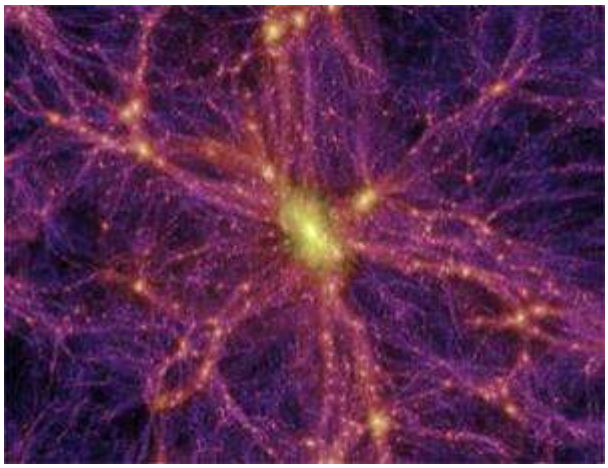
Pete Sasieni of the Wolfson Institute of Preventive Medicine in London says the results are "very encouraging", and may persuade some women to consider taking the drugs. But the big question is whether taking them for a short time, say five years beginning at 55, will then have a lifelong protective effect, as has been seen with tamoxifen.

Journal reference: *New England Journal of Medicine*, DOI: 10.1056/nejmoa1103507

http://www.newscientist.com/article/dn20602-statins-for-cancer-could-prevent-many-breast-cancers.html

Largest cosmic structures 'too big' for theories

- 20:11 21 June 2011 by **Stephen Battersby**



Galaxies, clusters, and superclusters - mere local details? (Image: Springel et al./Virgo Consortium)

Space is festooned with vast "hyperclusters" of galaxies, a new cosmic map suggests. It could mean that gravity or dark energy – or perhaps something completely unknown – is behaving very strangely indeed.

We know that the universe was smooth just after its birth. Measurements of the cosmic microwave background radiation (CMB), the light emitted 370,000 years after the big bang, reveal only very slight variations in density from place to place. Gravity then took hold and amplified these variations into today's galaxies and galaxy clusters, which in turn are arranged into big strings and knots called superclusters, with relatively empty voids in between.

On even larger scales, though, cosmological models say that the expansion of the universe should trump the clumping effect of gravity. That means there should be very little structure on scales larger than a few hundred million light years across.

But the universe, it seems, did not get the memo. Shaun Thomas of University College London (UCL), and colleagues have found aggregations of galaxies stretching for more than 3 billion light years. The hyperclusters are not very sharply defined, with only a couple of per cent variation in density from place to place, but even that density contrast is twice what theory predicts.

"This is a challenging result for the standard cosmological models," says Francesco Sylos Labini of the University of Rome, Italy, who was not involved in the work.

Colour guide

The clumpiness emerges from an enormous catalogue of galaxies called the Sloan Digital Sky Survey, compiled with a telescope at Apache Point, New Mexico. The survey plots the 2D positions of galaxies across a quarter of the sky. "Before this survey people were looking at smaller areas," says Thomas. "As you look at more of the sky, you start to see larger structures."

A 2D picture of the sky cannot reveal the true large-scale structure in the universe. To get the full picture, Thomas and his colleagues also used the colour of galaxies recorded in the survey.

More distant galaxies look redder than nearby ones because their light has been stretched to longer wavelengths while travelling through an expanding universe. By selecting a variety of bright, old elliptical galaxies whose natural colour is well known, the team calculated approximate distances to more than 700,000 objects. The upshot is a rough 3D map of one quadrant of the universe, showing the hazy outlines of some enormous structures.

Coagulating dark energy

The result hints at some profound new physical phenomenon, perhaps involving dark energy – the mysterious entity that is accelerating the expansion of space. Dark energy is usually assumed to be uniform across the

cosmos. If instead it can pool in some areas, then its repulsive force could push away nearby matter, creating these giant patterns.

Alternatively, we may need to extend our understanding of gravity beyond Einstein's general theory of relativity. "It could be that we need an even more general theory to explain how gravity works on very large scales," says Thomas.

A more mundane answer might yet emerge. Using colour to find distance is very sensitive to observational error, says David Spergel of Princeton University. Dust and stars in our own galaxy could confuse the dataset, for example. Although the UCL team have run some checks for these sources of error, Thomas admits that the result might turn out to be the effect of foreground stars either masking or mimicking distant galaxies.

Fractal structure?

"It will be essential to confirm this with another technique," says Spergel. The best solution would be to get detailed spectra of a large number of galaxies. Researchers would be able to work out their distances from Earth much more precisely, since they would know how much their light has been stretched, or red-shifted, by the expansion of space.

Sylos Labini has made such a map using a subset of Sloan data. It reveals clumpiness on unexpectedly large scales – though not as vast as these. He believes that the universe may have a fractal structure, looking similar at all scales.

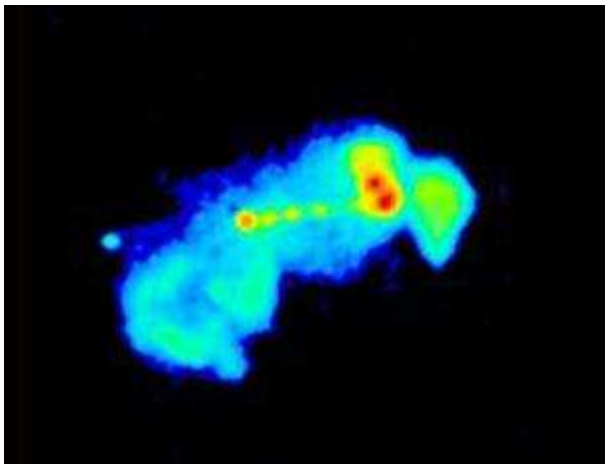
A comprehensive catalogue of spectra for Sloan galaxies is being assembled in a project called the Baryon Oscillation Spectroscopic Survey. Meanwhile, the Dark Energy Survey will use a telescope in Chile to measure the colours of even more galaxies than Sloan, beginning in October. Such maps might bring hyperclusters out of the haze – or consign them to the status of monstrous mirage.

Journal reference: *Physical Review Letters*, DOI: 10.1103/PhysRevLett.106.241301

http://www.newscientist.com/article/dn20597-largest-cosmic-structures-too-big-for-theories.html

Universe's highest electric current found

- 21 June 2011



The main power source for a jet emanating from galaxy 3C303 (red dot at centre of image) is a current of about 10^{18} amps (or one "exa-amp") (Image: Leahy and Perley (1991))

A COSMIC jet 2 billion light years away is carrying the highest electric current ever seen: 10^{18} amps, equivalent to a trillion bolts of lightning.

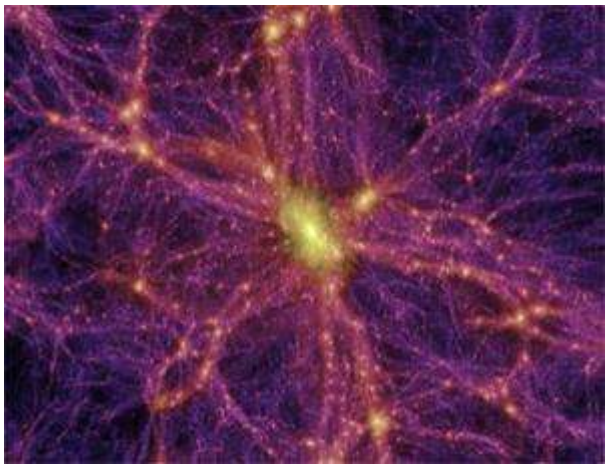
Philipp Kronberg of the University of Toronto in Canada and colleagues measured the alignment of radio waves around a galaxy called 3C303, which has a giant jet of matter shooting from its core. They saw a sudden change in the waves' alignment coinciding with the jet. "This is an unambiguous signature of a current," says Kronberg.

The team thinks magnetic fields from a colossal black hole at the galaxy's core are generating the current, which is powerful enough to light up the jet and drive it through interstellar gases out to a distance of about 150,000 light years (arxiv.org/abs/1106.1397).

http://www.newscientist.com/article/mg21028174.900-universes-highest-electric-current-found.html

Largest cosmic structures 'too big' for theories

- 20:11 21 June 2011 by **Stephen Battersby**



Galaxies, clusters, and superclusters - mere local details? (Image: Springel et al./Virgo Consortium)

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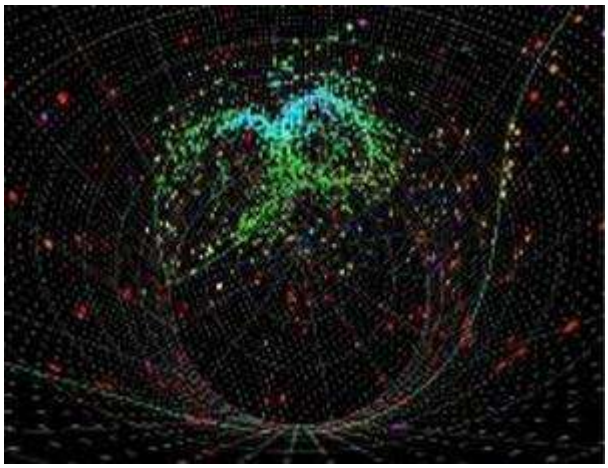
http://www.newscientist.com/article/dn20597-largest-cosmic-structures-too-big-for-theories.html

Neutrinos caught 'shape shifting' in new way

- 00:19 16 June 2011 by **David Shiga**



The first T2K neutrino event seen in the Super-Kamiokande in 2010. Each dot is a photomultiplier tube that has detected light (Image: T2K experiment)

Neutrinos have been caught spontaneously flip-flopping from one type to another in a way never previously seen. Further observations of this behaviour may shed light on how matter came to dominate over antimatter in the universe.

Neutrinos are among the most slippery particles known to physics. They rarely interact with ordinary matter, but massive experiments have been set up to detect the flashes of light produced when they do.

There are three known types, or flavours, of neutrino: electron, muon, and tau. Several experiments have found evidence that some flavours can spontaneously change into others, a phenomenon called neutrino oscillations. For example muon neutrinos can change into tau neutrinos.

Now, results from a Japanese experiment called T2K have tentatively added a new kind of transformation to the list of allowed types – the metamorphosis of muon neutrinos into electron neutrinos.

T2K generates muon neutrinos at the J-PARC accelerator in Tokai, Japan, and sends them in a beam towards the Super-Kamiokande neutrino detector in Kamioka, 295 kilometres away. It began operating in February 2010 and stopped gathering data in March, when Japan was rocked by the magnitude-9 megaquake.

Still tentative

On Wednesday, the team announced that six of the muon neutrinos that started off at J-PARC appear to have transformed into electron neutrinos before reaching Super-Kamiokande, where they were detected. This is the first time anyone has seen electron neutrinos show up in a beam of particles that started off as muon neutrinos.

"It shows the power of our experimental design that with only 2 per cent of our design data we are already the most sensitive experiment in the world for looking for this new type of oscillation," says T2K spokesperson Takashi Kobayashi of Japan's KEK particle physics laboratory.

However, the result is still tentative because of the small number of events seen and because of the possibility – considered rare – that muon neutrinos could be misidentified as electron neutrinos. Still, the researchers say experimental errors should give only 1.5 false events in the amount of data they analysed. There is only a 0.7 per cent chance of producing six false events.

Antimatter counterparts

The transformations appear to be happening relatively frequently. That means researchers will be able to quickly accumulate more events – once the experiment begins running again. The earthquake threw the accelerator used to make the neutrinos out of alignment. After adjustments are made, researchers hope to restart the experiment by year's end.

The researchers may eventually rerun the experiment with a beam of muon antineutrinos to see if their behaviour differs from their normal-matter counterparts.

If differences are found, it could help explain why there is a preponderance of matter in the universe. Standard theories say that matter and antimatter were created in equal amounts in the universe's first instants, but for unknown reasons, matter prevailed.

Skew the balance

Reactions involving neutrinos and antineutrinos in the early universe could have skewed the ratio of matter and antimatter production, leading to our matter-dominated universe. "You need some new laws of physics that aren't the same for matter and antimatter, and neutrino physics is one place you could put such laws," says David Wark of Imperial College London, who is a member of the T2K collaboration.

The US-based MiniBoone experiment recently found hints of an antimatter version of the oscillation seen by T2K. MiniBoone found signs that muon antineutrinos sometimes change into electron antineutrinos.

But physicists are still puzzling over the MiniBoone results. Based on the experiment's design, it should not have seen oscillations unless there are one or more extra types of neutrino that are sterile, meaning they are even more averse to interacting with matter than regular neutrinos.

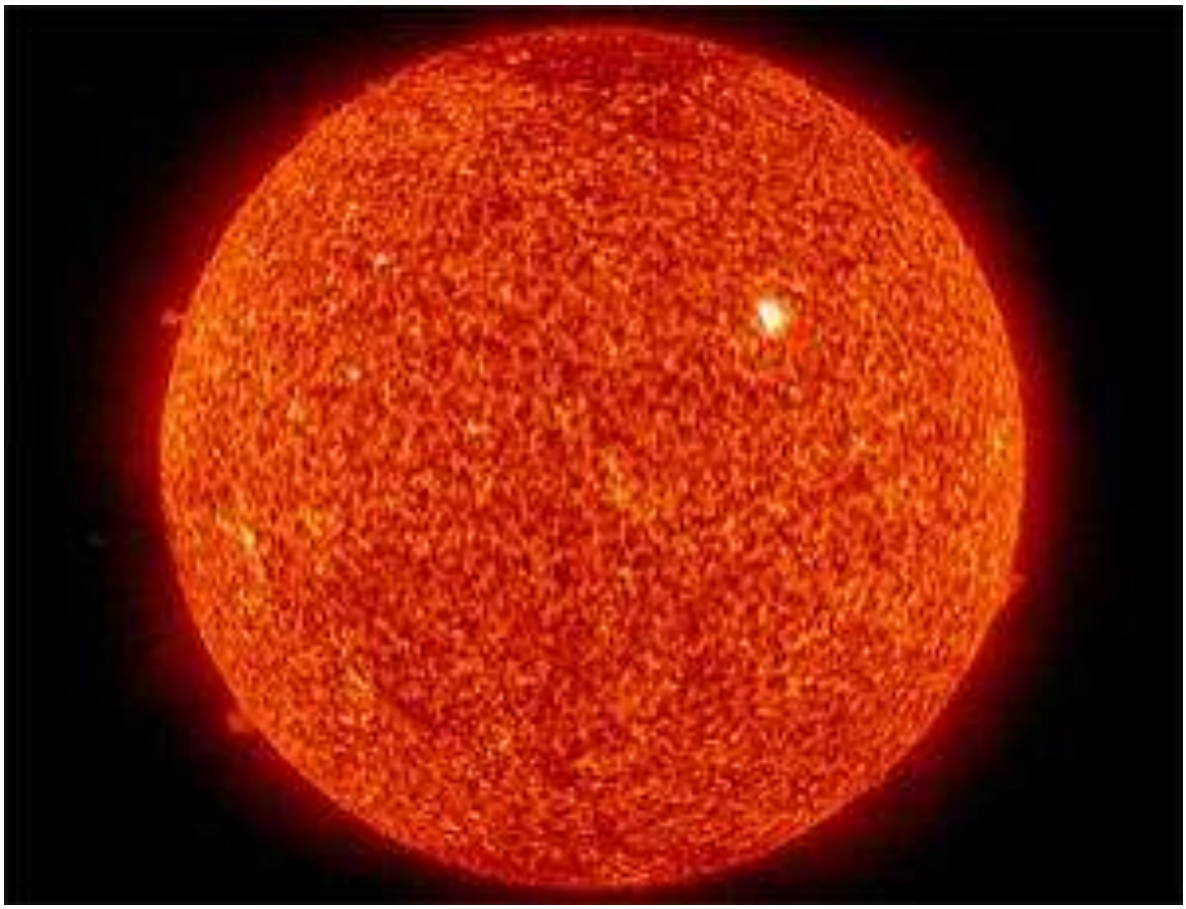
By contrast, the T2K result can be accommodated without invoking sterile neutrinos.

The T2K collaboration has submitted the new results (pdf) to *Physical Review Letters*.

http://www.newscientist.com/article/dn20578-neutrinos-caught-shape-shifting-in-new-way.html

Sluggish sun may 'sit out' next solar cycle

- 22:45 14 June 2011 by **David Shiga**



Feeling quiet (Image: SOHO Consortium/EIT/ESA/NASA)

The eerily lethargic sun shows no signs of perking up, solar physicists say. The sun may wallow in inactivity for the next decade – or longer, which could affect Earth's climate as well as the health of orbiting satellites.

The sun has been unusually placid lately. In 2008, the solar wind slowed to a 50-year low, coinciding with the least active point in the 11-year sunspot cycle. That dip in activity has also been deeper and longer than usual. Now, other diagnostic measurements of the sun also point to weird behaviour, suggesting the normal sunspot cycle may be interrupted.

"The sunspot cycle may be going into hibernation," says Frank Hill of the National Solar Observatory in Sunspot, New Mexico. He and other researchers are presenting their findings this week at a meeting of the American Astronomical Society's Solar Physics Division in Las Cruces, New Mexico.

Too weak

Solar cycle peaks are normally preceded by bright disturbances in the sun's wispy outer atmosphere or corona. Over several years, these drift towards the sun's poles after starting at lower latitudes.

But these migrating disturbances have not shown up on schedule for the next predicted maximum in 2013, say researchers led by Richard Altrock of the National Solar Observatory. "We'll see a very weak solar maximum in 2013, if at all," Altrock predicts.

And the sun may sit out the following solar maximum as well. Another team led by William Livingston, also of the National Solar Observatory, has observed magnetic fields necessary to produce sunspots steadily weakening for the past 13 years. If the trend continues, the fields may be too weak to birth new sunspots for the following cycle in 2022, they say.

A third team led by Hill has been tracking winds that blow beneath the sun's visible surface. A wind pattern that preceded previous solar cycle peaks has not appeared on schedule, which is another indication that the normal behaviour has broken down, they say.

Shields are down

The peak of the solar cycle, when sunspots are abundant, tends to unleash more outbursts of plasma from the sun, which can fry satellite electronics and interfere with radio communication and power grids on Earth. If the sun becomes especially quiet, these storms may be fewer and farther between.

On the other hand, an inactive sun also lets more cosmic rays into the solar system, which can cause glitches in spacecraft and boost cancer risks for astronauts venturing outside Earth's protective magnetic field.

An onset of quiet behaviour might also help scientists clarify how much the sun affects Earth's climate. The sun's solar cycle was interrupted once before during the so-called Maunder minimum from 1645 to 1715, when almost no sunspots appeared.

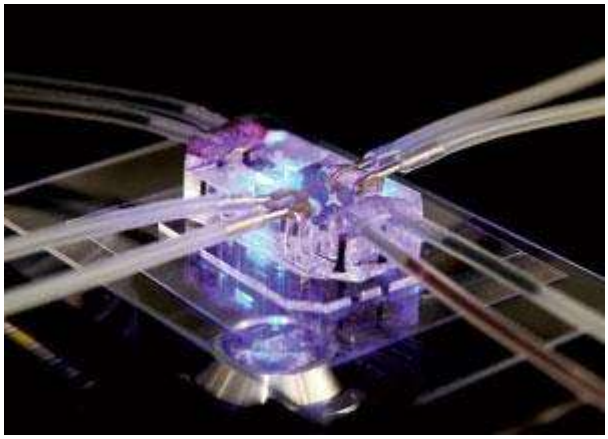
Some scientists have suggested this 70-year lull may have triggered or contributed to the pronounced cooling observed in northern Europe during this period, though the connection is disputed.

If a period of deep quiet is recurring, it "gives us an excellent opportunity to study that in real time", says Matt Penn of the National Solar Observatory, who contributed to the study led by Livingston.

http://www.newscientist.com/article/dn20575-sluggish-sun-may-sit-out-next-solar-cycle.html?full=true&print=true

Building a human on a chip, organ by organ

- 22 June 2011 by **Jessica Hamzelou**
- Magazine issue 2818



It's breathing… (Image: Wyss Institute/Harvard University)

Human "organs on chips" could be linked to make the ideal guinea pig, revolutionising the way drugs are tested and cancer is treated

JUSTIN WILLIAMS pokes his brain with a sharp object, then watches what happens through a microscope. He's studying how it responds to injury, and initial results are already providing new insights. "We've found that [immune] cells respond much more quickly than we would have anticipated - we normally think of these cells responding to injury in hours or days, but we see them respond within minutes," he says.

Needless to say, the brain Williams, at the University of Wisconsin, Madison, is needling is not his own. It is a small sample taken from a mouse and held in a "brain-on-a-chip" device: the tissue is suspended between two layers of plastic and surrounded by a nutrient-rich fluid. Williams presented his immune response findings at the International Wyss Symposium on Microfluidics and Medicine in Boston last month.

The brain is just the latest internal organ to be replicated in miniature form. From beating hearts to breathing lungs, livers to fallopian tubes, the list is continually growing. Now Williams and others at last month's symposium are trying to figure out ways to connect some of these chips together - a step towards creating a body-on-a-chip.

Each micro-organ contains a living core of animal cells sustained by nutrient-rich fluids, and all are revealing how cells respond inside the body in a way that traditional cell cultures cannot.

For instance, when Donald Ingber's team at Harvard University's Wyss Institute for Biologically Inspired Engineering created a "breathing" lung-on-a-chip last year, they discovered that it is the breathing mechanism itself - the way cells stretch and contract - that appears to encourage an inflammatory response to potentially harmful nanoparticles produced by the nanotechnology industry (*Science*, DOI: 10.1126/science.1188302). Studying static cells in a dish would have missed the importance of breathing.

Such organs on chips can be used to model how human organs function and respond to drugs, says Ingber. He thinks that they even have the potential to eliminate the use of animals in drug testing. "Animal testing is expensive and time-consuming, and animals are not always representative of humans."

Williams is not so sure. Even the most sophisticated organ-on-a-chip is unlikely to fully represent how a living organ functions. "So many of the things we like to study from the intact brain of living animals involve the animal's behaviour," he says. Even a complete brain on a chip cannot replicate this.

Still, Ingber points out that the chips can perform some roles that animal studies cannot. For instance, they could be personalised by building them from an individual's own cells. In theory, a doctor could send tissue samples to a lab to test a potentially harmful therapy on such a chip before handing out a prescription. This would be especially useful for people with cancer, as the various therapies available can have very different

effects on different people, Ingber says. "You could get a quick yes-or-no answer to whether a drug would work or not," he says.

Personalised chips might also speed up clinical trials. "Someday it might be possible to shortcut clinical trials by using chips containing cells from different human populations that are known to respond differently to specific drug classes," Ingber says.

To realise those goals, Ingber and Kevin Kit Parker, also at the Wyss Institute, are going beyond creating versions of isolated organs on chips and beginning to connect them together. At the Society of Toxicology annual meeting in Washington DC earlier in the year, Parker demonstrated his chip version of a beating heart, created by covering a flexible polymer with heart cells derived from mouse embryonic stem cells. The structure is a bit like a Fruit Roll-Up," says Parker. "The engineered muscle is on one side of the polymer." The heart cells are myogenic - they beat by themselves - just like those in a living heart, and by measuring the degree that the polymer bends, Parker can see if the cells are contracting properly. This makes the model ideal for testing drugs for heart failure - a condition in which cardiac cells often fail to contract strongly enough. "We're working with a pharmaceutical company to do just that," he says.

Parker's heart could join up with Ingber's lung. "We're trying to mimic natural organ-organ interactions," says Ingber (see diagram). The heart-lung device could be useful for testing the effects of aerosol-based drugs on the heart, as well the cardiac effects of inhaled particles and general air pollution, he says.

"The ultimate test will be if the lung can oxygenate the heart tissues, and we're still working out how that's going to happen," says Parker. If his team can figure out how to crack this problem, in theory the heart-on-a-chip could pump a blood substitute to the lung-on-a-chip, which could oxygenate the blood and send it back to the heart, mimicking what goes on in the body.

But once you've connected a mini-heart to a mini-lung, why stop there? "Putting other organs on is a big thing that we want to do," says Parker. As for which organ should be up next, "there's no doubt about it - I want to put a brain on there. "One of the brain regions that Williams has kept alive in chip form is the medulla - a part of the brainstem that is involved in automatic functions, such as breathing. "We've found that the tissue will continuously and automatically send out neural signals that would normally cause a person to breathe, even when it's outside the body," says Williams. His team has already attached electrodes to the nerve roots in the brain sample to tap into those signals. He thinks it would be relatively easy to use them to drive the pump that makes a lung-on-a-chip device "breathe".

Ingber has different ideas about which organs should be next in line for a whole-body model. "The most critical organs would be the kidney, gut and liver, which are all involved in drug metabolism and excretion," he says. Ingber's team is working on a way to mimic the gut's microbiome - its bacteria and their environment - on a chip, while different versions of a liver-on-a-chip have been developed by groups at Drexel University in Philadelphia, Pennsylvania, and the Massachusetts Institute of Technology.

Although a sequence of mini organs can never truly mimic an entire body, the human-on-a-chip could provide the ultimate guinea pig. "This is not going to be done overnight," says Parker. "But the rewards - for drug discovery and delivery, and for basic research - would be quite extraordinary."

http://www.newscientist.com/article/mg21028184.000-building-a-human-on-a-chip-organ-by-organ.html?full=true&print=true

Red wine's heart health chemical unlocked at last

- 22 June 2011
- Magazine issue 2818.

Nature's goodies (Image: Ilubi Images/Plainpicture)

FANCY receiving the heart protecting abilities of red wine without having to drink a glass every day? Soon you may be able to, thanks to the synthesis of chemicals derived from resveratrol, the molecule believed to give wine its protective powers. The chemicals have the potential to fight many diseases, including cancer.

Plants make a huge variety of chemicals, called polyphenols, from resveratrol to protect themselves against invaders, particularly fungi. But they only make tiny amounts of each chemical, making it extremely difficult for scientists to isolate and utilise them. The unstable nature of resveratrol has also hindered attempts at building new compounds from the chemical itself.

Scott Snyder at Columbia University in New York and his team have found a way around this: building polyphenols from compounds that resemble, but are subtly different to, resveratrol. These differences make the process much easier. Using these alternative starting materials, they have made dozens of natural polyphenols, including vaticanol C, which is known to kill cancer cells (*Nature*, DOI: 10.1038/nature10197). "It's like a recipe book for the whole resveratrol family," says Snyder. "We've opened up a whole casket of nature's goodies."

http://www.newscientist.com/article/mg21028185.300-red-wines-heart-health-chemical-unlocked-at-last.html

Muscles play a part in the rubber hand illusion

- 16:14 22 June 2011 by **Wendy Zukerman**

People with an anaesthetised finger can be convinced that a plastic finger is their own, in a modified version of the famous "rubber hand illusion". This suggests that the sense of touch is not essential to conjure up the illusion, as our muscles and nerves also play a role.

Over 10 years ago, psychologists found they could convince people a rubber hand was theirs by putting a fake hand on a table in front of them and stroking the rubber hand and the person's own hand at the same time.

More than just a party trick, the illusion revealed how easily our sense of ownership over our body can be manipulated. This is important, because disowning a healthy arm or a leg is common in people who have had a stroke or have schizophrenia. Understanding exactly what causes our perception of body ownership should help develop treatments.

The illusion was thought to be induced by a mismatch of information from our eyes and sense of touch. But Lee Walsh from Neuroscience Research Australia in Sydney suspects that our sense of body position, called proprioception, also plays a part.

Numb finger

To find out, Walsh and colleagues injected a local anaesthetic into one index finger of 30 people to deaden the finger's sense of touch. The participants could still sense the finger's movement and position, however, as the nerves that send this information to the brain start in the hand and arm muscles, which were not affected by the anaesthetic.

Participants rested the arm with the numbed finger on a table. A false arm, covered by a towel, was placed on a higher table, directly above their real hand, with a fake finger poking out. The plastic finger and the person's real finger were connected, so when the false finger moved, so did the real finger.

For 3 minutes, the experimenter bent the false finger, while the subject felt, but could not see, their own finger performing exactly the same movement simultaneously. Afterwards, all subjects reported that the plastic finger began to feel like it was theirs.

"This is the first study to show that the brain uses information from muscles to tell us what is our body and what isn't," says Walsh.

Alexander Mussap, a psychologist at Deakin University in Melbourne, Australia, describes the work as "very interesting". Knowing the position of our limbs is important to having a sense of ownership over them, he says.

Journal reference: *Journal of Physiology*, DOI: 10.1113/jphysiol.2011.204941

http://www.newscientist.com/article/dn20599-muscles-play-a-part-in-the-rubber-hand-illusion.html

Botclouds: a cyberattacker's dream

- 21 June 2011 by **Jacob Aron**
- Magazine issue 2817.

Cloudy, with a chance of fraud (Image: Gary S. Chapman/Getty)

OFFLOADING your software and data to a cloud computing service has never been easier.

Apple last week became the latest tech company - after Google and Amazon - to offer cheap online storage, with its new iCloud service allowing users to access music, documents and other files from any Apple device. But cloud services could also be used to launch attacks, send spam and commit fraud.

"Right now it's just a few attacks, most aren't well publicised and a lot can go undetected," says Kassidy Clark of the Delft University of Technology in the Netherlands. "As long as cloud service providers are not taking proactive steps to prevent these things, I think this trend will increase."

As well as basic online storage, firms such as Amazon, which provides the largest cloud service, also offer virtual computing. This allows people to rent as many "virtual computers" as they need.

Now Clark and colleagues have investigated how the cloud could be used to build a botnet, a network of infected computers under an attacker's control. Traditional botnets are built over time by taking control of ordinary people's computers without their knowledge, but a cloud botnet - or botcloud - can be put together in a couple of minutes just by purchasing space in the cloud with stolen credit card details. "It makes deployment much faster," says Clark, who presented his findings at the CLOSER cloud computing conference in Noordwijkerhout, the Netherlands, last month. "You don't have to wait months for millions of machines around the world to get infected."

To find out just how easy it is to construct a botcloud, Clark and colleagues hired 20 virtual computers from a leading cloud service provider for around €100 and used them to carry out attacks on their own web server. They first attempted a distributed denial of service (DDoS) attack, which floods a target with massive

amounts of traffic. The botcloud pumped out 20,000 page requests per second and brought the server down in just 10 seconds.

Clark also built a larger botcloud and used it to simulate "click fraud" - clicking links in pay-per-click adverts in order to generate fraudulent revenue. Advertising companies normally stop this by tracking the internet protocol (IP) address of each individual computer and blocking one if it clicks a link too many times. The researchers circumvented this defence by setting up a botcloud of 1000 virtual computers, each with its own address. Neither botcloud attack was detected or shut down by the cloud provider.

So are botclouds being used? There were certainly rumours that the recent attack on Sony's PlayStation Network was carried out via Amazon servers rented using stolen credit cards, but these have not been substantiated. "We have seen spam coming from some of these environments, but not on a massive scale," says Paul Wood, a senior analyst at Symantec.cloud, which provides cloud-based security services. He says that it is even possible for a virtual computer in the cloud to become infected by an ordinary botnet, because cloud users don't normally run anti-virus software.

Thomas Roth, a security researcher in Cologne, Germany, who recently showed how to use Amazon's servers to crack Wi-Fi passwords, agrees the lack of anti-virus protection in the cloud is a problem. "I think that Amazon should provide infrastructure for doing vulnerability assessments and virus scans," he says.

"Amazon Web Services employs a number of mitigation techniques, both manual and automated, to prevent the misuse of the services," Amazon told *New Scientist*. "We have automatic systems in place that detect and block many attacks before they leave our infrastructure."

But Wood warns that attacks from the cloud could easily take off in countries with more lax web policing. "It's only a matter of time before a Russian or Chinese equivalent of Amazon offers similar services," agrees Clark. "You put malicious or illegal software there, it doesn't matter, they will never take you offline."

http://www.newscientist.com/article/mg21028175.500-botclouds-a-cyberattackers-dream.html

Cracking the code of machine translation

- 20 June 2011 by **Jacob Aron**
- Magazine issue 2817.

What if there's no Rosetta stone? (Image: John Brecher/Corbis)

AUTOMATIC translation services seem like magic. Input some foreign text and you instantly get a decent English version in return - unless your text happens to be in Farsi, Pashto or any number of other widely used languages that computers can't currently translate.

That's because machine translation techniques rely on analysing the statistical properties of the same text written in two different languages - a Spanish-English dictionary, for example. "You have parallel data for common language pairs like French-English, but for rare or uncommon language pairs it's very difficult to find bilingual sources," explains Sujith Ravi, a computer scientist at the University of Southern California in Marina Del Rey, who is trying a new approach to the problem.

Ravi and his colleague Kevin Knight treat translation as a cryptographic problem, as if the foreign text were simply English written in an advanced cipher. Their software cracks the code by estimating the probability that a foreign word matches an English word based on the number of times it appears in the text - a frequently occurring word is more likely to mean "the" or "a" than "antidisestablishmentarianism".

To ensure the translation makes sense, the pair use another piece of software to evaluate the quality of English that comes out. This in turn tweaks the probabilities used in the translation software. They tested the system on a collection of short phrases such as "last year" and "the fourth quarter", attempting to translate the Spanish equivalents back into English, along with a number of movie subtitles that existed in both languages.

The resulting translations - known, confusingly, as "monolingual" translations - rated highly compared with standard computer translation techniques. But it remains to be seen whether the models can be scaled up from such short phrases to deal with longer, more complex texts.

Chris Callison-Burch of Johns Hopkins University in Baltimore, Maryland, says Ravi and Knight's method is "extremely promising" but adds that it hasn't proved itself yet. His team is also working on translation software that eschews parallel data. Their version crawls online texts and compares disparate texts from different languages - say, a collection of Spanish blog posts and news stories in English. For example, the word "tsunami" spiked in 2004 and 2011 following the Indian Ocean and Japanese events, as did the equivalent word in Spanish, *maremoto*, suggesting that they mean the same thing.

Ravi and Knight are also exploring how monolingual methods could help us crack long-lost languages or unknown ciphers (see "Machine versus the Zodiac killer"). But what about the ultimate unknown tongue - could their methods translate an alien language? "Totally," says Ravi. "You could also think of deciphering dolphin-speak."

Monolingual translation might also help soldiers or aid workers react quickly in countries with unfamiliar languages; responding to a bombing in Indonesia or an earthquake in Haiti, for instance.

Don't expect a Google Translate upgrade just yet, though. "They're trying to do something very ambitious," says Phil Blunsom, a machine translation researcher at the University of Oxford. "It's not something you're going to see popping up in commercial systems any time soon."

Machine versus the Zodiac killer

Coded messages apparently sent by a San Francisco serial killer in the late 1960s have baffled cryptanalysts ever since, but Ravi and Knight's translation model could help crack the cipher. The Zodiac killer's code replaced letters with strange symbols and sometimes used multiple symbols for the same letter, making it very hard to decipher.

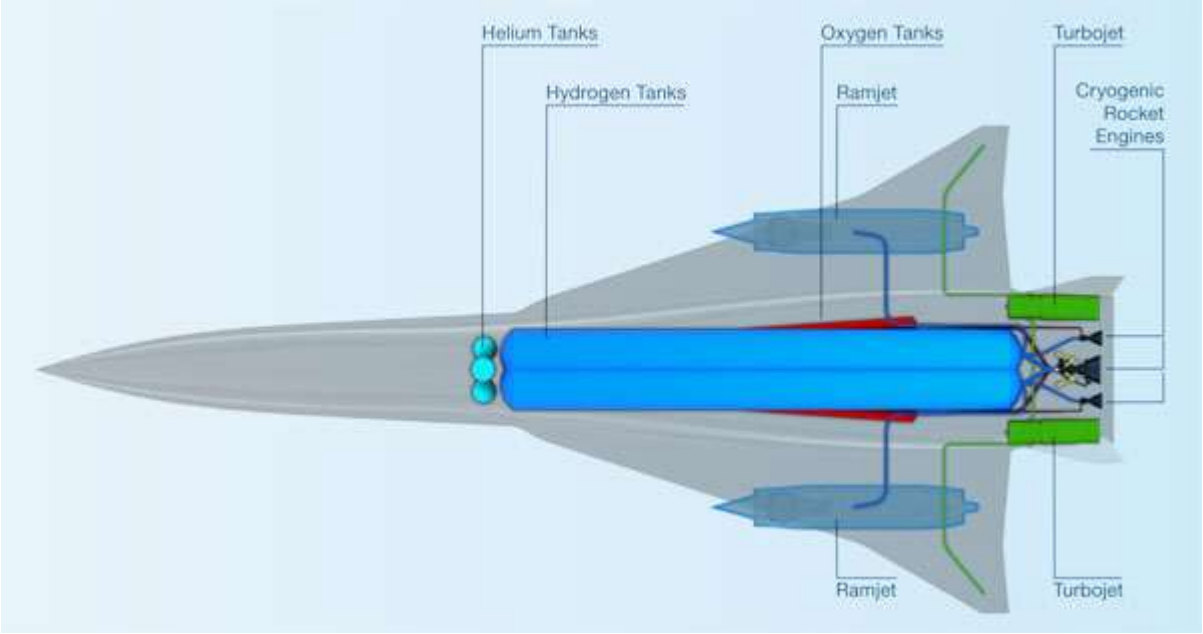
The first three messages were decoded by hand, revealing them to be parts of a single message, but the fourth remains unsolved to this day. Ravi and Knight's model has successfully cracked the first messages - the first time this has been achieved without human intervention - and they now hope to decode the fourth.

http://www.newscientist.com/article/mg21028175.400-cracking-the-code-of-machine-translation.html

Triple-engine trick fuels return to supersonic travel

17:15 20 June 2011*Paul Marks, senior technology correspondent*

Eight years after shelving Concorde, European firm EADS now thinks supersonic passenger aircraft could make a comeback - but not until 2050.
The Airbus owner believes that a novel combination of propulsion technologies might make supersonic travel both cost-effective and environmentally acceptable. The firm estimates speeds of Mach 4 are attainable - that's nearly 5000 kilometres per hour.
"Concorde was 1950s and 1960s technology. We think the three different propulsion types we're considering - one of which we have perfected for the Ariane rocket - could make this achievable by 2050," says EADS spokesman Gregor von Kursell.



(Image: EADS)
The firm revealed its hypersonic plane design at this week's Paris Air Show. Called the Zero Emission Hypersonic Transport (ZEHST) it would take off conventionally - using two-rear-mounted jet engines burning an algae-derived biofuel - but at an altitude of 6 kilometres would then turn to an Ariane-style liquid oxygen and liquid hydrogen-fuelled rocket engine.
The rocket engine lofts the delta-wing plane - which looks like a scaled-up Lockheed SR71 Blackbird spyplane - to the stratosphere at an altitude of 32 kilometres. Once in that ultra thin air, a "ramjet" slung beneath each of the delta wings handles the flight's Mach 4 cruise phase.
Unlike a regular jet engine, a ramjet has no compressor turbine and uses its sheer speed (they work up to Mach 5) to scoop enough high-pressure air in for efficient combustion. What's critical is that air does not enter a ramjet too fast: front-mounted "shock-cones" slow the airflow to subsonic levels.
If this three-way (jet/rocket/ramjet) propulsion choreography can be made to work, EADS expects Tokyo to London flights to take just 2 hours and 20 minutes.

http://www.newscientist.com/blogs/onepercent/2011/06/triple-engined-trick-fuels-ret.html

Rocky Mountains Losing Their Snow

Trees grow at high elevations in the Rockies, fed by melting snow. (Photo: Greg Pederson, 2009, © Science/AAAS)

More than 70 million people across the North American West depend on water from the Columbia, Missouri or Colorado Rivers. And 60 to 80 percent of that water originates as snowpack. But that snowpack has been declining in recent decades, a worrisome trend as Western cities continue to grow and water demand rises. Researchers led by the U.S. Geological Survey, reporting this week in *Science*, wanted to see if these recent trends are truly unprecedented. So they created snowpack histories for three regions—the upper Colorado, the Northern Rockies and the greater Yellowstone area—by using 66 tree-ring chronologies.

Trees record in their patterns of growth (i.e., tree rings) the amount of water available to them during the growing season. In the West, that water is largely controlled by the amount of water in the snowpack, and by concentrating their tree-ring data on trees from areas where the precipitation comes mostly in the form of snow and on trees known to be most sensitive to the snowpack, the scientists were able to create a good record of snowpack levels in the area going back to around 1200 A.D.

The record has plenty of variability—snowpack levels are dependent on many different variables, such as sea surface temperatures, that aren't consistent from year to year. But around 1900, two of the three regions underwent a major decline in snowpack, and then all three dropped precipitously starting around 1980. "Over the past millennium, late-20th century snowpack reductions are almost unprecedented in magnitude across the

northern Rocky Mountains," the scientists write. The culprit? "Unprecedented springtime warming due to positive reinforcement of the anthropogenic warming by decadal variability." Translation: climate change. Last year when I was reporting my story on the Colorado River, Patricia Mulroy, who manages Las Vegas's water, told me that we need a new attitude about water, especially in the West. "It's not abundant, it's not reliable, it's not going to always be there," she said. How many times do we need to be told before it sinks in?

http://blogs.smithsonianmag.com/science/2011/06/rocky-mountains-losing-their-snow/

Does Your Last Name Affect Your Buying Habits?

Can a letter in your name truly affect your purchasing habits? (courtesy of flickr user Leo Reynolds)

If you've never noticed my last name, just know that it begins with a Z. Some people might have found that annoying—Thomas Zych ran for president in 2004 on a platform of ending the "tyranny" of ordering things alphabetically—but I've always thought it rather convenient. I've never had to waste time finding my place in line. My name is always easy to find at the end of any list. And the line for voting is almost always shorter for those of us at the end of the alphabet.

So I read with some interest this study from the *Journal of Consumer Research*, titled "The Last Name Effect: How Last Name Influences Acquisition Timing." In it, Kurt Carlson of Georgetown University and Jacqueline Conard of Belmont University test their theory that people who grow up with last names near the end of the alphabet have a very different experience from their classmates at the beginning. And as a result, those of us with names near the end become more opportunistic and respond more quickly to what the researchers term "acquisition opportunities"—direct-mail offers, replacing objects that have reached the end of their useful lives or adopting new technologies.

Carlson and Conard performed four experiments to test their theory—offering MBA students free tickets to a basketball game; asking a group of adults to participate in a survey in exchange for a chance to win $500; giving undergraduate and graduate students the opportunity to participate in a wine-choice study and receive $5 and a bottle of wine; and asking undergrads about the appeal of a discount when buying a needed backpack. In each case, the researchers looked at how quickly a person responded to the offer and compared it to where his or her last name (during childhood) could be found alphabetically. And they found a small effect each time, with people near the end of the alphabet responding to the offer a little more quickly than people at the beginning.

But I'm skeptical. I'm not an early adopter of new technologies, I take my time to research options before any big purchase and I rarely respond to direct mail (or e-mail) offers. I don't seem to fit into this "last name effect" theory.

Then again, I never found that being a Z was all that onerous. And perhaps other people truly were affected by their placement in lines while growing up and that now has some effect on how they act when making a purchase.

But as Timothy Noah noted in Slate:

Carlson and Conard concede at the study's end that they can't really say whether the R-Zs' quicker response to act-now-type marketing makes them smart shoppers or suckers. In the first and third experiments, it seems to me a toss-up as to whether the responders are acting on sincere priorities or merely demonstrating suggestibility as they rearrange plans to seize free basketball tickets and bottles of wine. The second and fourth experiments seem clearer cases of what economists call "maximizing utility." I don't know anyone who couldn't use an extra $500; do you? And the hypothetical about the backpack assumes that the student

really needs a new backpack, so unless he's on his way to an exam or a first date with his future wife or a job interview with Goldman Sachs—and none of these are in the hypothetical—he'd be foolish to pass up the discount.
The big message in the study, however, is one to marketers (what else would you expect from a journal about consumers?). Carlson and Conard note that people at the end of the alphabet would make better targets for certain promotions and when marketers want to build a customer base quickly.
I suppose, then, that the big take-home message for me is that I can expect more junk mail.

http://blogs.smithsonianmag.com/science/2011/06/does-your-last-name-affect-your-buying-habits/

Should We Blame Scientists for Not Predicting Earthquakes?

The April 6, 2009 earthquake in Italy destroyed many buildings, new and old. Photo courtesy of Frengo2.0.

Last year I wrote about a group of Italian scientists who had just been indicted on charges of manslaughter for not alerting the public that a particularly bad (magnitude 6.3) earthquake would occur on April 6, 2009 in the Abruzzo region. Several months later, after scientists worldwide protested the move, it looked as if the charges would be dropped. But that has now changed, and the scientists are likely to go on trial; if convicted, they face up to 12 years in prison. They've not been blamed for not predicting the earthquake, but close enough, as the *New York Times* explained yesterday:

They do not stand accused of failing to predict the earthquake; everyone agrees that would have been impossible. But prosecutors say that by playing down the risk of a major earthquake, the panel — the National Commission for the Forecast and Prevention of Major Risks — failed to uphold its mandate and did not allow the local population to make adequately informed decisions about whether to stay in their homes or move to a safer place.

Here's what happened back in 2009:

Before the April 6 earthquake, the region had been experiencing smaller earthquakes for some months. Following a magnitude-4.0 quake on March 30, the six scientists now under indictment met with Bernardo De Bernardinis, the deputy technical head of the Civil Protection Agency, to discuss the risk of a larger event. After the meeting, De Bernardinis told reporters at a press conference that "the scientific community tells us there is no danger, because there is an ongoing discharge of energy. The situation looks favorable."

The minutes of that meeting, however, show that the scientists were cautious in their evaluation of the situation, *Nature* reports, saying that a major quake in the region was "unlikely" but could not be ruled out.

Either way, the claim that people would have altered their behavior if the scientists had been less cautious and issued a more forceful warning is simply not plausible. The way that you prepare for an earthquake when you live in an earthquake-prone area—be it Italy or California—should be to build to certain standards to make structures as earthquake-proof as possible. You don't wait for some sign that you should flee the area and then hope for the best.

And it appears that the region had failed that preparation, which was apparent even in the first days after the 2009 quake. From Reuters the day after:

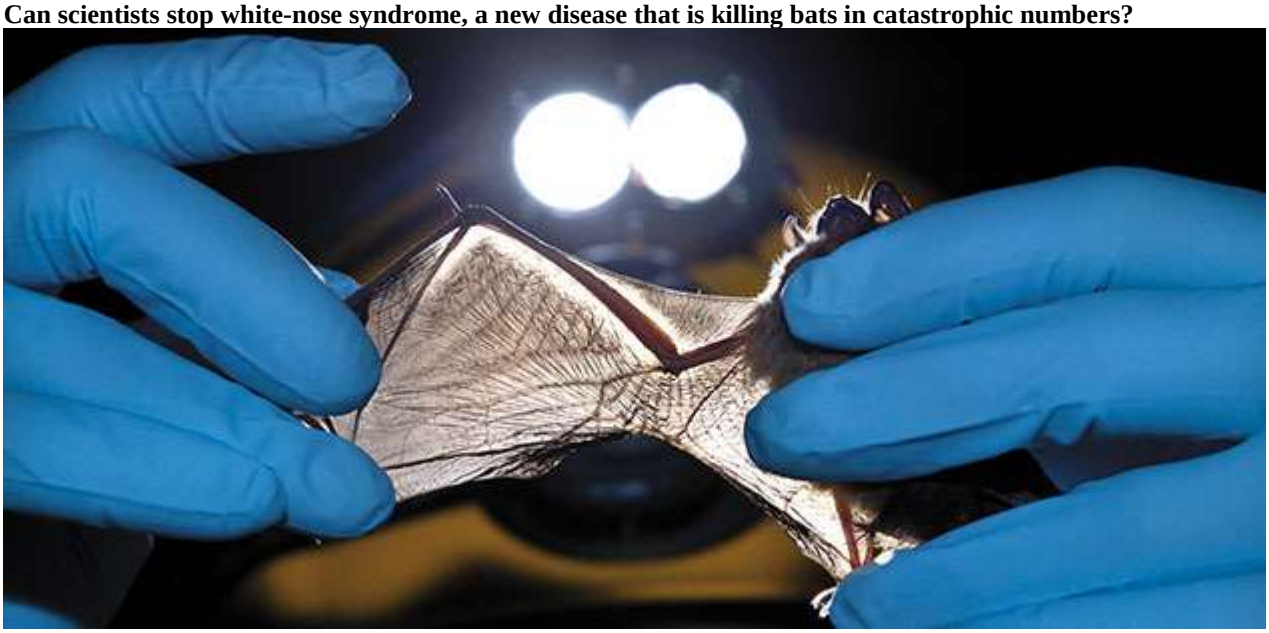
…shocked Italians asked how modern buildings — not just historic churches and stone houses — could crumble into pieces in a region known for its high seismic risk.

"Once again we are faced with the lack of control on the quality of construction," Franco Barberi, who heads a committee assessing earthquake risks at Italy's Civil Protection agency, told reporters in L'Aquila.
"In California, an earthquake like this one would not have killed a single person," he said.
The tragedies in this story keep mounting—309 people died. Innocent scientists could be put in prison. And I have to wonder if the real reason for all those deaths, that modern buildings were apparently not built to adequate standards for the area's risk, is being completely ignored, thus setting up Italians for more disasters.

http://blogs.smithsonianmag.com/science/2011/06/should-we-blame-scientists-for-not-predicting-earthquakes/

What is Killing the Bats?

Can scientists stop white-nose syndrome, a new disease that is killing bats in catastrophic numbers?



In the worst animal epidemic in years, white-nose syndrome threatens to wipe out some bat species.

Read more: http://www.smithsonianmag.com/science-nature/What-is-Killing-the-Bats.html#ixzz1QKzy3oQ9

- By Michelle Nijhuis
- *Smithsonian* magazine, August 2011

Inside the gaping mouth of Mammoth Cave, hibernating bats sleep in permanent twilight, each huddled in its own limestone crevice. Every fall, these big brown bats *(Eptesicus fuscus)* squeeze their furry bodies into nooks in the cave walls, where they enjoy protection from the bitter wind and the waterfall that sprays across the entrance. But there's little a snoozing bat can do about a persistent scientist.

"Just...let...go...with...your...feet," coaxes Brooke Slack, a biologist at the Kentucky Department of Fish and Wildlife Resources, as she stands on tiptoes and reaches with gloved hands to pry a bat from the wall.

The bat, visible by the light of her headlamp, lets out a stream of tiny, infuriated shrieks, baring its sharp white teeth in protest. Slack gently loosens the bat's claws from the rock and slips the four-inch-long animal into a brown paper bag. On this gray December afternoon, Slack and her colleague, a Northern Kentucky University microbiologist named Hazel Barton, are pressing this unlucky bat into service for its species.

Mammoth Cave, the longest known cave in the world, stretches at least 390 miles under the forests of southern Kentucky, and its twisting tunnels have fascinated explorers, scientists and tourists for well over a century. Slack and Barton have come for a different reason: the cave is a front line in the most precipitous decline of North American wildlife in living memory.

With a half-dozen grumpy bats bagged, Slack, Barton and several co-workers lug their gear to the cave's Rotunda Room, where the limestone forms a grand domed ceiling. On summer days, this natural underground chamber is packed with tourists, but today the scientists have the place to themselves. Clad in disposable white Tyvek suits to avoid tracking microbes into or out of the cave, Slack holds each protesting bat while Barton clips samples of hair and swabs faces and wings.

"Look at you, with your dirty, dusty little face," Barton coos, shining her helmet lamp on one screaming bat.

Barton and Slack are good friends, and they work together often even though they have different passions. Barton is interested in bats because they live in caves. Slack is interested in caves because they're home to bats. Barton has a map of South Dakota's Wind Cave tattooed on her arm. Slack has a tiny silhouette of a bat tattooed behind her ear.

They both know that somewhere in this cave, even on these bats, may lie spores of the fungus *Geomyces destructans*, which is devastating hibernating bat populations in the Northeastern United States. The fungus appears to be the cause of a disease called white-nose syndrome, which has killed more than a million bats in the past four years. It even threatens some of the continent's most abundant bat species with extinction. Mammoth Cave has nearly 500,000 visitors per year, any one of whom could transport spores in or out. So far, despite painstaking searches by Slack and her crew, the fungus has not been found. But the disease has been confirmed in neighboring Virginia, West Virginia and, most worrisome, in a Tennessee cave only 80 miles from Mammoth.

"Oh, look at this," Slack says to her colleagues. They hear the note of concern in her voice, and the silence is immediate and thick. As headlamps turn toward her, Slack stretches out a bat wing, its thin membrane marked by two half-inch tears. They could be from a run-in with an owl, or a barbed-wire fence. Or they could be a sign that white-nose syndrome has crossed the state line and arrived in Mammoth.

The other bats collected today will be returned, ruffled but unharmed, to their hibernation perches, but this one will be euthanized for laboratory tests. Reluctantly, Slack and Mike Armstrong from the U.S. Fish and Wildlife Service do the deed with a vial of the chemical isoflourine. "Sorry, little girl," Armstrong says. One bat sacrificed, in hopes of saving another million of its kind.

Barton has just spent eight days squeezing her lanky frame through unexplored sections of Lechuguilla Cave, a southern New Mexico cave thought to be the deepest in North America. Access is restricted to protect Lechuguilla's delicate crystals and stalactites as well as its relatively undisturbed microbial community. Though Barton is an expert caver, more than a week in tight passages has tested even her stamina, leaving her knees sore and her gait stiff. But she saw a part of the world that's never been seen before.

She grew up in Bristol, England, in a family she describes as "not the slightest bit outdoorsy." When she was 14, she participated in a required high-school course that included rock-climbing, kayaking, horseback riding and a day of caving. "Everything terrified me but the caving," she says. "In the cave, I stayed in the back of the group thinking, 'I love this. This is cool.'"

Barton began to explore the caves near her hometown, caving with friends several times a week ("My mother would say, 'You can't go caving now! It's dark!'" she says with a laugh). As her curiosity and enthusiasm grew, she began exploring more difficult and distant caves.

She had also been fascinated by microscopic organisms ever since hearing BBC-TV naturalist David Attenborough marvel about the complexity of life in a single drop of water. When she was 14, Barton swept her hair against a petri dish of nutrients in science class. "By the next day, all kinds of disgusting things had grown out of it," she remembers with a grin. After studying biology at the University of the West of England, she moved to the University of Colorado to pursue a PhD in microbiology.

A collaborator, Norman Pace, suggested she study the microscopic life in caves, which scientists knew little about. "There aren't many microbiologists who can go where you go," Pace told her. Barton didn't want caving—her hobby—to become her job, but eventually she relented and began to plumb caves in Mexico, Guatemala, Belize, Venezuela and throughout the United States for signs of microbial activity. Caves, she has found, are swarming with microbes adapted to life without photosynthesis. She has identified microbes that can digest industrial chemicals and others with antibiotic properties—organisms that she and other researchers are studying for their potential to treat drug-resistant human diseases.

Barton's experience schooled her in the tenacity of these tiny life-forms. For her PhD research, she studied a bacterium that infects the lungs of cystic fibrosis patients, and she came to think of caves as somewhat like human bodies—complex places that host a vast variety of organisms, each adapted to its environment in a different way. Yet when Barton heard that a bat-killing fungus had managed to spread from caves in New York State all the way to West Virginia in just two years, even she was surprised by its velocity.

"if you sat down and thought, 'What would I design to kill bats, and how would I design it?' and you took time to think about the worst possible combination of factors that a pathogen would have, this would be it," says Barton.

Because *G. destructans* thrives in cool temperatures, it attacks bats while they hibernate for the winter, when their immune systems are effectively shut down. The fungus may spread from bat to bat, and when the animal colonies disperse in the spring, the fungus may persist in cave sediment, poised to infect the next winter's arrivals. Bats with white-nose syndrome rouse more frequently from their winter torpor, which causes them to waste precious body fat at the coldest time of the year. (In what's been dubbed the "itch and scratch" hypothesis, some scientists posit that the bats are disturbed by the fungus, which accumulates on their muzzle and wings.) The fungus also infects the bats' delicate wing membranes, eating away at the skin until the wings resemble torn, crumpled tissue paper.

The disease was discovered in early 2007, when bats in upstate New York started behaving oddly. Instead of hibernating through the winter, they flew into neighborhoods during the day, wandering dangerously far from their caves. "There would be three feet of snow and it would be 20 degrees—not bat-flying weather—and you'd see bats flying out and taking off into the distance," says Al Hicks, then a wildlife biologist for the New York State Department of Environmental Conservation. "You'd know every darn one of them was going to die. It was awful."

Later that winter, during a routine cave survey, New York State biologists found thousands of dead bats in a limestone cave near Albany, many encrusted with a strange white fuzz. During the winters that followed, dead bats piled up in caves throughout the Northeast. The scientists would emerge filthy and saddened, with bat bones—each as thin and flexible as a pine needle—wedged into their boot treads.

By the end of 2008, wildlife-disease researchers had identified the fuzz as a fungus new to North America. Today the fungus has spread to 19 states and 4 Canadian provinces, and infected nine bat species, including the endangered Indiana and gray bats. A 2010 study in the journal *Science* predicted that the little brown bat—once one of the most common bat species in North America—may go extinct in the eastern United States within 16 years.

"When it first hit, I thought, 'OK, is there anything we can do to keep it within this cave?'" remembers Hicks. "The next year it was, 'Is there anything we can do to secure our largest colonies?' And then the next year it was, 'Can we keep any of these colonies going?' Now we're asking if we can keep these species going."

G. destructans also infects bats in Europe—but it doesn't kill them, at least not in large numbers. *G. destructans* may have swept through European caves in the distant past, leaving only bats that could withstand the fungus. Researchers don't know when and how the fungus made its way to North America, but they speculate that it may be so-called "pathogen pollution," the inadvertent human transport of diseases—in this case possibly by a cave-visiting tourist—into new and hospitable habitats.

With their undeserved association with creepy folk tales, bats don't have much of a constituency. But bat biologists say the consequences of the North American die-off stretch far beyond the animals themselves. For instance, one million bats—the number already felled by white-nose syndrome—consume some 700 tons of insects, many of them pests, every year. Fewer bats mean more mosquitoes, aphids and crop failures. A study published in *Science* this spring estimated that bats provide more than $3.7 billion in pest-control services to U.S. agriculture every year.

With *G. destructans* reaching farther each winter, Barton, Slack and an array of other biologists are racing to understand the fungus in time to contain it. Since scientists aren't sure how easily people may spread the fungus, many caves have been closed, and tourists, recreational cavers as well as scientists are advised to clean their gear between trips underground. Barton and her students have shown that common cleaning products, such as Woolite and Formula 409, kill *G. destructans* without harming caving gear.

But even as Barton, Slack and their colleagues patrol the perimeter of the disease, they acknowledge that the syndrome is likely to continue its spread across the continent.

"Who's going to live, and who's going to die?" asks DeeAnn Reeder. "That's the big thing I think about all the time." Reeder, a biology professor at Bucknell University in central Pennsylvania, spends her days surrounded by white-nose syndrome. *G. destructans* thrives in nearby caves and mines, on many of the bats in her campus laboratories, and even on a set of petri dishes secured in an isolated laboratory refrigerator. Up close, the epidemic is more complicated than it first appears, for some bat species—and some individual bats—are proving more resistant than others. Reeder wants to know why.

Reeder never expected to study white-nose syndrome, but like Barton, she was perfectly prepared for the job. Fascinated by mammals since her childhood summers in the Sierra Nevada, she studied primate physiology and behavior before switching to bats. At first, the reasons were practical—bats were easy to catch and

sample in large numbers—but "I just fell in love with them," Reeder says. "They're so tough. I've always said that nothing will take them down, that they're completely resilient. And then we got this *fungus*," she says, shaking her head. "It caught us all off guard—and it caught them off guard, too."

After Reeder came to Pennsylvania in 2005, she outfitted her laboratory with a set of climate-controlled chambers designed to mimic natural cave conditions. She and her students had just begun to collect data on bat hibernation patterns when white-nose syndrome emerged. Suddenly, biologists all over the continent had questions about how bats behaved during hibernation, and Reeder was one of the only researchers well-positioned to answer them. "They'd say, 'What do we know about hibernation?' and I'd say, 'Well, we know *this* much,'" says Reeder, holding a finger and thumb close together.

Like Barton and the rest of the small corps of researchers pursuing the disease, Reeder abruptly reoriented her career to deal with it. She and her students picked up the normally stately pace of science, running experiments in the field and lab as quickly as they could devise them. These days, the hallway outside her laboratory is crowded with worn backpacks and other scuffed field gear. "Sometimes I feel like a rat on an electrified grid," she says with a laugh.

In Kentucky, Barton was also working overtime, sampling skin secretions and hair from bats in caves throughout the state. In her laboratory, she and her students cataloged naturally occurring antifungal compounds produced by bacteria and other fungi, identifying some compounds that might protect vulnerable bats from white-nose syndrome. But to test the most promising compounds, she needed something Kentucky didn't yet have: sick bats.

When Reeder and Barton met at a bat conference in 2009, their complementary skills were obvious. "We spoke different languages, but it was clear that we needed to talk to each other," says Reeder. Last fall, in southeastern Pennsylvania, Barton and several of Reeder's students donned Tyvek suits and belly-crawled into the depths of one of the oldest limestone mines in North America. There, they trapped more than 100 infected bats and confined them in mesh enclosures with aerosolized antifungal compounds. They then left the bats alone to hibernate, hoping that some would survive until spring. They repeated the experiment in Reeder's lab, applying the compounds to infected bats in her hibernation chambers.

On a mid-March afternoon, Reeder visits the four laboratory hibernation chambers that house the treated bats. The chambers, which resemble bulky refrigerators, held 128 bats last fall. Now, three of the four chambers are empty and quiet, shut down after the last of their bats died last month. In the corner of the dimly lit room, in the only operating chamber, a single bat survives—but it won't live much longer. Through a small window, it's possible to see its silhouette, hanging motionless from the metal rack inside. Its furry body is no larger than a human thumb.

Reeder and her students travel through the rolling Pennsylvania countryside, headed for the limestone mine where bats were caged last fall. The roadsides are dotted with gray stone houses and churches, reminders of the time when the area's limestone provided shelter for people as well as bats. The mouth of the mine, tucked into a steep hillside above a two-lane highway, is blocked with a forbidding metal gate, designed to keep out vandals. Still, the cave is littered with beer bottles, and a message is unevenly spray-painted on the clammy rock: "This is great."

But not for the bats in this mine, whose numbers have dropped from an estimated 10,000 two years ago to roughly 180 today. Reeder and her students zip up their Tyvek suits and pick their way through the fallen rocks on the mine floor, the beams of their headlamps cutting through the cool, misty half-dark. Little brown bats are hanging onto the rocks, alone or in twos and threes, their fur glistening with moisture. Here and there, a dead bat lies on the ground, the bodies hardly more substantial than dried leaves. The crew counts 35 live bats hanging just inside the mouth of the mine, almost half bearing visible signs of white-nose syndrome. All are far closer to the mine entrance than is normal for this time of year. Later, a few will flutter out of the mine, pale brown and reeling in the daylight.

The crew slips through a narrow horizontal slot on the side of the mine, crawling headfirst down a boulder-filled slope. There, more bad news awaits: the mesh cages have been vandalized by raccoons, and the treated bats inside have all either escaped or been eaten. An entire season of data lost—to raccoons! Among the researchers, the frustration is palpable, their reactions unprintable.

By the time she returns to the mouth of the mine, Reeder is philosophical. "I don't do mopey very well," she says. From her laboratory experiments, she already knows that the treatments they used can't save bats from white-nose syndrome; at best, they may prolong their lives a little while. Perhaps different compounds, or

higher concentrations of the same compounds, might boost survival rates, but those are questions for the next study.

In their search for patterns in the white-nose epidemic, Reeder and her students have found that bats in cooler conditions may have better survival rates. So it's possible that humans could alter the temperatures in some mines—by changing the shape of entrances to direct airflow, for instance. In Tennessee, conservationists are already planning to build an artificial cave that can be kept fungus-free, and in New Hampshire, biologists are studying bats that hibernate in abandoned World War II-era bunkers, hoping that climate conditions inside will help some bats survive. The National Zoo has attempted to keep endangered Virginia big-eared bats alive in captivity, so far with limited success.

Even if such heroic measures can reduce the toll, many bat species will take generations to recover from white-nose syndrome. Thomas Kunz, a bat researcher at Boston University, is already preparing for these diminished populations. Since bats depend on each other's body heat to warm their summer roosts, Kunz has devised artificial roosts—narrow crevices built of scrap lumber—that can be warmed efficiently by just a few bats.

"On my worst days, I feel like we're working our tails off just to document an extinction," says Reeder. "But somehow in really teasing apart all of this, in really understanding how they die and why, we may find something really important, something we didn't predict, something that might help."

This past winter, Brooke Slack and her crew conducted their annual survey of nearly 100 Kentucky caves. The early results were good: the bat she had euthanized in Mammoth Cave tested negative for white-nose syndrome, and the rest of their cave surveys came up clean. It looked as if Kentucky bats had, against the odds, made it through another winter fungus-free. But then white-nose syndrome showed up in southern Ohio, and Slack decided to recheck a few sites near the border, just to be sure.

On April 1, in a limestone cave in southwestern Kentucky, a researcher working with Slack found a little brown bat with white fuzz on its muzzle. They sent it to a laboratory, and a week later Slack got the news she'd anticipated, but dreaded, for the past three years: white-nose syndrome had finally arrived in Kentucky. Now, Slack's job is not only to slow the spread of white-nose syndrome, but also to learn as much as she can about the disease as it moves through her state—and her beloved bats. "There's a sense of helplessness," she admits. "But I don't feel like we can say, 'Well, we've got it, so we give up.' We've got an obligation to move forward."

Michelle Nijhuis has written about Atlantic puffins, Henry David Thoreau and last year's Gulf oil spill for *Smithsonian*.

Find this article at:
http://www.smithsonianmag.com/science-nature/What-is-Killing-the-Bats.html

Artificial Pancreas Being Developed to Ease Diabetes Burden

Glucose level blood test. Researchers are developing an artificial pancreas that will deliver insulin automatically and with an individualized precision never before possible. (Credit: © evgenyb / Fotolia)

ScienceDaily (June 24, 2011) — The 25.8 million Americans who have diabetes may soon be free of finger pricks and daily insulin dosing. Mayo Clinic endocrinologists Yogish Kudva, M.B.B.S., and Ananda Basu, M.B.B.S., M.D., are developing an artificial pancreas that will deliver insulin automatically and with an individualized precision never before possible.

As part of this effort, Drs. Kudva and Basu will present their latest findings on how the mundane movements of everyday life affect blood sugar to the American Diabetes Association meeting this month in San Diego. "The effects of low-intensity physical activity, mimicking activities of daily living, measured with precise accelerometers on glucose variability in type 1 diabetes had not been examined," says Dr. Kudva.

Among his newest findings is that even basic physical activity after meals has a profound impact on blood sugar levels for people with type 1 diabetes. "You would expect this result, but we wanted to know to what extent this phenomena would happen in people with type 1 diabetes," Dr. Kudva says.

Diabetics who engaged in low-grade physical activity after eating had blood sugar levels close to those of people with fully functioning pancreases. Those who remained sedentary after their meal, however, had elevated blood sugars.

The researchers plan to incorporate these findings into an artificial pancreas being developed at Mayo Clinic. The "Closed Loop System" under development includes a blood sugar monitor, an automatic insulin pump, a set of activity monitors that attach to the body and a central processing unit.

Clinical trials of the artificial pancreases are likely to begin in November with a handful of inpatient volunteers. Study participants will follow strict diet, exercise and insulin-delivery regimens in Mayo's Clinical

Research Unit. Data will then be fed into an insulin-delivery algorithm, which mimics the body's natural process of monitoring and responding to glucose levels in the bloodstream.
"Physical activity enhances insulin action, hence lowering blood glucose concentration," Dr. Kudva says. "Real-time detection of physical activity -- and modeling of its effect on glucose dynamics -- is vital to design an automatic insulin delivery system."
Dr. Kudva and other Mayo researchers have spent nearly 15 years working on various aspects of diabetes and obesity. They are collaborating on the artificial pancreas and developing an algorithm that will afford patients the peace of mind to eliminate their daily routine of diabetes maintenance.
Dr. Basu will present findings that blood sugar levels decrease faster in the mornings in healthy adults than at dinner time, suggesting a diurnal pattern to natural insulin action. He proposes further study of this phenomenon and possible incorporation into the algorithm that drives the Closed Loop System.
The research has been funded by grants from the National Institutes of Health.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Mayo Clinic**.

http://www.sciencedaily.com/releases/2011/06/110624182303.htm

Some Captive Chimpanzees Show Signs of Compromised Mental Health, Research Shows

Captive chimpanzee. (Credit: © Lucy Birkett)

ScienceDaily (June 24, 2011) — New research from the University of Kent has shown that serious behavioral abnormalities, some of which could be compared to mental illness in humans, are endemic among captive chimpanzees.

These include self-mutilation, repetitive rocking, as well as the eating of feces and drinking of urine.

The research, which was conducted by Dr Nicholas Newton-Fisher and Lucy Birkett from the University's School of Anthropology and Conservation and is published by the online journal *PLoS ONE*, was conducted among 40 socially-housed zoo-living chimpanzees from six collections in the USA and UK. After determining the prevalence, diversity, frequency, and duration of abnormal behavior from 1200 hours of continuous behavioral data, the researchers concluded that, while most behavior of zoo-living chimpanzees is 'normal' in that it is typical of their wild counterparts, abnormal behavior is endemic in this population despite enrichment efforts such as social housing.

Such abnormal behavior has been attributed to the fact that many zoo-living chimpanzees have little opportunity to adjust association patterns, occupy restricted and barren spaces compared to the natural habitat, and have large parts of their lives substantially managed by humans. Controlled diets and provisioned feeding contrast radically with the ever-changing foraging and decision-making processes of daily life in the wild.

To date, published literature on abnormal behavior in wild chimpanzees is sparse and rates of abnormality comparable to those described in the study have never been reported.

Dr Newton-Fisher, a primate behavioral ecologist and expert in wild chimpanzee behavior, said: 'The best zoo environments, which include all zoos in this study, try hard to enrich the lives of the chimpanzees in their care. Their efforts include providing unpredictable feeding schedules and extractive foraging opportunities, and opportunities for normal social interactions by housing chimpanzees in social groups. There are limits to what zoos can provide, however; the apes are still in captivity.

'What we found in this study is that some abnormal behaviors persist despite interventions to 'naturalize' the captive conditions. The pervasive nature of abnormal behavior, and its persistence in the face of

environmental enrichment and social group housing, raises the concern that at least some examples of such behavior are indicative of possible mental health problems.
'We suggest that captivity itself may be fundamental as a causal factor in the presence of persistent, low-level, abnormal behavior -- and potentially more extreme levels in some individuals. Therefore, it is critical for us to learn more about how the chimpanzee mind copes with captivity, an issue with both scientific and welfare implications that will impact potential discussions concerning whether chimpanzees and similar species should be kept in captivity at all.'

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Kent**.

Journal Reference:

1. Lucy P. Birkett, Nicholas E. Newton-Fisher. **How Abnormal Is the Behaviour of Captive, Zoo-Living Chimpanzees?** *PLoS ONE*, 2011; 6 (6): e20101 DOI: 10.1371/journal.pone.0020101

http://www.sciencedaily.com/releases/2011/06/110622102327.htm

Deep History of Coconuts Decoded: Origins of Cultivation, Ancient Trade Routes, and Colonization of the Americas

Analysis of coconut DNA revealed much more structure than scientists expected given the long history of coconut exploitation by people. Written in the DNA are two origins of cultivation and many journeys of exploration and colonization. (Credit: Kenneth Olsen/WUSTL)

ScienceDaily (June 24, 2011) — The coconut (the fruit of the palm *Cocos nucifera*) is the Swiss Army knife of the plant kingdom; in one neat package it provides a high-calorie food, potable water, fiber that can be spun into rope, and a hard shell that can be turned into charcoal. What's more, until it is needed for some other purpose it serves as a handy flotation device.

No wonder people from ancient Austronesians to Captain Bligh pitched a few coconuts aboard before setting sail. (The mutiny of the Bounty is supposed to have been triggered by Bligh's harsh punishment of the theft of coconuts from the ship's store.)

So extensively is the history of the coconut interwoven with the history of people traveling that Kenneth Olsen, a plant evolutionary biologist, didn't expect to find much geographical structure to coconut genetics when he and his colleagues set out to examine the DNA of more than 1300 coconuts from all over the world. "I thought it would be mostly a mish-mash," he says, thoroughly homogenized by humans schlepping coconuts with them on their travels.

He was in for a surprise. It turned out that there are two clearly differentiated populations of coconuts, a finding that strongly suggests the coconut was brought under cultivation in two separate locations, one in the Pacific basin and the other in the Indian Ocean basin. What's more, coconut genetics also preserve a record of prehistoric trade routes and of the colonization of the Americas.

The discoveries of the team, which included Bee Gunn, now of the Australian National University in Australia, and Luc Baudouin of the Centre International de Recherches en Agronomie pour le Développement (CIRAD) in Montpellier, France, as well as Olsen, associate professor of biology at Washington University in St. Louis, are described in the June 23 online issue of the journal *PLoS ONE*.

Morphology a red herring

Before the DNA era, biologists recognized a domesticated plant by its morphology. In the case of grains, for example, one of the most important traits in domestication is the loss of shattering, or the tendency of seeds to break off the central grain stalk once mature.

The trouble was it was hard to translate coconut morphology into a plausible evolutionary history.

There are two distinctively different forms of the coconut fruit, known as niu kafa and niu vai, Samoan names for traditional Polynesian varieties. The niu kafa form is triangular and oblong with a large fibrous husk. The niu vai form is rounded and contains abundant sweet coconut "water" when unripe.
"Quite often the niu vai fruit are brightly colored when they're unripe, either bright green, or bright yellow. Sometimes they're a beautiful gold with reddish tones," says Olsen.
Coconuts have also been traditionally classified into tall and dwarf varieties based on the tree "habit," or shape. Most coconuts are talls, but there are also dwarfs that are only several feet tall when they begin reproducing. The dwarfs account for only 5 percent of coconuts.
Dwarfs tend to be used for "eating fresh," and the tall forms for coconut oil and for fiber.
"Almost all the dwarfs are self fertilizing and those three traits -- being dwarf, having the rounded sweet fruit, and being self-pollinating -- are thought to be the definitive domestication traits," says Olsen.
"The traditional argument was that the niu kafa form was the wild, ancestral form that didn't reflect human selection, in part because it was better adapted to ocean dispersal," says Olsen. Dwarf trees with niu vai fruits were thought to be the domesticated form.
The trouble is it's messier than that. "You almost always find coconuts near human habitations," says Olsen, and "while the niu vai is an obvious domestication form, the niu kafa form is also heavily exploited for copra (the dried meat ground and pressed to make oil) and coir (fiber woven into rope)."
"The lack of universal domestication traits together with the long history of human interaction with coconuts, made it difficult to trace the coconut's cultivation origins strictly by morphology," Olsen says.
DNA was a different story.

Collecting coconut DNA

The project got started when Gunn, who had long been interested in palm evolution, and who was then at the Missouri Botanical Garden, contacted Olsen, who had the laboratory facilities needed to study palm DNA. Together they won a National Geographic Society grant that allowed Gunn to collect coconut DNA in regions of the western Indian Ocean for which there were no data. The snippets of leaf tissue from the center of the coconut tree's crown she sent home in zip-lock bags to be analyzed.
"We had reason to suspect that coconuts from these regions -- especially Madagascar and the Comoros Islands -- might show evidence of ancient 'gene flow' events brought about by ancient Austronesians setting up migration routes and trade routes across the southern Indian Ocean," Olsen says.
Olsen's lab genotyped 10 microsatellite regions in each palm sample. Microsatellites are regions of stuttering DNA where the same few nucleotide units are repeated many times. Mutations pop up and persist pretty easily in these regions because they usually don't affect traits that are important to survival and so aren't selected against, says Olsen. "So we can use these genetic markers to 'fingerprint' the coconut," he says.
The new collections were combined with a vast dataset that had been established by CIRAD, a French agricultural research center, using the same genetic markers. "These data were being used for things like breeding, but no one had gone through and systematically examined the genetic variation in the context of the history of the plant," Olsen says.

Two origins of cultivation

The most striking finding of the new DNA analysis is that the Pacific and Indian Ocean coconuts are quite distinct genetically. "About a third of the total genetic diversity can be partitioned between two groups that correspond to the Indian Ocean and the Pacific Ocean," says Olsen.
"That's a very high level of differentiation within a single species and provides pretty conclusive evidence that there were two origins of cultivation of the coconut," he says.
In the Pacific, coconuts were likely first cultivated in island Southeast Asia, meaning the Philippines, Malaysia, Indonesia, and perhaps the continent as well. In the Indian Ocean the likely center of cultivation was the southern periphery of India, including Sri Lanka, the Maldives, and the Laccadives.
The definitive domestication traits -- the dwarf habit, self-pollination and niu vai fruits -- arose only in the Pacific, however, and then only in a small subset of Pacific coconuts, which is why Olsen speaks of origins of cultivation rather than of domestication.
"At least we have it easier than scientists who study animal domestication," he says. "So much of being a domesticated animal is being tame, and behavioral traits aren't preserved in the archeological record."

Did it float or was it carried?

One exception to the general Pacific/Indian Ocean split is the western Indian Ocean, specifically Madagascar and the Comoros Islands, where Gunn had collected. The coconuts there are a genetic mixture of the Indian Ocean type and the Pacific type.
Olsen and his colleagues believe the Pacific coconuts were introduced to the Indian Ocean a couple of thousand years ago by ancient Austronesians establishing trade routes connecting Southeast Asia to Madagascar and coastal east Africa.
Olsen points out that no genetic admixture is found in the more northerly Seychelles, which fall outside the trade route. He adds that a recent study of rice varieties found in Madagascar shows there is a similar mixing of the japonica and indica rice varieties from Southeast Asia and India.
To add to the historical shiver, the descendants of the people who brought the coconuts and rice are still living in Madagascar. The present-day inhabitants of the Madagascar highlands are descendants of the ancient Austronesians, Olsen says.
Much later the Indian Ocean coconut was transported to the New World by Europeans. The Portuguese carried coconuts from the Indian Ocean to the West Coast of Africa, Olsen says, and the plantations established there were a source of material that made it into the Caribbean and also to coastal Brazil.
So the coconuts that you find today in Florida are largely the Indian ocean type, Olsen says, which is why they tend to have the niu kafa form.
On the Pacific side of the New World tropics, however, the coconuts are Pacific Ocean coconuts. Some appear to have been transported there in pre-Columbian times by ancient Austronesians moving east rather than west.
During the colonial period, the Spanish brought coconuts to the Pacific coast of Mexico from the Philippines, which was for a time governed on behalf of the King of Spain from Mexico.
This is why, Olsen says, you find Pacific type coconuts on the Pacific coast of Central America and Indian type coconuts on the Atlantic coast.
"The big surprise was that there was so much genetic differentiation clearly correlated with geography, even though humans have been moving coconut around for so long."
Far from being a mish-mash, coconut DNA preserves a record of human cultivation, voyages of exploration, trade and colonization.

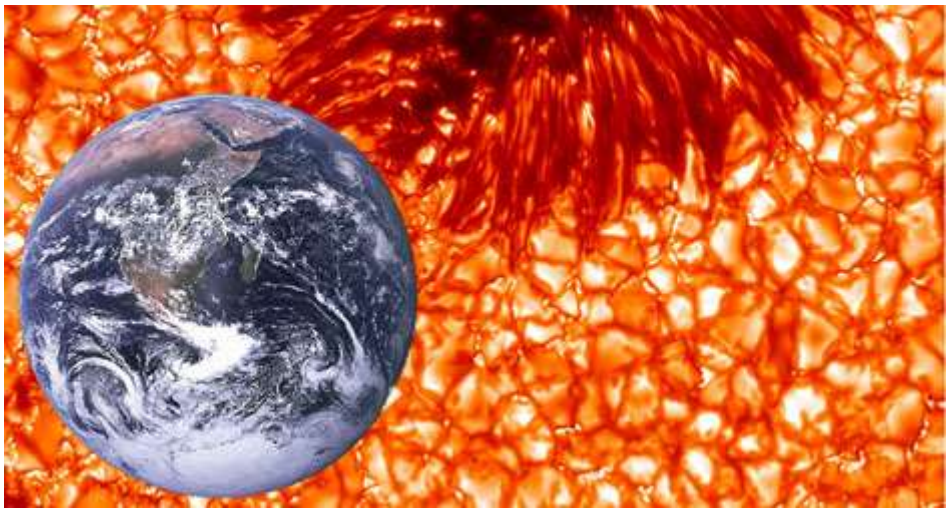
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Washington University in St. Louis**. The original article was written by Diana Lutz.

Journal Reference:

1. Bee F. Gunn, Luc Baudouin, Kenneth M. Olsen. **Independent Origins of Cultivated Coconut (Cocos nucifera L.) in the Old World Tropics**. *PLoS ONE*, 2011; 6 (6): e21143 DOI: 10.1371/journal.pone.0021143

http://www.sciencedaily.com/releases/2011/06/110624142037.htm

The Source of the Sun's Dark Spots



A sunspot is bigger than the Earth, as demonstrated in this colorized image. (Credit: The Royal Swedish Academy of Sciences, V.M.J. Henriques (sunspot). NASA Apollo 17 (Earth))

From here on Earth, a spot on the Sun is barely a speck on that bright yellow ball in the sky. But sunspots are huge, bigger than our planetary home, and they have a complex structure that can't be seen without some kind of help. Close up, you'll see that a sunspot has a central dark area—called the umbra, which appears dark because it's cooler than the rest of the Sun's surface—with some lighter spots, and that center is surrounded by a lighter filamentary area, called the penumbra, that flows outward.

Scientists used the Swedish 1-m Solar Telescope (which, despite its name, is on the Canary Island of La Palma, off the coast of Africa) to observe a sunspot near the middle of the Sun on May 23, 2010, and look at how gas flowed in and out; they then used those observations to create computer simulations of sunspots. Their results appear this week in *Science*.

The study supports the idea that sunspots occur as hot gases rise to the surface of the Sun and spread out, cool and then flow back into the star. This convective flow creates the pimple-like pattern of a sunspot, according to the study. And the filaments of the penumbra are actually columns of gases.

We care about what's happening with the Sun because our nearest star can sometimes turn on us, blasting powerful solar storms toward Earth that "could zap satellites, disable communication networks and GPS systems and fry power grids at a cost of $1 trillion or more," Rob Irion noted in his April story for Smithsonian, "Something New Under the Sun." Scientists are using a suite of satellites aimed at the star as well as telescopes here on Earth to learn more about the Sun. And it's increasingly important work: as solar and space physicist Daniel Baker of the University of Colorado noted in Irion's story, "The Sun is a highly variable star…. We live in its outer atmosphere, and the cyber-electric cocoon that surrounds Earth is subject to its whims. We'd better come to terms with that."

http://blogs.smithsonianmag.com/science/2011/06/the-source-of-the-sun%E2%80%99s-dark-spots/

A Quick Guide to Owning the Universe

What bits of the universe are legal to own? (credit: NASA)

If someone tries to sell you the Brooklyn Bridge, you know it's a hoax. But what about a meteorite, moon or star? Here's a quick guide to owning anything with origins outside the Earth:

Lunar Property: The 1967 Outer Space Treaty prohibits nations from claiming property rights on the Moon or anywhere else in space (including planets, asteroids, comets and anything else you can think of). Dennis Hope, a Nevada entrepreneur, thinks that the treaty has a loophole, however, and doesn't prohibit a person—who, after all, is not a nation—from claiming rights to extra-terrestrial objects. And so he claimed the Moon in 1980, later set up the Lunar Embassy, complete with its own government, and started selling. An acre of "prime" lunar property goes for $19.99 (plus $1.51 in tax, $12.50 shipping and handling and an extra $2.50 if you want your name printed on the deed). Good luck trying to claim that land, though.

Lunar Resources: A 1979 treaty set out guidelines for managing the Moon's natural resources, though hardly anyone signed that agreement. That's not a problem for now, but it does present an extra layer of uncertainty on any future plans to colonize our nearest neighbor.

Moon Rocks: These might seem to be an obtainable way to own a bit of Earth's biggest satellite, but you'd be out of luck. NASA owns every bit of the 840 pounds of the stuff that Apollo astronauts brought back to Earth from 1969 to 1972. Scientists can request bits of lunar material to study, but it's illegal to own or sell

any of it. Those who can afford to buy a piece of space history, however, might get a tiny bit of Moon dust if they buy an object used by one of the Apollo astronauts.

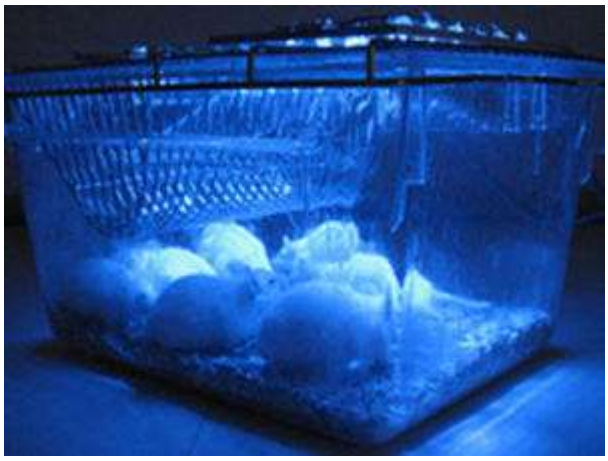
Meteorites: In the United States, meteorites belong to whoever owns the property where it lands (although that's not always straightforward), and then they can be sold or donated wherever the owner likes. Most meteorites originate in the solar system's Asteroid Belt, but some come from the Moon or Mars, making meteorites the easiest way to own a bit of those faraway places.

Stars: Stars and other astronomical objects have strict naming conventions overseen by the International Astronomical Union (which means that there's far less fun in these names than in naming critters and plants). That hasn't stopped any number of companies from selling stars, though. But, as the IAU notes, all you really get is "an expensive piece of paper and a temporary feeling of happiness, like if you take a cup of tea instead of the Doctor's recommended medicine."

Scientists have access to other bits of the universe, too, such as a sample of asteroid collected by the Japanese Haybusa mission or pieces of comet brought back by NASA's Stardust. But for the rest of us, we'll just have to make do with visiting a museum.

http://blogs.smithsonianmag.com/science/2011/05/a-quick-guide-to-owning-the-universe/

Genes at the Flick of a Light Switch: Human Cells Fitted With Synthetic Signaling Cascade



Under a blue light, biotechnologically modified cells implanted in mice produce proteins that could one day be used for treatment purposes. (Credit: ETH Zurich/Martin Fussenegger)

ScienceDaily (June 24, 2011) — Researchers from ETH Zurich have fitted human cells with a synthetic signaling cascade that can be used to switch on and regulate genes via blue light. This "gene light switch" makes interesting therapies possible, which could be used to treat type 2 diabetes, for instance.

The latest feat to come out of Martin Fussenegger's lab almost sounds like science fiction: the professor of biotechnology and bioengineering and his team have constructed a genetic network in living cells that can be used to switch on and regulate specific genes via blue light. However, rather than create the whole network the bioengineers have merely connected up natural signaling pathways -- one from the eye and one from the immune system. The cells are inserted under the skin, complete with the functioning gene network, and blue light is shone onto the implant from outside. This enables the researchers to control the target gene with extreme precision, reports first author Haifeng Ye from Fussenegger's team in the latest issue of Science.

The "gene light switch" the scientists use to switch on the network is made of melanopsin, a protein found in the retina of the human eye that forms a complex with Vitamin A. When blue light hits this complex, the first signaling cascade is activated, which ensures that calcium accumulates inside the cell -- a process that also takes place naturally in the eye and is responsible for setting the biological clock in the brain every day. However, the scientists have re-connected it -- to a signaling pathway that plays a key role in immunoregulation.

Light against winter blues

The calcium inside the cell activates an enzyme that separates the phosphate group (P) from the protein NFAT-P. NFAT thus enters the cell nucleus, where it binds to a synthetic control sequence and switches on the target gene the researchers have introduced. The gene becomes active and the cell produces numerous copies of the protein, for which the gene is the blueprint. By controlling the amount of light and its intensity, the researchers can also regulate how much of the protein is produced. Switching the gene off is easy: light off, gene off. After all, without light melanopsin is no longer stimulated, no more calcium accumulates in the cells and the signal cascade is interrupted.

This artificial signaling cascade is synthesised in human cells which, suitably parcelled, are implanted in mice. The blue light reaches the cell implants either via an ultra-thin glass fibre optic cable or, if the implant is placed directly under the skin, simply by placing the animals under a blue lamp. For the light source, the researchers used commercially available LEDs or a blue-light lamp that is used to combat winter depression. Since it does not contain a UV proportion, the light is not harmful for the skin.

Diabetes treatment conceivable

In their experiments with cell cultures and mice, the researchers tested the light-controlled production of GLP-1, a hormone that controls the production of insulin directly and thus regulates the blood glucose level. And it showed the researchers that their approach works: the GLP-1 that was upregulated using light helped diabetic mice to improve the organism's insulin production, quickly remove the glucose from the blood and restore the blood-sugar balance in the organism.

Martin Fussenegger can imagine the GLP-1 gene therapy his team has developed replacing the classical injection of insulin for diabetics one day. People suffering from type 2 diabetes, for instance, could have an implant placed under the skin as outpatients. A black plaster containing LED lamps shields the relevant area of the skin from the daylight. As and when needed, such as after a meal, for instance, the patient switches on the LED lamps by pushing a button and shines them on the implant for a few minutes to stimulate the production of GLP-1. As soon as enough of the hormone is circulating in the body, the patient simply switches the lamps back off. "That's still the stuff of science fiction, though," stresses the ETH Zurich professor; it will be quite some time before we see a product like this on the market.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **ETH Zürich**, via AlphaGalileo.

Journal Reference:

1. Haifeng Ye, Marie Daoud-El Baba, Ren-Wang Peng, Martin Fussenegger. **A Synthetic Optogenetic Transcription Device Enhances Blood-Glucose Homeostasis in Mice**. *Science*, 2011; 332 (6037): 1565-1568 DOI: 10.1126/science.1203535

http://www.sciencedaily.com/releases/2011/06/110623141200.htm

Sun and Planets Constructed Differently Than Thought, NASA Mission Suggests

Artist rendering of the Genesis spacecraft during collection phase of mission. (Credit: NASA/JPL-Caltech)

ScienceDaily (June 24, 2011) — Researchers analyzing samples returned by NASA's 2004 Genesis mission have discovered that our sun and its inner planets may have formed differently than previously thought. Data revealed differences between the sun and planets in oxygen and nitrogen, which are two of the most abundant elements in our solar system. Although the difference is slight, the implications could help determine how our solar system evolved.

"We found that Earth, the moon, as well as Martian and other meteorites which are samples of asteroids, have a lower concentration of the O-16 than does the sun," said Kevin McKeegan, a Genesis co-investigator from UCLA, and the lead author of one of two *Science* papers published this week. "The implication is that we did not form out of the same solar nebula materials that created the sun -- just how and why remains to be discovered."

The air on Earth contains three different kinds of oxygen atoms which are differentiated by the number of neutrons they contain. Nearly 100 percent of oxygen atoms in the solar system are composed of O-16, but there are also tiny amounts of more exotic oxygen isotopes called O-17 and O-18. Researchers studying the oxygen of Genesis samples found that the percentage of O-16 in the sun is slightly higher than on Earth or on other terrestrial planets. The other isotopes' percentages were slightly lower.

Another paper detailed differences between the sun and planets in the element nitrogen. Like oxygen, nitrogen has one isotope, N-14, that makes up nearly 100 percent of the atoms in the solar system, but there is also a tiny amount of N-15. Researchers studying the same samples saw that when compared to Earth's atmosphere, nitrogen in the sun and Jupiter has slightly more N-14, but 40 percent less N-15. Both the sun and Jupiter appear to have the same nitrogen composition. As is the case for oxygen, Earth and the rest of the inner solar system are very different in nitrogen.

"These findings show that all solar system objects including the terrestrial planets, meteorites and comets are anomalous compared to the initial composition of the nebula from which the solar system formed," said Bernard Marty, a Genesis co-investigator from Centre de Recherches Pétrographiques et Géochimiques and the lead author of the other new Science paper. "Understanding the cause of such a heterogeneity will impact our view on the formation of the solar system."

Data were obtained from analysis of samples Genesis collected from the solar wind, or material ejected from the outer portion of the sun. This material can be thought of as a fossil of our nebula because the preponderance of scientific evidence suggests that the outer layer of our sun has not changed measurably for billions of years.

"The sun houses more than 99 percent of the material currently in our solar system, so it's a good idea to get to know it better," said Genesis Principal Investigator Don Burnett of the California Institute of Technology, Pasadena, Calif. "While it was more challenging than expected, we have answered some important questions, and like all successful missions, generated plenty more."

Genesis launched in August 2000. The spacecraft traveled to Earth's L1 Lagrange Point about 1 million miles from Earth, where it remained for 886 days between 2001 and 2004, passively collecting solar-wind samples.

On Sept. 8, 2004, the spacecraft released a sample return capsule, which entered Earth's atmosphere. Although the capsule made a hard landing as a result of a failed parachute in the Utah Test and Training Range in Dugway, Utah, it marked NASA's first sample return since the final Apollo lunar mission in 1972, and the first material collected beyond the moon. NASA's Johnson Space Center in Houston curates the samples and supports analysis and sample allocation.
The Jet Propulsion Laboratory, Pasadena, Calif., managed the Genesis mission for NASA's Science Mission Directorate, Washington. The Genesis mission was part of the Discovery Program managed at NASA's Marshall Space Flight Center in Huntsville, Ala. Lockheed Martin Space Systems, Denver, developed and operated the spacecraft. Analysis at the Centre de Recherches Pétrographiques et Géochimiques, Nancy, France, was supported by the Centre National d'Etudes Spatiales, Paris, and the Centre National de la Recherche Scientifique, Paris, France.
For more information on the Genesis mission, visit: http://genesismission.jpl.nasa.gov .

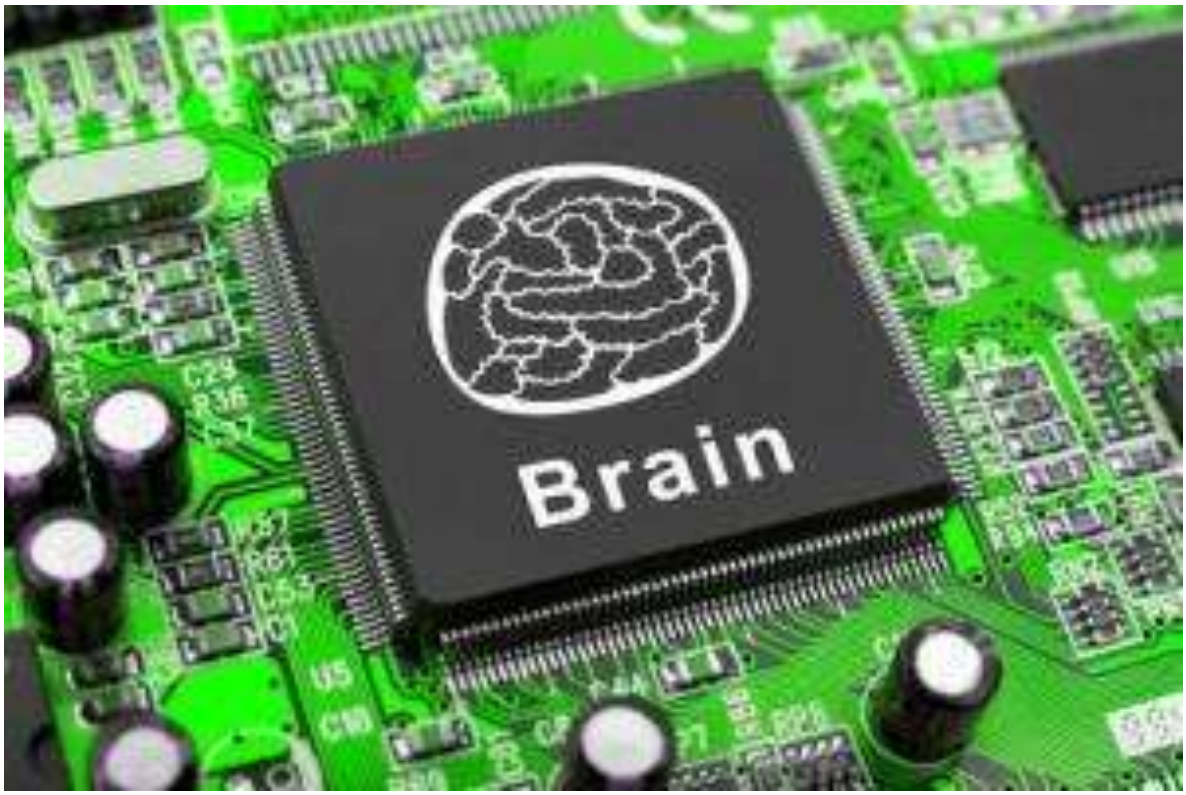
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NASA/Jet Propulsion Laboratory**.

Journal References:

1. K. D. McKeegan, A. P. A. Kallio, V. S. Heber, G. Jarzebinski, P. H. Mao, C. D. Coath, T. Kunihiro, R. C. Wiens, J. E. Nordholt, R. W. Moses, Jr., D. B. Reisenfeld, A. J. G. Jurewicz, D. S. Burnett. **The Oxygen Isotopic Composition of the Sun Inferred from Captured Solar Wind**. *Science*, 2011; 332 (6037): 1528-1532 DOI: 10.1126/science.1204636
2. B. Marty, M. Chaussidon, R. C. Wiens, A. J. G. Jurewicz, D. S. Burnett. **A ^{15}N-Poor Isotopic Composition for the Solar System As Shown by Genesis Solar Wind Samples**. *Science*, 2011; 332 (6037): 1533-1536 DOI: 10.1126/science.1204656

http://www.sciencedaily.com/releases/2011/06/110623145430.htm

Brain-Like Computing a Step Closer to Reality



Artist's concept. Researchers have demonstrated simultaneous information processing and storage using phase-change materials. This new technique could revolutionize computing by making computers faster and more energy-efficient, as well as making them more closely resemble biological systems. (Credit: © Nikolai Sorokin / Fotolia)

ScienceDaily (June 24, 2011) — The development of 'brain-like' computers has taken a major step forward with the publication of research led by the University of Exeter.

Published in the journal *Advanced Materials*, the study involved the first ever demonstration of simultaneous information processing and storage using phase-change materials. This new technique could revolutionize computing by making computers faster and more energy-efficient, as well as making them more closely resemble biological systems.

Computers currently deal with processing and memory separately, resulting in a speed and power 'bottleneck' caused by the need to continually move data around. This is totally unlike anything in biology, for example in human brains, where no real distinction is made between memory and computation. To perform these two functions simultaneously the University of Exeter research team used phase-change materials, a kind of semi-conductor that exhibits remarkable properties.

Their study demonstrates conclusively that phase-change materials can store and process information simultaneously. It also shows experimentally for the first time that they can perform general-purpose computing operations, such as addition, subtraction, multiplication and division. More strikingly perhaps it shows that phase-change materials can be used to make artificial neurons and synapses. This means that an artificial system made entirely from phase-change devices could potentially learn and process information in a similar way to our own brains.

Lead author Professor David Wright of the University of Exeter said: "Our findings have major implications for the development of entirely new forms of computing, including 'brain-like' computers. We have uncovered a technique for potentially developing new forms of 'brain-like' computer systems that could learn, adapt and change over time. This is something that researchers have been striving for over many years."

This study focused on the performance of a single phase-change cell. The next stage in Exeter's research will be to build systems of interconnected cells that can learn to perform simple tasks, such as identification of certain objects and patterns.
This research was funded by the Engineering and Physical Sciences Research Council.

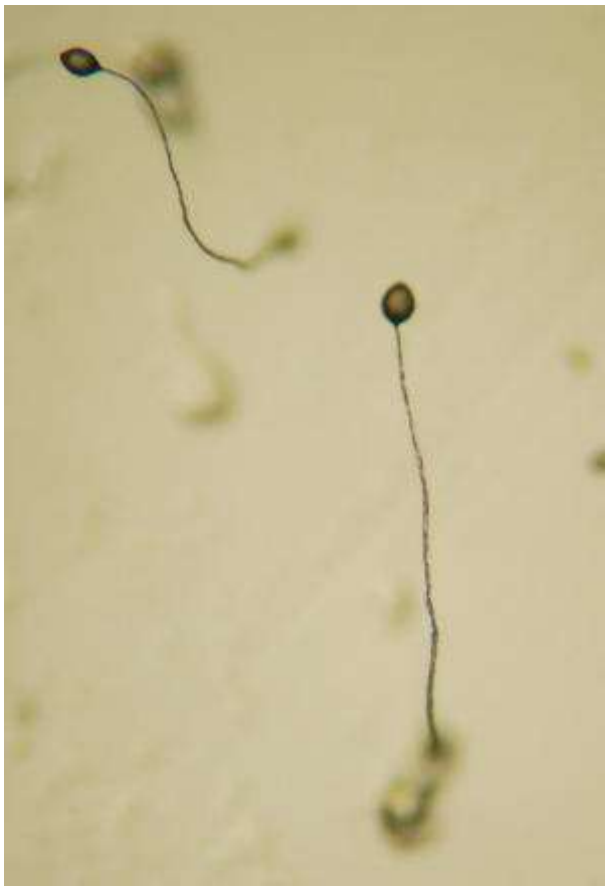
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Exeter**.

Journal Reference:

1. C. David Wright, Yanwei Liu, Krisztian I. Kohary, Mustafa M. Aziz, Robert J. Hicken. **Arithmetic and Biologically-Inspired Computing Using Phase-Change Materials**. *Advanced Materials*, 2011; DOI: 10.1002/adma.201101060

http://www.sciencedaily.com/releases/2011/06/110623130736.htm

Social Amoebae Rely On Genetic 'Lock and Key' to Identify Kin



Dictyostelium fruiting bodies. (Credit: Bruno in Columbus, via Wikimedia Commons, public domain)

ScienceDaily (June 24, 2011) — The ability to identify self and non-self enables cells in more sophisticated animals to ward off invading infections, but it is critical to even simpler organisms such as the social amoebae *Dictyostelium discoideum*.

Dictyostelium exists as a single cell when times are good, but when starved, the cells aggregate and become multi-cellular fruiting bodies with a dead stalk and live spores that allow the cells to survive and pass on genes. When the social amoeba aggregates, it prefers to do so with "kin," the cells that are genetically most like it.

Now researchers at Baylor College of Medicine have identified the genetic "lock and key" that enable the amoeba to tell kin from non-kin. A report on their work appears online in *Science* Express.

"We hypothesized that the molecules that enable these cells to tell kin from non-kin would have properties similar to those of membrane-spanning proteins that contain immunoglobulin folds (such proteins are involved in immunity in mammals)," said Dr. Gad Shaulsky, professor of molecular and human genetics and a corresponding author on the report. "One property is that part of the molecule goes through the membrane and protrudes from the cells. It's an extracellular cue."

Just as the uniforms of armies enable soldiers to differentiate foe from friend, these amoebae use the protruding proteins as a kind of flag. In this case, the flag that protruded differs among strains of the *Dictyostelium*. These differences are critical to the kin/non-kin discrimination.

They identified "suspect proteins" called TgrB1 and TgrC1 that met all their criteria. It was reminiscent of the major histocompatibility complex (MHC) that is part of the immune systems in higher organisms. TgrB1 and TgrC1 were proteins that protruded on the outside of the membrane of the *Dictyostelium* cells.

"Our hypothesis was that TgrB1 on the membrane of one cell recognizes TgrC1 on the membrane of another," said Shaulsky. "The two cells stick together, and the proteins act like a lock and key. If your key matches my lock, you stay and we develop together. If your key does not match my lock, you cannot participate."
Shaulsky credits graduate student Dr. Rocio Benabentos in his laboratory and postdoctoral associate Dr. Shigenori Hirose in the laboratory of Dr. Adam Kuspa with doing much of the bench work in the report. Graduate student Hsing-I Ho in Shaulsky's laboratory also took part. Kuspa, professor of biochemistry and molecular biology, molecular and human genetics and pharmacology and vice president for research at BCM, is also a corresponding author on this report.
In a complicated series of experiments, they removed or added TgrB1 and TgrC1 together or one by one. The result was the same. If the TgrB1 on one cell came from the same strain as the TgrC1 on the other, the cells could cooperate. If either one of the protein or both were from foreign strains, they could not aggregate with cells that had proteins from the original strain they studied.
No matter how they modified TgrB1 and TgrC1 proteins in *Dictyostelium*, those proteins remain key to determining kin/non-kin.
To prove that the TgrB1/TgrC1 complex was truly a lock and key and not related to some process within the cell itself, they replaced only one of the proteins, producing a strain that had a normal TgrB1 protein and a foreign TgrC1 protein.
"It's as though you had a blue lock and a blue key and a yellow lock and a yellow key," said Shaulsky. "If one cell has the blue lock and the other the blue key, then they can cooperate. They see each other as kin. However if one cells has a blue key and the other a yellow lock, it will not work.
To determine if the cells are actually adhering to one another, they marked one population green and the other red. They separated them into single cells and then incubated the cells together. The cells that had the same TgrB1 and TgrC1 stuck together into red-green aggregates. Those in which the proteins were different separated into red and green populations.
"As long as they have a shared lock and key set, then they can aggregate," said Shaulsky. "This is the first demonstration in a unicellular organism that immunoglobulin-like molecules are participating in self/non-self discrimination."
The molecules involved in the social amoebae are different from those seen in immunity in higher organisms, but the principle remains.
"What it says is that during evolution, there must have been several independent cases where self-recognition evolved and it always used the same concept -- a membrane protein that has immunoglobulin folds outside the cells and is polymorphic (looks different in different strains of the bacteria)," he said.
"By revealing the molecular basis of self-recognition, this study elegantly exemplifies the value of single-celled model organisms in uncovering a fundamental biological phenomenon," said Stefan Maas, Ph.D., who oversees Dr. Shaulsky's and other cell signaling grants at the National Institutes of Health. "These findings provide novel insights into the biology and evolution of complex cellular behaviors for which there are many parallels in multi-cellular organisms with implications for human health."
Funding for this work came from the National Institutes of Health, a National Research Service Award from the National Institute of General Medical Sciences and the National Science Foundation.

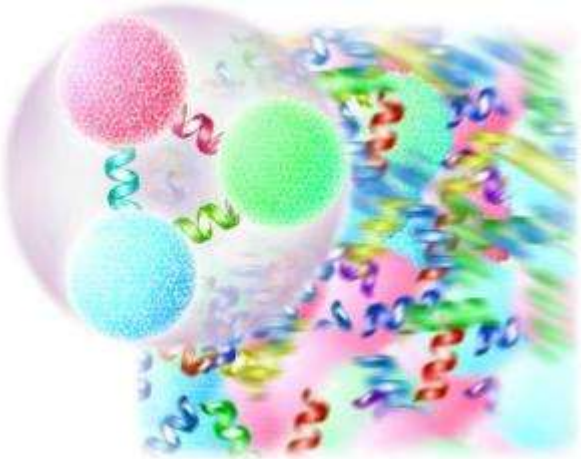
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Baylor College of Medicine**.

Journal Reference:

1. Shigenori Hirose, Rocio Benabentos, Hsing-I Ho, Adam Kuspa, Gad Shaulsky. **Self-Recognition in Social Amoebae Is Mediated by Allelic Pairs of Tiger Genes**. *Science*, June 23, 2011 DOI: 10.1126/science.1203903

http://www.sciencedaily.com/releases/2011/06/110623141314.htm

When Matter Melts: Scientists Map Phase Changes in Quark-Gluon Plasma



An ordinary proton or neutron (foreground) is formed of three quarks bound together by gluons, carriers of the color force. Above a critical temperature, protons and neutrons and other forms of hadronic matter "melt" into a hot, dense soup of free quarks and gluons (background), the quark-gluon plasma. (Credit: Lawrence Berkeley National Laboratory)

ScienceDaily (June 24, 2011) — In its infancy, when the universe was a few millionths of a second old, the elemental constituents of matter moved freely in a hot, dense soup of quarks and gluons. As the universe expanded, this quark-gluon plasma quickly cooled, and protons and neutrons and other forms of normal matter "froze out": the quarks became bound together by the exchange of gluons, the carriers of the color force.

"The theory that describes the color force is called quantum chromodynamics, or QCD," says Nu Xu of the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab), the spokesperson for the STAR experiment at the Relativistic Heavy Ion Collider (RHIC) at DOE's Brookhaven National Laboratory. "QCD has been extremely successful at explaining interactions of quarks and gluons at short distances, such as high-energy proton and antiproton collisions at Fermi National Accelerator Laboratory. But in bulk collections of matter -- including the quark-gluon plasma -- at longer distances or smaller momentum transfer, an approach called lattice gauge theory has to be used."

Until recently, lattice QCD calculations of hot, dense, bulk matter could not be tested against experiment. Beginning in 2000, however, RHIC was able to recreate the extreme conditions of the early universe in miniature, by colliding massive gold nuclei (heavy ions) at high energies.

Experimentalists at RHIC, working with theorist Sourendu Gupta of India's Tata Institute of Fundamental Research, have recently compared lattice-theory predictions about the nature of the quark-gluon plasma with certain STAR experimental results for the first time. In so doing they have established the temperature boundary where ordinary matter and quark matter cross over and change phase. Their results appear in the journal *Science*.

Phase diagrams

The aim of both the theoretical and experimental work is to explore and fix key points in the phase diagram for quantum chromodynamics. Phase diagrams are maps, showing, for example, how changes in pressure and temperature determine the phases of water, whether ice, liquid, or vapor. A phase diagram of QCD would map the distribution of ordinary matter (known as hadronic matter), the quark-gluon plasma, and other possible phases of QCD such as color superconductivity.

"Plotting a QCD phase diagram requires both theory calculations and experimental effort with heavy-ion collisions," says Xu, who is a member of Berkeley Lab's Nuclear Science Division and an author of the *Science* paper. Experimental studies require powerful accelerators like RHIC on Long Island or the Large

Hadron Collider at CERN in Geneva, while calculations of QCD using lattice gauge theory require the world's biggest and fastest supercomputers. Direct comparisons can achieve more than either approach alone.
One of the basic requirements of any phase diagram is to establish its scale. A phase diagram of water might be based on the Celsius temperature scale, defined by the boiling point of water under normal pressure (i.e., at sea level). Although the boiling point changes with pressure -- at higher altitudes water boils at lower temperatures -- these changes are measured against a fixed value.
The scale of the QCD phase diagram is defined by a transition temperature at the zero value of "baryon chemical potential." Baryon chemical potential measures the imbalance between matter and antimatter, and zero indicates perfect balance.
Through extensive calculations and actual data from the STAR experiment, the team was indeed able to establish the QCD transition temperature. Before they could do so, however, they first had to realize an equally significant result, showing that the highly dynamical systems of RHIC's gold-gold collisions, in which the quark-gluon plasma winks in and out of existence, in fact achieve thermal equilibrium. Here's where theory and experiment worked hand in hand.
"The fireballs that result when gold nuclei collide are all different, highly dynamic, and last an extremely short time," says Hans Georg Ritter, head of the Relativistic Nuclear Collisions program in Berkeley Lab's Nuclear Science Division and an author of the *Science* paper. Yet because differences in values of the kind observed by STAR are related to fluctuations in thermodynamic values predicted by lattice gauge theory, says Ritter, "by comparing our results to the predictions of theory, we have shown that what we measure is in fact consistent with the fireballs reaching thermal equilibrium. This is an important achievement."
The scientists were now able to proceed with confidence in establishing the scale of the QCD phase diagram. After a careful comparison between experimental data and the results from the lattice gauge theory calculations, the scientists concluded that the transition temperature (expressed in units of energy) is 175 MeV (175 million electron volts).
Thus the team could develop a "conjectural" phase diagram that showed the boundary between the low-temperature hadronic phase of ordinary matter and the high-temperature quark-gluon phase.

In search of the critical point

Lattice QCD also predicts the existence of a "critical point." In a QCD phase diagram the critical point marks the end of a line showing where the two phases cross over, one into the other. By changing the energy, for example, the baryon chemical potential (balance of matter and antimatter) can be adjusted.
Among the world's heavy-ion colliders, only RHIC can tune the energy of the collisions through the region of the QCD phase diagram where the critical point is most likely to be found -- from an energy of 200 billion electrons volts per pair of nucleons (protons or neutrons) down to 5 billion electron volts per nucleon pair.
Says Ritter, "Establishing the existence of a QCD critical point would be much more significant than setting the scale." In 2010, RHIC started a program to search for the QCD critical point.
Xu says, "In this paper, we compared experimental data with lattice calculations directly, something never done before. This is a real step forward and allows us to establish the scale of the QCD phase diagram. Thus begins an era of precision measurements for heavy-ion physics."

Story Source:

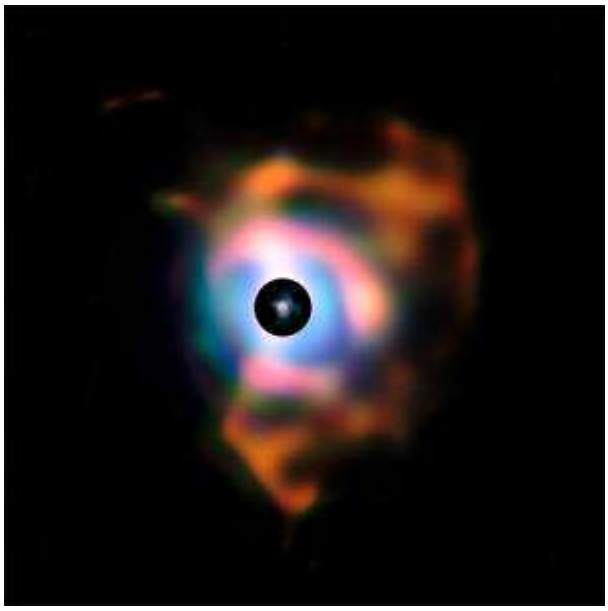
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Lawrence Berkeley National Laboratory**.

Journal Reference:

1. Sourendu Gupta, Xiaofeng Luo, Bedangadas Mohanty, Hans Georg Ritter and Nu Xu. **Scale for the phase diagram of quantum chromodynamics**. *Science*, 24 June 2011 DOI: 10.1126/science.1204621

http://www.sciencedaily.com/releases/2011/06/110623141318.htm

Flames of Betelgeuse: New Image Reveals Vast Nebula Around Famous Supergiant Star



This picture of the dramatic nebula around the bright red supergiant star Betelgeuse was created from images taken with the VISIR infrared camera on ESO's Very Large Telescope (VLT). This structure, resembling flames emanating from the star, forms because the behemoth is shedding its material into space. The earlier NACO observations of the plumes are reproduced in the central disc. The small red circle in the middle has a diameter about four and half times that of the Earth's orbit and represents the location of Betelgeuse's visible surface. The black disc corresponds to a very bright part of the image that was masked to allow the fainter nebula to be seen. (Credit: ESO/P. Kervella)

ScienceDaily (June 23, 2011) — Using the VISIR instrument on the European Southern Observatory's Very Large Telescope (VLT), astronomers have imaged a complex and bright nebula around the supergiant star Betelgeuse in greater detail than ever before. This structure, which resembles flames emanating from the star, is formed as the behemoth sheds its material into space.

Betelgeuse, a red supergiant in the constellation of Orion, is one of the brightest stars in the night sky. It is also one of the biggest, being almost the size of the orbit of Jupiter -- about four and half times the diameter of Earth's orbit. The VLT image shows the surrounding nebula, which is much bigger than the supergiant itself, stretching 60 billion kilometres away from the star's surface -- about 400 times the distance of Earth from the Sun.

Red supergiants like Betelgeuse represent one of the last stages in the life of a massive star. In this short-lived phase, the star increases in size, and expels material into space at a tremendous rate -- it sheds immense quantities of material (about the mass of the Sun) in just 10,000 years.

The process by which material is shed from a star like Betelgeuse involves two phenomena. The first is the formation of huge plumes of gas (although much smaller than the nebula now imaged) extending into space from the star's surface, previously detected using the NACO instrument on the VLT [1]. The other, which is behind the ejection of the plumes, is the vigorous up and down movement of giant bubbles in Betelgeuse's atmosphere -- like boiling water circulating in a pot.

The new results show that the plumes seen close to the star are probably connected to structures in the outer nebula now imaged in the infrared with VISIR. The nebula cannot be seen in visible light, as the very bright Betelgeuse completely outshines it. The irregular, asymmetric shape of the material indicates that the star did not eject its material in a symmetric way. The bubbles of stellar material and the giant plumes they originate may be responsible for the clumpy look of the nebula.

The material visible in the new image is most likely made of silicate and alumina dust. This is the same material that forms most of the crust of Earth and other rocky planets. At some time in the distant past, the silicates of Earth were formed by a massive (and now extinct) star similar to Betelgeuse.
In this composite image, the earlier NACO observations of the plumes are reproduced in the central disc. The small red circle in the middle has a diameter about four and half times that of Earth's orbit and represents the location of Betelgeuse's visible surface. The black disc corresponds to a very bright part of the image that was masked to allow the fainter nebula to be seen. The VISIR images were taken through infrared filters sensitive to radiation of different wavelengths, with blue corresponding to shorter wavelengths and red to longer. The field of view is 5.63 x 5.63 arcseconds.
This research was presented in a paper to appear in the journal *Astronomy & Astrophysics*.
The team is composed of P. Kervella (Observatoire de Paris, France), G. Perrin (Observatoire de Paris, France), A. Chiavassa (Universite Libre de Bruxelles, Belgium), S. T. Ridgway (National Optical Astronomy Observatories, Tucson, USA), J. Cami (University of Western Ontario,Canada; SETI Institute, Mountain View, USA), X. Haubois (Universidade de Sao Paulo, Brazil) and T. Verhoelst (Instituut voor Sterrenkunde, Leuven, Belgium).
Note:
[1] NACO is a VLT instrument that combines the Nasmyth Adaptive Optics System (NAOS) and the Near-infrared Imager and Spectrograph (CONICA). It provides adaptive optics assisted imaging, imaging polarimetry, coronography and spectroscopy, at near-infrared wavelengths.

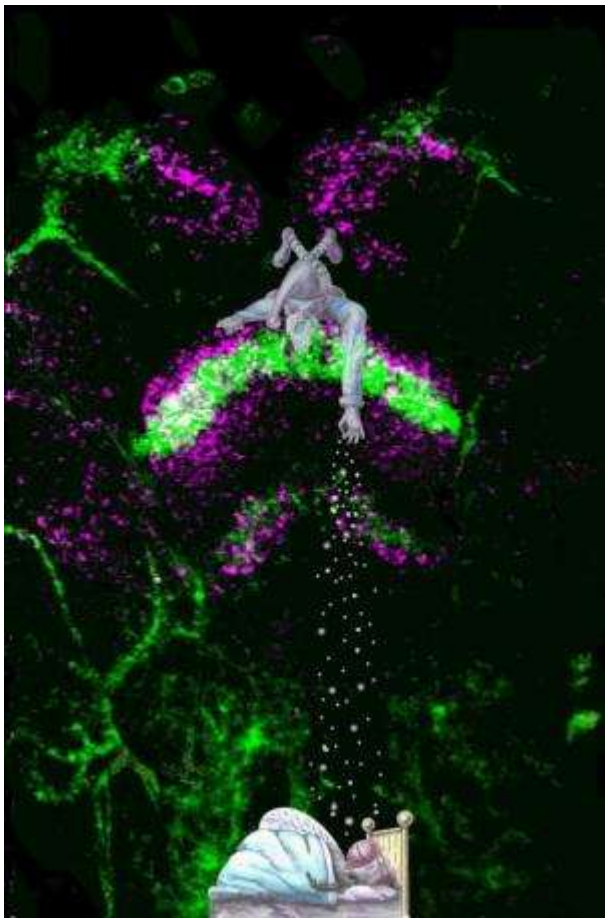
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **European Southern Observatory - ESO**, via AlphaGalileo.

Journal Reference:

1. P. Kervella, G. Perrin, A. Chiavassa, S. T. Ridgway, J. Cami, X. Haubois, T. Verhoelst. **The close circumstellar environment of Betelgeuse. II. Diffraction-limited spectro-imaging from 7.76 to 19.50 microns with VLT/VISIR**. *Astronomy & Astrophysics*, 2011; DOI: 10.1051/0004-6361/201116962

http://www.sciencedaily.com/releases/2011/06/110623085844.htm

Sleep Switch Found in Fruit Flies



Scientists have identified an area in the fruit fly brain (highlighted in green and pink, under the sandman illustration) with cells that can put flies to sleep. (Credit: Scott Loebl, Asa Winther, Cassandra Vandun)

ScienceDaily (June 23, 2011) — Rather than count sheep, drink warm milk or listen to soothing music, many insomniacs probably wish for a switch they could flick to put themselves to sleep.

Scientists at Washington University School of Medicine in St. Louis have discovered such a switch in the brains of fruit flies. In a study appearing June 24 in *Science,* the researchers show that a group of approximately 20 cells in the brains of fruit flies controls when and how long the flies sleep. Slumber induced through this sleep switch was essential to the creation of long-term memory, directly proving a connection between memory and sleep that scientists have long suspected.

"This is exciting because this induced sleep state so far appears to be very similar to spontaneous sleep," says Paul Shaw, PhD, associate professor of neurobiology. "That means we can manipulate these cells to explore a whole new realm of questions about the purposes of sleep. Such studies might one day lead us to more natural ways of inducing sleep in humans."

The key cells are found in an area of the fly brain known as the dorsal fan-shaped body. Scientists in Shaw's lab genetically modified the cells to increase their activity. One effect of making these cells more active was that adult flies slept for an additional seven hours a day.

When scientists added a gene that increases the cells' activity only at warmer temperatures, they could determine when and how long flies would sleep by simply adjusting the temperature in the flies' habitats.

To analyze the similarity of induced sleep to spontaneous sleep, scientists tested whether induced slumber was essential to the formation of long-term memories. In a process called courtship conditioning, male flies were exposed to other males genetically modified to make female sex pheromones.

"The subject fly will initiate courtship because of the female pheromones, but the modified male making those pheromones inevitably rejects him," says first author Jeff Donlea, PhD, now a postdoctoral research assistant at Oxford University. "This is an ecologically relevant way to test memory because a male fly in the wild needs to quickly assess whether a particular female is interested in mating so that he doesn't waste time making unproductive advances."

The researchers used a training protocol that normally only creates a memory that lasts a few hours in fruit flies. After being "rejected" multiple times over three hours, the fly learns not to make advances when he encounters the altered male again at a later time. But when scientists used the cells in the dorsal fan-shaped body to put the fly to sleep immediately after training, the fly formed a long-term memory of his experience that lasted for at least several days.

To rule out the possibility that the increased excitability of the cells could be directly responsible for the long-term memory, scientists activated the sleep-regulating cells following training but prevented the flies from sleeping. The flies did not remember the training, indicating that sleep itself was important for the consolidation of memory.

Scientists have yet to determine whether a counterpart for the dorsal fan-shaped body exists in human brains. Shaw's lab is currently working to see if the cells they singled out can be matched to other brain cell types based on the chemical messengers they produce.

Funding from the National Institutes of Health (NIH) supported this research.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Washington University School of Medicine**. The original article was written by Michael C. Purdy.

Journal Reference:

1. Jeffrey M. Donlea, Matthew S. Thimgan, Yasuko Suzuki, Laura Gottschalk, Paul J. Shaw. **Inducing Sleep by Remote Control Facilitates Memory Consolidation in Drosophila**. *Science*, 2011; 332 (6037): 1571-1576 DOI: 10.1126/science.1202249

http://www.sciencedaily.com/releases/2011/06/110623141325.htm

Modern Fish Communities Live Fast and Die Young

The Wildlife Conservation Society compared the remains of fish from ancient Swahili refuse heaps in Kenya with data from recently caught fish to understand how fish communities there have changed over time. The finding: fishing pressures have greatly reduced the percentage of longer-lived, slower growing species such as the lined surgeonfish. (Credit: T. McClanahan/Wildlife Conservation Society)

ScienceDaily (June 23, 2011) — Fish communities in the 21st century live fast and die young. That's the main finding of a recent study by researchers from the Wildlife Conservation Society who compared fish recently caught in coastal Kenya with the bones of fish contained in ancient Swahili refuse heaps in order to understand how to rebuild the current fisheries.

Of course, modern fish communities are not victims of reckless living, but of overfishing which has caused an ecosystem-level transition that may not be easily reversible, according to the study. Over the centuries, human fishing has greatly reduced or eliminated larger and longer-lived species that were more commonly caught in the Middle Ages. The remaining fish communities today contain more species with shorter life spans, faster growth rates, smaller average sizes, and fewer top predators.

The study -- which utilized more than 5,475 samples of ancient fish remains dating between 1250 and 600 years before the present (approximately AD 750 -- 1400) -- appears in the current online edition of the journal *Conservation Biology*. The authors are Tim R. McClanahan and Johnstone O. Omukoto of the Wildlife Conservation Society.

"The ancient Swahili middens represent a time capsule of data, containing information on the composition of the region's fish assemblages and how human communities influenced the marine environment," said McClanahan, WCS Senior Conservationist and head of the WCS's coral reef research and conservation program. "The historical data suggest that fishing removes the slower-growing, longer-lived species over time and that marine protected areas are only partially successful in recovering the fish communities of the past."

Seeking to examine how fish populations are impacted by increasing fishing pressure over time, McClanahan and Omukoto compared data on the life histories of modern fish communities (gathered from fish caught in both heavily fished sites and protected closures on the Kenyan coast) with data gathered from fish remains excavated from an ancient Swahili settlement located in Shanga, Kenya. Spanning some 650 years, the refuse heaps provided the researchers with valuable insights into how fish assemblages and fishing pressures changed during that time span.

The researchers discovered that the life histories of fish caught by modern fisheries and the remains of ancient fish assemblages were significantly different. Whereas ancient fish communities had a high percentage of top predators -- species that prey on fish and large invertebrates such as snails, sea urchins, and clams -- modern

fish communities contain more species that feed on plants, small invertebrates like sea lice, generally smaller species that feed lower on the food chain. Modern fish assemblages also contain more species that are smaller in size with higher growth and mortality rates.
The researchers also found that the number of fish bones in the middens peaked between AD 1000-1100 (approximately 1000-900 BP) before declining, while the bones of sheep and goats become more prevalent in the higher levels of substrate, suggesting a shift in human diet to domesticated animals.
"The archeological evidence demonstrates the incredible longevity of humanity's utilization of coastal fisheries, while emphasizing the critical need to actively manage slower growing, longer-lived species within an ecosystem approach," said Dr. Caleb McClennen, Director of WCS's Marine Program. "The evidence from Kenya aligns with findings from around the world that for millennia humanity has relied on the world's oceans for our basic needs -- but has more recently failed to do so in a manner that also will sufficiently sustain that resource."
From Fiji to Kenya to Glover's Reef, Dr. McClanahan's research has been examining the ecology, fisheries, climate change effects, and management of coral reefs at key sites throughout the world. This work has been supported by the John D. and Catherine T. MacArthur Foundation and The Tiffany & Co. Foundation.

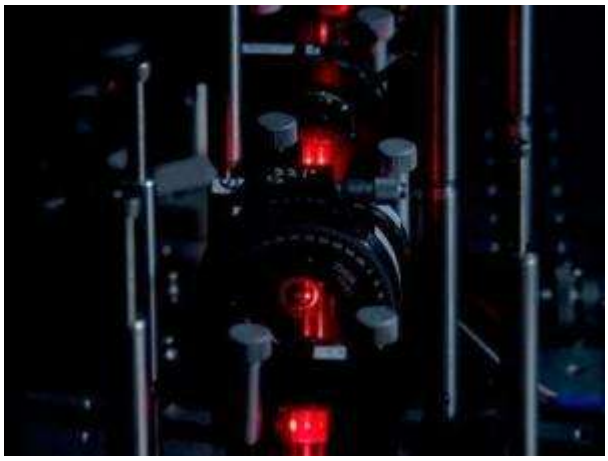
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Wildlife Conservation Society**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Timothy R. McClanahan, Johnstone O. Omukoto. **Comparison of Modern and Historical Fish Catches (AD 750-1400) to Inform Goals for Marine Protected Areas and Sustainable Fisheries**. *Conservation Biology*, 2011; DOI: 10.1111/j.1523-1739.2011.01694.x

http://www.sciencedaily.com/releases/2011/06/110623141329.htm

'Quantum Magic' Without Any 'Spooky Action at a Distance'



The central part of the optical setup used to demonstrate that even a system which does not allow entanglement exhibits features commonly attributed to this phenomenon. (Credit: IQOQI; Jacqueline Godany 2011)

ScienceDaily (June 25, 2011) — Quantum mechanical entanglement is at the heart of the famous quantum teleportation experiment and was referred to by Albert Einstein as "spooky action at a distance." A team of researchers led by Anton Zeilinger at the University of Vienna and the Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences used a system which does not allow for entanglement, and still found results which cannot be interpreted classically.

Their findings were published in the latest issue of the journal *Nature*.

Asher Peres, a pioneer of quantum information theory, once remarked jokingly in a letter to a colleague (Dagmar Bruß): Entanglement is a trick 'quantum magicians' use to produce phenomena that cannot be imitated by 'classical magicians'. When two particles are entangled, measurements performed on one of them immediately affect the other, no matter how far apart the particles are. What if, in an experiment, one considers a system that does not allow for entanglement? Will the quantum magicians still have an advantage over the classical magicians?

Quantum physics beyond magic

This is the question the team of quantum physicists led by Anton Zeilinger from the Faculty of Physics at the University of Vienna and from the IQOQI of the Austrian Academy of Sciences addressed in their experiment. The physicists used a "qutrit" -- a quantum system consisting of a single photon that can assume three distinguishable states. "We were able to demonstrate experimentally that quantum mechanical measurements cannot be interpreted in a classical way even when no entanglement is involved," Radek Lapkiewicz explains. The findings relate to the theoretical predictions by John Stewart Bell, Simon B. Kochen, and Ernst Specker.

Quantum world versus everyday life

Quantum physics is in stark contrast with what we perceive and experience in our everyday lives and what we understand as "classical physics." Let us, for example, examine a globe: from a given point of view we can only see one respective hemisphere at any given time. When spinning the globe once around its axis we are able to construct a meaningful and "true" picture of our planet assuming that the shape of the continents stays the same, even when we cannot see them.

Therefore, by means of our experience and the assumptions made in classical physics, we can assign certain properties to a system without actually observing it. This is no longer the case if one pictures a "quantum globe." Contrary to a globe where -- due to the assumptions of classical properties -- the various pieces fit together as they do in a puzzle, the pictures of the quantum globe do not fit together. Yet the pattern is not random: it is possible to predict by how much the individual parts will differ from each other after an observation.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Vienna**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Radek Lapkiewicz, Peizhe Li, Christoph Schaeff, Nathan K. Langford, Sven Ramelow, Marcin Wieśniak, Anton Zeilinger. **Experimental non-classicality of an indivisible quantum system**. *Nature*, 2011; 474 (7352): 490 DOI: 10.1038/nature10119

http://www.sciencedaily.com/releases/2011/06/110624111942.htm

Ancient Species of Mayfly Had Short, Tragic Life

This ancient mayfly, trapped 100 million years ago in amber, is a new species named Vetuformosa buckleyi. (Credit: Photo by George Poinar, Jr., courtesy of Oregon State University)

ScienceDaily (June 24, 2011) — About 100 million years ago, a tiny mayfly had a problem.

Like most adult mayflies, she only had that one day to live anyway, so there was no time to waste. She took her mating flight, got fertilized, and was about to lay her eggs when something went horribly wrong. She got stuck in some oozing tree sap and died, preserved for all time in the magic of amber. There would be ho hatchlings.

It was a pretty rude ending to what was already going to be a short adulthood. But her personal tragedy proved fortunate for scientists. The tiny specimen -- just described by an Oregon State University researcher as a new subfamily, genus and species of mayfly -- has helped to shed further light on the ecology of the distant past. And at least she didn't get eaten by a fish.

"Understanding the ecology and history of mayflies is important, in part because they are one of the most important fish foods in the world," said George Poinar, Jr., a professor of entomology at OSU and one of the world's leading experts in the use of amber to study ancient life forms.

"This is the first time we ever documented such long antennae and an ovipositor in this order of insects," Poinar said. "This species is now extinct. It probably had to lay its eggs on a certain type of substrate or habitat that disappeared, and the species disappeared with it. It's not good to be too specialized."

An ovipositor, Poinar said, is an egg-laying mechanism many insects use to place their eggs in a specific location, like inside plant tissue. No mayflies have ovipositors today.

Around the world, this group of insects is hugely important in stream biology. They furnish food for most stream predators, including fish.

They are also followed closely by fishermen, who create lures to resemble the latest mayfly hatch in streams and lakes. Many regions have charts to outline the expected hatch dates of particular mayfly species, which often fill the streams with flying insects and send fish into a feeding frenzy used to the advantage of astute anglers.

The life of a mayfly is odd. It lives in nymph form for about a year in freshwater, then emerges for only a single day as an adult to mate, lay eggs and then die.

"After their mating flight mayflies are usually dead by the end of the day," Poinar said. "There's only one thing they really care about on that one eventful day, and it's not eating. They don't even have functional mouth parts."

Clues learned from insect specimens such as this, researchers say, can provide invaluable insights into ancient ecosystems, what life forms existed, and how they may have interacted. Specimens can be preserved in near-perfect form when captured in tree sap that later becomes fossilized into amber, a semi-precious stone.

This particular fossil came from the Hukawng Valley of Burma, now known as Myanmar. It was formed between 97 and 110 million years ago. The findings of this study were published in *Historical Biology*, a professional journal.

"She was a very young female," Poinar said. "I named the genus Vetuformosa, which in Latin means old and beautifully formed."

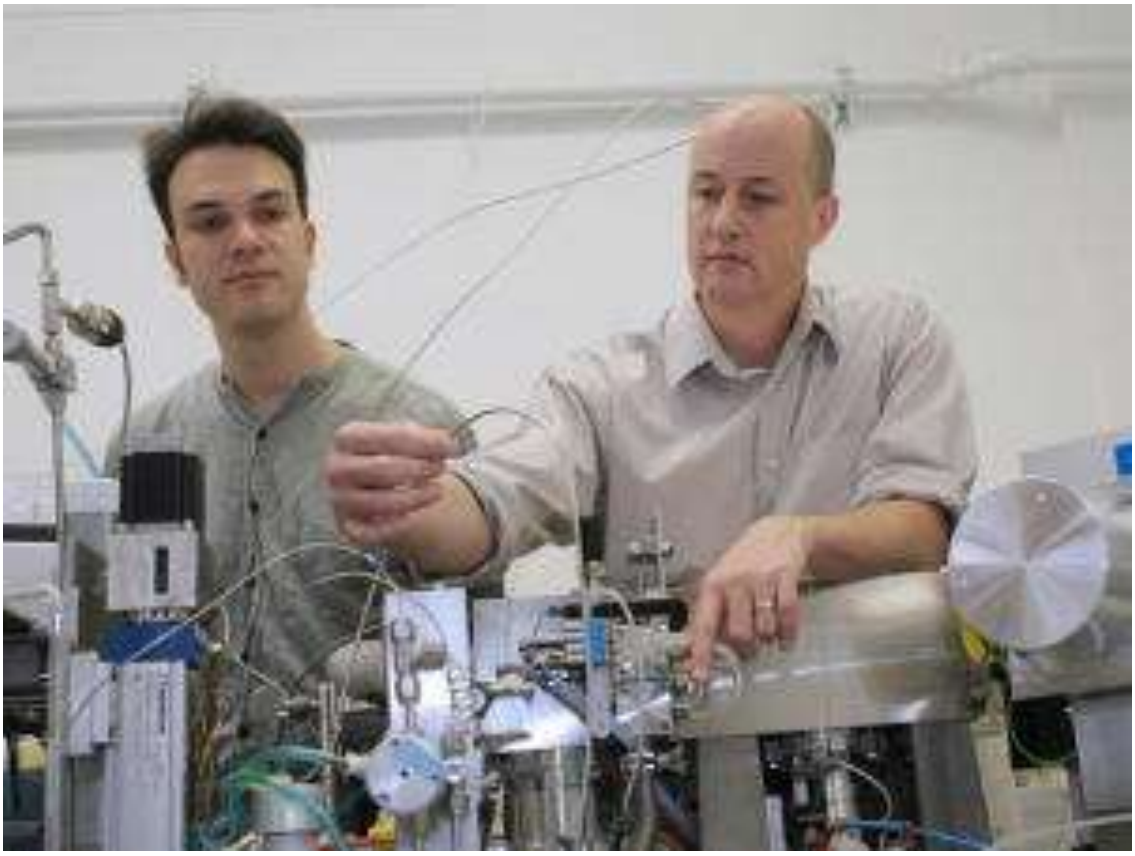
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Oregon State University**.

Journal Reference:

1. George Poinar. **Vetuformosa buckleyi n. gen., n. sp. (Ephemeroptera: Baetidae; Vetuformosinae n. subfam.), a new subfamily of mayflies in Early Cretaceous Burmese amber**. *Historical Biology*, 2011; DOI: 10.1080/08912963.2011.559084

http://www.sciencedaily.com/releases/2011/06/110624130034.htm

Body Temperatures of Dinosaurs Measured for First Time: Some Dinosaurs Were as Warm as Most Modern Mammals



Caltech geochemists Rob Eagle (left) and John Eiler adjust equipment used to analyze the isotopic concentrations in dinosaur teeth and reveal the body temperature of the extinct creatures. (Credit: Caltech / Lance Hayashida)

ScienceDaily (June 23, 2011) — Were dinosaurs slow and lumbering, or quick and agile? It depends largely on whether they were cold or warm blooded. When dinosaurs were first discovered in the mid-19th century, paleontologists thought they were plodding beasts that had to rely on their environments to keep warm, like modern-day reptiles. But research during the last few decades suggests that they were faster creatures, nimble like the velociraptors or *T. rex* depicted in the movie Jurassic Park, requiring warmer, regulated body temperatures like in mammals.

Now, a team of researchers led by the California Institute of Technology (Caltech) has developed a new approach to take body temperatures of dinosaurs for the first time, providing new insights into whether dinosaurs were cold or warm blooded. By analyzing isotopic concentrations in teeth of sauropods, the long-tailed, long-necked dinosaurs that were the biggest land animals to have ever lived -- think *Apatosaurus* (also known as *Brontosaurus*) -- the team found that the dinosaurs were about as warm as most modern mammals.

"This is like being able to stick a thermometer in an animal that has been extinct for 150 million years," says Robert Eagle, a postdoctoral scholar at Caltech and lead author on the paper to be published online in the June 23 issue of *Science* Express.

"The consensus was that no one would ever measure dinosaur body temperatures, that it's impossible to do," says John Eiler, a coauthor and the Robert P. Sharp Professor of Geology and professor of geochemistry. And yet, using a technique pioneered in Eiler's lab, the team did just that.

The researchers analyzed 11 teeth, dug up in Tanzania, Wyoming, and Oklahoma, that belonged to *Brachiosaurus* brancai and *Camarasaurus*. They found that the *Brachiosaurus* had a temperature of about 38.2 degrees Celsius (100.8 degrees Fahrenheit) and the Camarasaurus had one of about 35.7 degrees Celsius

(96.3 degrees Fahrenheit), warmer than modern and extinct crocodiles and alligators but cooler than birds. The measurements are accurate to within one or two degrees, Celsius.

"Nobody has used this approach to look at dinosaur body temperatures before, so our study provides a completely different angle on the longstanding debate about dinosaur physiology," Eagle says.

The fact that the temperatures were similar to those of most modern mammals might seem to imply that dinosaurs had a warm-blooded metabolism. But, the researchers say, the issue is more complex. Because large sauropod dinosaurs were so huge, they could retain their body heat much more efficiently than smaller mammals like humans. "If you're an animal that you can approximate as a sphere of meat the size of a room, you can't be cold unless you're dead," Eiler explains. So even if dinosaurs were "cold blooded" in the sense that they depended on their environments for heat, they would still have warm body temperatures.

"The body temperatures we've estimated now provide a key piece of data that any model of dinosaur physiology has to be able to explain," says Aradhna Tripati, a coauthor who's an assistant professor at UCLA and visiting researcher in geochemistry at Caltech. "As a result, the data can help scientists test physiological models to explain how these organisms lived."

The measured temperatures are lower than what's predicted by some models of body temperatures, suggesting there is something missing in scientists' understanding of dinosaur physiology. These models imply dinosaurs were so-called gigantotherms, that they maintained warm temperatures by their sheer size. To explain the lower temperatures, the researchers suggest that the dinosaurs could have had some physiological or behavioral adaptations that allowed them to avoid getting too hot. The dinosaurs could have had lower metabolic rates to reduce the amount of internal heat, particularly as large adults. They could also have had something like an air-sac system to dissipate heat. Alternatively, they could have dispelled heat through their long necks and tails.

Previously, researchers have only been able to use indirect ways to gauge dinosaur metabolism or body temperatures. For example, they infer dinosaur behavior and physiology by figuring out how fast they ran based on the spacing of dinosaur tracks, studying the ratio of predators to prey in the fossil record, or measuring the growth rates of bone. But these various lines of evidence were often in conflict. "For any position you take, you can easily find counterexamples," Eiler says. "How an organism budgets the energy supply that it gets from food and creates and stores the energy in its muscles -- there are no fossil remains for that," he says. "So you just sort of have to make your best guess based on indirect arguments."

But Eagle, Eiler, and their colleagues have developed a so-called clumped-isotope technique that shows that it is possible to take body temperatures of dinosaurs -- and there's no guessing involved. "We're getting at body temperature through a line of reasoning that I think is relatively bullet proof, provided you can find well-preserved samples," Eiler says. In this method, the researchers measure the concentrations of the rare isotopes carbon-13 and oxygen-18 in bioapatite, a mineral found in teeth and bone. How often these isotopes bond with each other -- or "clump" -- depends on temperature. The lower the temperature, the more carbon-13 and oxygen-18 tend to bond in bioapatite. So measuring the clumping of these isotopes is a direct way to determine the temperature of the environment in which the mineral formed -- in this case, inside the dinosaur.

"What we're doing is special in that it's thermodynamically based," Eiler explains. "Thermodynamics, like the laws of gravity, is independent of setting, time, and context." Because thermodynamics worked the same way 150 million years ago as it does today, measuring isotope clumping is a robust technique.

Identifying the most well-preserved samples of dinosaur teeth was one of the major challenges of the analysis, the researchers say, and they used several ways to find the best samples. For example, they compared the isotopic compositions of resistant parts of teeth -- the enamel -- with easily altered materials -- dentin and fossil bones of related animals. Well-preserved enamel would preserve both physiologically possible temperatures and be isotopically distinct from dentin and bone.

The next step is to take temperatures of more dinosaur samples and extend the study to other species of extinct vertebrates, the researchers say. In particular, taking the temperature of unusually small and young dinosaurs would help test whether dinosaurs were indeed gigantotherms. Knowing the body temperatures of more dinosaurs and other extinct animals would also allow scientists to learn more about how the physiology of modern mammals and birds evolved.

In addition to Eagle, Eiler, and Tripati, the other authors are Thomas Tütken from the University of Bonn, Germany; Caltech undergraduate Taylor Martin; Henry Fricke from Colorado College; Melissa Connely from

the Tate Geological Museum in Casper, Wyoming; and Richard Cifelli from the University of Oklahoma. Eagle also has a research affiliation with UCLA.
This research was supported by the National Science Foundation and the German Research Foundation.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **California Institute of Technology**. The original article was written by Marcus Woo.

Journal Reference:

1. Robert A. Eagle, Thomas Tütken, Taylor S. Martin, Aradhna K. Tripati, Henry C. Fricke, Melissa Connely, Richard L. Cifelli, John M. Eiler. **Dinosaur Body Temperatures Determined from Isotopic (^{13}C-^{18}O) Ordering in Fossil Biominerals**. *Science*, 2011; DOI: 10.1126/science.1206196

http://www.sciencedaily.com/releases/2011/06/110623141312.htm

Speed of Brain Signals Clocked: New Studies Illuminate Brain's Complex Neurotransmission Machinery

Artist's rendering of neurons. Researchers have uncovered surprising details about the complex process that leads to the flow of neurotransmitters between brain neurons -- a dance of chemical messages so delicate that missteps often lead to neurological dysfunction. (Credit: © nobeastsofierce / Fotolia)

ScienceDaily (June 23, 2011) — Two studies featuring research from Weill Cornell Medical College have uncovered surprising details about the complex process that leads to the flow of neurotransmitters between brain neurons -- a dance of chemical messages so delicate that missteps often lead to neurological dysfunction.

A recent *Nature Neuroscience* study led by Dr. Timothy Ryan, professor of biochemistry at Weill Cornell Medical College, demonstrates that individual neurons somehow control the speed by which they recycle synaptic vesicles that store neurotransmitters before they are released. No one had expected that neurons would have such a powerful "gas pedal," says Dr. Ryan.

Dr. Ryan is also contributing author of a second, Yale University-led study published June 22 in the online edition of *Neuron*. It shows that the common understanding about how proteins help form these key storage vesicles is flawed.

The two findings help refine science's understanding of the biomechanics that control neurotransmission at the synaptic gap between brain neurons, Dr. Ryan says.

"We are looking under the hood of these machines for the first time," he says. "Many neurological diseases such as Alzheimer's disease, Parkinson's disease, schizophrenia and other neurodegenerative and psychiatric disorders are considered to be synaptopathies -- pathologies of synaptic function. So repairing them will require that we understand how they work."

Both studies focus on synaptic vesicles, which are bubble-like structures that store neurotransmitters within a bi-layer of fatty membranes at the synaptic junction.

Scientists know that in order to deliver neurotransmitter messages between cells, the synaptic vesicle merges with the surface of the brain cell at the synapse and releases the message. Then these synaptic vesicles, which are in limited supply, must be retrieved, rebuilt and refilled with neurotransmitters, Dr. Ryan says. "Failure to

do so would result in the synapse running out of vesicles rather quickly, and proper neurotransmitter function depends on their continuous availability."

Measuring Neuronal Speed

The Nature Neuroscience study was designed to look at what controlled the speed of the vesicle recovery process. This speed, which dictates the availability of vesicles, has long been considered to be one of the limits as to how fast neurons can continuously communicate, especially in high-demand situations, Dr. Ryan says.

To study the speed of this recovery process, senior author Dr. Ryan and first author Moritz Armbruster, a Rockefeller University graduate student who worked in Dr. Ryan's laboratory, used a tool that took optical recordings of the speed of vesicle recycling across 84 different neurons.

They discovered something quite unexpected -- an individual neuron retrieves all of its synaptic vesicles at pretty much the same speed. "It is as if the neuron is following orders from a cell-wide central gas pedal," Dr. Ryan says. They also found that while each cell had its own speed at recovering the vesicles, that rate varied four-fold across the different neurons -- even if the neurons were performing identical functions, such as secreting the same neurotransmitter.

"When we compared different neurons, we found that each cell is telling its synapses to go at its own speed," he says. "The mystery that remains is the nature of this gas pedal, and if it might be important in therapeutic approaches to tackling synaptopathies."

Debunking the Dynamin Theory of Synaptic Recovery

The *Neuron* study looked at proteins involved in one phase of the recovery process, the separating and pinching off of the membrane of the synaptic vesicle from the membrane of the neuronal cell. It was led by Dr. Pietro De Camilli, a professor of cell biology and neurobiology at Yale University and a Howard Hughes Medical Institute investigator, and his colleague Dr. Shawn Ferguson, currently an assistant professor of cell biology also at Yale.

Based on studies in the 1980s, researchers had believed that a protein called dynamin, which comes in three forms (1, 2 and 3), was critical to this "membrane fission" step in the formation of vesicles.

In 2007, the Yale researchers tested whether dynamin 1, which represents 90 percent of all dynamin in the brain, was, as believed, the key protein involved in synaptic vesicle membrane fission. They generated a mouse that lacked the protein but found it produced only subtle differences in the fission process. This surprising discovery was published in Science.

In the new study, the research team, which included Drs. Ryan, Mr. Armbruster and others, looked at what happened when both dynamin 1 and dynamin 3, which makes up 99 percent of dynamin protein, are missing. They used the same optical methods employed in the Nature Neuroscience study to examine the speed of the synaptic vesicle retrieval process.

"Our studies showed that retrieval is now severely impaired when you have neither dynamin 1 nor dynamin 3, which shows us that dynamin 3 has a major presynaptic function," Dr. Ryan says. "Remarkably, however, the retrieval process still happens, and it is unknown whether that could be due to dynamin 2, because that protein accounts for only a tiny percentage of dynamin protein in the brain. It makes sense that there is another protein or biomechanical process that is contributing."

Dynamin is a protein known to play a critical role in synaptic vesicle retrieval. The observation that synaptic transmission can still occur, albeit in a much-impaired way, in the absence of the overwhelming majority of dynamin reveals a remarkable and unexpected plasticity of nerve terminals, says Dr. De Camilli.

The *Nature Neuroscience* study was funded by grants from the National Institutes of Health and the David Rockefeller Graduate Study of the Rockefeller University.

The *Neuron* study was supported in part by the G. Harold and Leila Y. Mathers Charitable Foundation, National Institutes of Health grants, and the W.M. Keck Foundation. Co-authors are, from Yale University School of Medicine: Andrea Raimondi, Shawn M. Ferguson, Xuelin Lou, Summer Paradise, Silvia Giovedi, Mirko Messa, Nao Kono, Junko Takasaki and Valentina Cappello; and Eileen O'Toole from the University of Colorado at Boulder.

| More

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **New York- Presbyterian Hospital/Weill Cornell Medical Center/Weill Cornell Medical College**.

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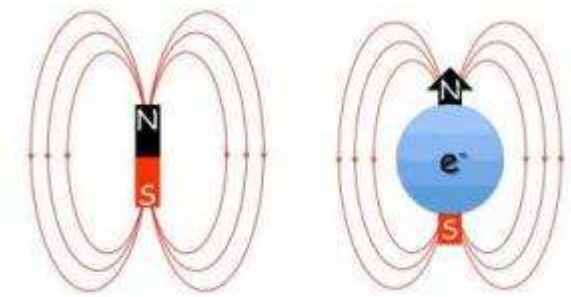
http://www.sciencedaily.com/releases/2011/06/110622145902.htm

Harnessing Electron Spin: Toward a New Breed of Computers That Can Process Data Using Less Power



Just like a magnet with a north and a south pole (left), electrons are surrounded by a magnetic field (right). This magnetic momentum, or spin, could be used to store information in more efficient ways. (Credit: Philippe Jacquod)

ScienceDaily (June 23, 2011) — Physicists at the University of Arizona have achieved a breakthrough toward the development of a new breed of computing devices that can process data using less power.

In a recent publication in *Physical Review Letters*, the physicists propose a way to translate the elusive magnetic spin of electrons into easily measurable electric signals. The finding is a key step in the development of computing based on spintronics, which doesn't rely on electron charge to digitize information. Unlike conventional computing devices, which require electric charges to flow along a circuit, spintronics harnesses the magnetic properties of electrons rather than their electric charge to process and store information.

"Spintronics has the potential to overcome several shortcomings of conventional, charge-based computing. Microprocessors store information only as long as they are powered up, which is the reason computers take time to boot up and lose any data in their working memory if there is a loss of power," said Philippe Jacquod, an associate professor with joint appointments in the College of Optical Sciences and the department of physics at the College of Science, who published the research together with his postdoctoral assistant, Peter Stano.

"In addition, charge-based microprocessors are leaky, meaning they have to run an electric current all the time just to keep the data in their working memory at their right value," Jacquod added. "That's one reason why laptops get hot while they're working."

"Spintronics avoids this because it treats the electrons as tiny magnets that retain the information they store even when the device is powered down. That might save a lot of energy."

To understand the concept of spintronics, it helps to picture each electron as a tiny magnet, Jacquod explained.

"Every electron has a certain mass, a certain charge and a certain magnetic moment, or as we physicists call it, a spin," he said. "The electron is not physically spinning around, but it has a magnetic north pole and a magnetic south pole. Its spin depends on which pole is pointing up."

Current microprocessors digitize information into bits, or "zeroes" and "ones," determined by the absence or presence of electric charges. "Zero" means very few electronic charges are present; "one" means there are many of them. In spintronics, only the orientation of an electron's magnetic spin determines whether it counts as a zero or a one.

"You want as many magnetic units as possible, but you also want to be able to manipulate them to generate, transfer and exchange information, while making them as small as possible" Jacquod said.

Taking advantage of the magnetic moment of electrons for information processing requires converting their magnetic spin into an electric signal. This is commonly achieved using contacts consisting of common iron magnets or with large magnetic fields. However, iron magnets are too crude to work at the nanoscale of tomorrow's microprocessors, while large magnetic fields disturb the very currents they are supposed to measure.

"Controlling the spin of the electrons is very difficult because it responds very weakly to external magnetic fields," Jacquod explained. "In addition, it is very hard to localize magnetic fields. Both make it hard to miniaturize this technology."

"It would be much better if you could read out the spin by making an electric measurement instead of a magnetic measurement, because miniaturized electric circuits are already widely available," he added.
In their research paper, based on theoretical calculations controlled by numerical simulations, Jacquod and Stano propose a protocol using existing technology and requiring only small magnetic fields to measure the spin of electrons.
"We take advantage of a nanoscale structure known as a quantum point contact, which one can think of as the ultimate bottleneck for electrons," Jacquod explained. "As the electrons are flowing through the circuit, their motion through that bottleneck is constrained by quantum mechanics. Placing a small magnetic field around that constriction allows us to measure the spin of the electrons."
"We can read out the spin of the electrons based on how the current through the bottleneck changes as we vary the magnetic field around it. Looking at how the current changes tells us about the spin of the electrons."
"Our experience tells us that our protocol has a very good chance to work in practice because we have done similar calculations of other phenomena," Jacquod said. "That gives us the confidence in the reliability of these results."
In addition to being able to detect and manipulate the magnetic spin of the electrons, the work is a step forward in terms of quantifying it.
"We can measure the average spin of a flow of electrons passing through the bottleneck," Jacquod explained. "The electrons have different spins, but if there is an excess in one direction, for example ten percent more electrons with an upward spin, we can measure that rather precisely."
He said that up until now, researchers could only determine there was excess, but were not able to quantify it.
"Once you know how to produce the excess spin and know how to measure it, you could start thinking about doing basic computing tasks," he said, adding that in order to transform this work into applications, some distance has yet to be covered.
"We are hopeful that a fundamental stumbling block will very soon be removed from the spintronics roadmap," Stano added.
Spintronics could be a stepping stone for quantum computing, in which an electron not only encodes zero or one, but many intermediate states simultaneously. sTo achieve this, however, this research should be extended to deal with electrons one-by-one, a feat that has yet to be accomplished.

story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Arizona**. The original article was written by Daniel Stolte, University Communications.

Journal Reference:

1. Peter Stano, Philippe Jacquod. **Spin-to-Charge Conversion of Mesoscopic Spin Currents**. *Physical Review Letters*, 2011; 106 (20) DOI: 10.1103/PhysRevLett.106.206602

http://www.sciencedaily.com/releases/2011/06/110621173527.htm

Birds' Eye View Is Far More Colorful Than Our Own

Birds are well known for their stunning plumage colors, which are created by a diverse set of pigment-based and structural (optical) mechanisms. (Credit: Courtesy of David Kjaer)

ScienceDaily (June 23, 2011) — The brilliant colors of birds have inspired poets and nature lovers, but researchers at Yale University and the University of Cambridge say these existing hues represent only a fraction of what birds are capable of seeing.

The findings based on study of the avian visual system, reported in the June 23 issue of the journal *Behavioral Ecology*, show that over millions of years of evolution plumage colors went from dull to bright as birds gradually acquired the ability to create newer pigments and structural colors.

"Our clothes were pretty drab before the invention of aniline dyes, but then color became cheap and there was an explosion in the colorful clothes we wear today," said Richard Prum, chair and the William Robertson Coe Professor in the Department of Ornithology, Ecology and Evolutionary Biology and co-author of the paper. "The same type of thing seemed to have happened with birds."

Scientists have speculated for years on how birds obtained their colors, but the Yale/Cambridge study was the first to ask what the diversity of bird colors actually look like to birds themselves. Ironically, the answer is that birds see many more colors than humans can, but birds are also capable of seeing many more colors than they have in their plumage. Birds have additional color cones in their retina that are sensitive to ultraviolet range so they see colors that are invisible to humans.

Over time, birds have evolved a dazzling combination of colors that included various melanin pigments, which give human skin its tint, carotenoid pigments, which come from their diets, and structural colors, like the blue eyes of humans. The study shows that the structural colors produce the lion's share of color diversity to bird feathers, even though they are relatively rare among birds.

Co-author Mary Caswell Stoddard of Cambridge, who began investigating the avian visual system as an undergraduate at Yale, would like to know why birds have not yet developed the ability to produce, for example, ultraviolet yellow or red colors in their feathers -- colors invisible to humans but visible to the birds themselves.

"We don't know why plumage colors are confined to this subset," Stoddard said. "The out of gamut colors may be impossible to make with available mechanisms or they may be disadvantageous."
"That doesn't mean that birds' color palette might not eventually evolve to expand into new colors," Prum said.

"Birds can make only about 26 to 30 percent of the colors they are capable of seeing but they have been working hard over millions of years to overcome these limitations," Prum said. "The startling thing to realize

is that although the colors of birds look so incredibly diverse and beautiful to us, we are color blind compared to birds."

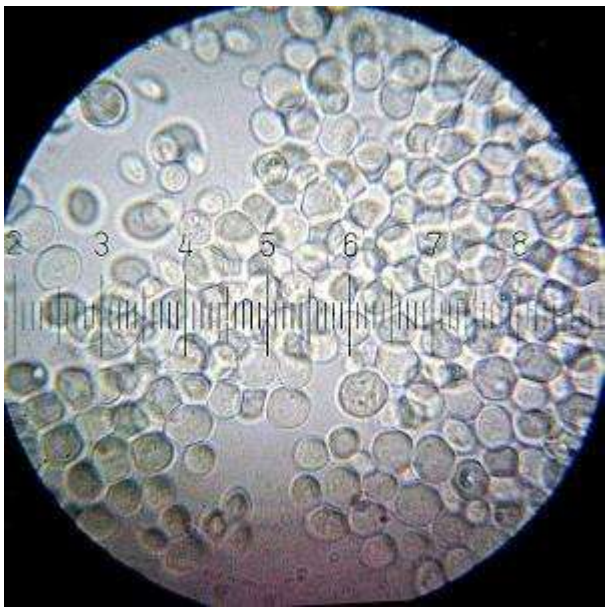
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Yale University**.

Journal Reference:

1. M. C. Stoddard, R. O. Prum. **How colorful are birds? Evolution of the avian plumage color gamut**. *Behavioral Ecology*, 2011; DOI: 10.1093/beheco/arr088

http://www.sciencedaily.com/releases/2011/06/110622224455.htm

Evolution to the Rescue: Species May Adapt Quickly to Rapid Environmental Change, Yeast Study Shows



Saccharomyces cerevisiae -- baker's yeast. (Credit: Bob Blaylock / Wikimedia Commons, Creative Commons Attribution 3.0 Unported license)

ScienceDaily (June 23, 2011) — Evolution is usually thought to be a very slow process, something that happens over many generations, thanks to adaptive mutations. But environmental change due to things like climate change, habitat destruction, pollution, etc. is happening very fast. There are just two options for species of all kinds: either adapt to environmental change or become extinct.

So, according to McGill biology professor, Andrew Gonzalez, the question arises, "Can evolution happen quickly enough to help a species survive?" The answer, according to his most recent study, published in *Science*, is a resounding yes.

By using a long-armed robot working 24/7 over a period of several of months, McGill Professors Graham Bell and Gonzalez were able to track the fate of over 2000 populations of baker's yeast for many generations. Yeast was chosen for the experiment because a lot is known about the genetic makeup of this model organism and because it can reproduce in a matter of hours. Bell and Gonzalez used the robot to submit different yeast populations to varying degrees of environmental stress in the form of salt and so study evolutionary rescue, which is the ability of a population to adapt rapidly through evolution, in real time.

What they observed was that the likelihood of evolutionary rescue depended on the severity and rate of change of the environment and the degree of prior exposure of populations to the environmental stressor (salt). The degree of isolation from neighboring populations also affected the capacity of the yeast populations to adapt through the accumulation of beneficial mutations.

Gonzalez and his team were in effect watching evolution at work. And what they discovered is that it can happen surprisingly fast, within 50 to 100 generations.

"The same general processes are occurring whether it's yeast or mammals," said Gonzalez. "At the end of the day we can't do the experiment with a panda or a moose, for example, because the time it would take to study their evolution is far longer than the time we have given the current rate of environmental change. At some point we have to work at the level of a model and satisfy ourselves that the basic reality we capture is sufficient to extrapolate from." While there has been theoretical work on the subject done in the past, this is the first time anyone has done a practical experiment of this kind, and shown evolutionary rescue at work.

Bell and Gonzalez discovered that a population was more likely to adapt quickly through evolutionary rescue if:

1. There was slow environmental deterioration, i.e. a slow increase in the concentration of salt, along with modest levels of contact with other populations. These populations were then able to adapt to environmental stress that would have been sufficient to eradicate their ancestors.
2. It was connected by dispersal, i.e. had previous contact, with another population that had already experienced environmental change. This population then had a much greater probability of avoiding extinction after a rapid and severe perturbation.

The research was funded by Canadian Foundation for Innovation, the Canada Research Chair Program and the Natural Sciences and Engineering Research Council of Canada.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **McGill University**.

Journal Reference:

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http://www.sciencedaily.com/releases/2011/06/110622115311.htm

Current Carbon Dioxide Emission Higher Than It Was Just Before Ancient Episode of Severe Global Warming

Core shed in Spitsbergen. (Credit: Image courtesy of National Oceanography Centre, Southampton (UK))

ScienceDaily (June 8, 2011) — The present rate of greenhouse carbon dioxide emissions through fossil fuel burning is higher than that associated with an ancient episode of severe global warming, according to new research. The findings are published online this week by the journal *Nature Geoscience*.

Around 55.9 million years ago, Earth experienced a period of intense global warming known as the Palaeocene-Eocene Thermal Maximum (PETM), which lasted for around 170,000 years. During its main phase, average annual temperatures rose by around 5°C.

Scientists believe that the warming may have been initially triggered by an event such as the baking of organic-rich sediments by igneous activity that released the potent greenhouse gas, methane. This initial temperature increase warmed ocean bottom waters which allowed the break down of gas hydrates (clathrates), which are found under deep ocean sediments: this would have greatly amplified the initial warming by releasing even more vast volumes of methane. As the methane diffused from the seawater into the atmosphere it would have been oxidised to form carbon dioxide, another potent and longer-lived greenhouse gas.

Adam Charles and his PhD supervisor, Dr Ian Harding, both palaeoceanographers at the University of Southampton's School of Ocean and Earth Science (SOES) based at the National Oceanography Centre, Southampton, co-authored the report. Dr Harding said: "The PETM has been seen by many as a natural test bed for understanding modern human-made global warming, despite it not being a perfect analogy. However, the total amount of carbon released during this climatic perturbation and its rate of release have been unclear."

To help fill this gap in knowledge, the researchers measured carbon isotope ratios of marine organic matter preserved in sediments collected in Spitsbergen. The sedimentary section is important because it records the entirety of the PETM, from its initiation to through the recovery period, and as such is the most complete record of the warming event so far known in high northern latitudes.

Based on their carbon isotope measurements and computer simulations of Earth system, the researchers estimated that the rate of carbon emissions during the PETM peaked at between 300 million and 1,700 million metric tonnes per year, which is much slower than the present carbon emission rate.

"Our findings suggest that humankind may be causing atmospheric carbon dioxide to increase at rates never previously seen on Earth, which would suggest that current temperatures will potentially rise much faster than they did during the PETM," concluded Dr Harding.
This research was supported by The Worldwide Universities Network, Pennsylvania State University, and the US National Science Foundation.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Oceanography Centre, Southampton (UK)**.

Journal Reference:

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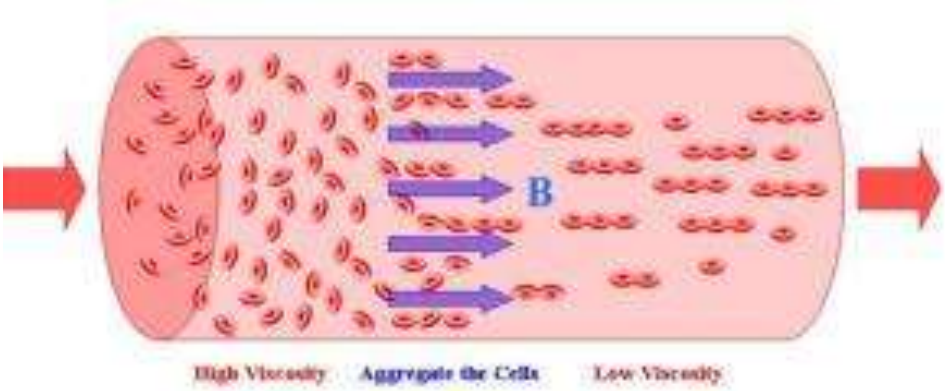
http://www.sciencedaily.com/releases/2011/06/110607121525.htm

Using Magnets to Help Prevent Heart Attacks: Magnetic Field Can Reduce Blood Viscosity, Physicist Discovers



Aggregated red-cell clusters have a streamlined shape, leading to further viscosity reduction. (Credit: Image courtesy of Temple University)

ScienceDaily (June 8, 2011) — If a person's blood becomes too thick it can damage blood vessels and increase the risk of heart attacks. But a Temple University physicist has discovered that he can thin the human blood by subjecting it to a magnetic field.

Rongjia Tao, professor and chair of physics at Temple University, has pioneered the use of electric or magnetic fields to decrease the viscosity of oil in engines and pipelines. Now, he is using the same magnetic fields to thin human blood in the circulation system.

Because red blood cells contain iron, Tao has been able to reduce a person's blood viscosity by 20-30 percent by subjecting it to a magnetic field of 1.3 Telsa (about the same as an MRI) for about one minute.

Tao and his collaborator tested numerous blood samples in a Temple lab and found that the magnetic field polarizes the red blood cells causing them to link together in short chains, streamlining the movement of the blood. Because these chains are larger than the single blood cells, they flow down the center, reducing the friction against the walls of the blood vessels. The combined effects reduce the viscosity of the blood, helping it to flow more freely.

When the magnetic field was taken away, the blood's original viscosity state slowly returned, but over a period of several hours.

"By selecting a suitable magnetic field strength and pulse duration, we will be able to control the size of the aggregated red-cell chains, hence to control the blood's viscosity," said Tao. "This method of magneto-rheology provides an effective way to control the blood viscosity within a selected range."

Currently, the only method for thinning blood is through drugs such as aspirin; however, these drugs often produce unwanted side effects. Tao said that the magnetic field method is not only safer, it is repeatable. The magnetic fields may be reapplied and the viscosity reduced again. He also added that the viscosity reduction does not affect the red blood cells' normal function.

Tao said that further studies are needed and that he hopes to ultimately develop this technology into an acceptable therapy to prevent heart disease.

Tao and his former graduate student, Ke "Colin" Huang, now a medical physics resident in the Department of Radiation Oncology at the University of Michigan, are publishing their findings in the journal *Physical Review E*.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Temple University**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2011/06/110607121523.htm

Bacteria On Old-Growth Trees May Help Forests Grow

Old oak tree. Biology researchers discover that bacteria living in mosses on tree branches are twice as effective at 'fixing' nitrogen as those on the ground. (Credit: © Piotr Skubisz / Fotolia)

ScienceDaily (June 8, 2011) — Biology researchers discover that bacteria living in mosses on tree branches twice as effective at 'fixing' nitrogen as those on the ground.

A new study by Dr. Zoë Lindo, a post-doctoral fellow in the Department of Biology at McGill University, and Jonathan Whiteley, a doctoral student in the same department, shows that large, ancient trees may be very important in helping forests grow.

These findings highlight the importance of maintaining the large old-growth trees in the coastal temperate rainforests that stretch from Southern Alaska to Northern California. Lindo's findings suggest that it is the interactions between old trees, mosses and cyanobacteria, which contribute to nutrient dynamics in a way that may actually sustain the long-term productivity of these forests.

"What we're doing is putting large old trees into a context where they're an integral part of what a forest is," says Dr. Lindo. "These large old trees are doing something: they're providing habitat for something that provides habitat for something else that's fertilizing the forest. It's like a domino effect; it's indirect but without the first step, without the trees, none of it could happen."

There are three players in this story: 1) large, old trees; 2) mosses that grow along their branches; and 3) a group of bacteria called cyanobacteria associated with the mosses. The cyanobacteria take nitrogen from the atmosphere and make it available to plants-a process called "nitrogen fixation" that very few organisms can do.

The growth and development of many forests is thought to be limited by the availability of nitrogen. Cyanobacteria in mosses on the ground were recently shown to supply nitrogen to the Boreal forest, but until now cyanobacteria have not been studied in coastal forests or in canopies (tree-tops). By collecting mosses on the forest floor and then at 15 and 30 metres up into the forest canopy, Lindo was able to show both that the cyanobacteria are more abundant in mosses high above the ground, and that they "fix" twice as much nitrogen as those associated with mosses on the forest floor.

Moss is the crucial element. The amount of nitrogen coming from the canopy depends on trees having mosses.
"You need trees that are large enough and old enough to start accumulating mosses before you can have the cyanobacteria that are associated with the mosses," Lindo said. "Many trees don't start to accumulate mosses until they're more than 100 years old. So it's really the density of very large old trees that are draped in moss that is important at a forest stand level. We surveyed trees that are estimated as being between 500 and 800 years old."
The research was funded by the Natural Sciences and Engineering Research Council of Canada (NSERC).

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **McGill University**.

Journal Reference:

1. Zoë Lindo, Jonathan A. Whiteley. **Old trees contribute bio-available nitrogen through canopy bryophytes**. *Plant and Soil*, 2011; 342 (1-2): 141 DOI: 10.1007/s11104-010-0678-6

http://www.sciencedaily.com/releases/2011/06/110607121144.htm

Ten Famous Intellectual Property Disputes

From Barbie to cereal to a tattoo, a copyright lawsuit can get contentious; some have even reached the Supreme Court

By Megan Gambino

Smithsonian.com, June 22,

Mike Tyson's tattoo artist S. Victor Whitmill filed a lawsuit against Warner Bros. Entertainment this spring, claiming that the use of his design in the movie *The Hangover Part II* was copyright infringement.

Courtesy of Warner Bros. Pictures / Everett Collection

1. S. Victor Whitmill v. Warner Bros. Entertainment Inc.

In the recent movie *The Hangover Part II*, Stu Price, a strait-laced dentist played by actor Ed Helms, wakes up after a night of debauchery in Bangkok to find a tribal tattoo wrapped around his left eye, his skin still painfully pink. Price's tattoo is identical to the one Mike Tyson has, and it alludes to the boxer's cameo in the original 2009 movie *The Hangover*.

Tyson's tattoo artist S. Victor Whitmill filed a lawsuit against Warner Bros. Entertainment on April 28, just weeks before the movie's May 26 opening. Since he obtained a copyright for the eight-year-old "artwork on 3-D" on April 19, he claimed that the use of his design in the movie and in advertisements without his consent was copyright infringement. Warner Bros., of course, saw it as a parody falling under "fair use."

On May 24, 2011 Chief Judge Catherine D. Perry of the United States District Court for the Eastern District of Missouri denied an injunction on the movie's release, but said Whitmill still had a case. If it meant avoiding a long trial, Warner Bros. said, in early June, that it would be willing to "digitally alter the film to substitute a different tattoo on Ed Helms's face" when the movie is released on home video. But that ending was avoided on June 17, when Warner Bros. and Whitmill hashed out an agreement of undisclosed terms.

2. Isaac Newton v. Gottfried Wilhelm Leibniz

By the early 18th century, many credited the German mathematician and philosopher Gottfried Wilhelm Leibniz with inventing the study of calculus. Leibniz had, after all, been the first to publish papers on the topic in 1684 and 1686. But when Englishman Isaac Newton published a book called *Opticks* in 1704, in which he asserted himself as the father of calculus, a debate arose. Each of the thinkers' respective countries wanted to stake a claim in what was one of the biggest advances in mathematics.

Newton claimed to have thought up the "science of fluxions," as he called it, first. He apparently wrote about the branch of mathematics in 1665 and 1666, but only shared his work with a few colleagues. As the battle between the two intellectuals heated up, Newton accused Leibniz of plagiarizing one of these early circulating drafts. But Leibniz died in 1716 before anything was settled. Today, however, historians accept that Newton and Leibniz were co-inventors, having come to the idea independently of each other.

3. Kellogg Co. v. National Biscuit Co.

In 1893, a man named Henry Perky began making a pillow-shaped cereal he called Shredded Whole Wheat. John Harvey Kellogg said that eating the cereal was like "eating a whisk broom," and critics at the World Fair in Chicago in 1893 called it "shredded doormat." But the product surprisingly took off. After Perky died in 1908 and his two patents, on the biscuits and the machinery that made them, expired in 1912, the Kellogg Company, then whistling a different tune, began selling a similar cereal. In 1930, the National Biscuit Company, a successor of Perky's company, filed a lawsuit against the Kellogg Company, arguing that the new shredded wheat was a trademark violation and unfair competition. Kellogg, in turn, viewed the suit as an attempt on National Biscuit Company's part to monopolize the shredded wheat market. In 1938, the case was brought to the Supreme Court, which ruled in favor of the Kellogg Company on the grounds that the term "shredded wheat" was not trademarkable, and its pillow shape was functional and therefore able to be copied after the patent had expired.

4. Marcantonio Raimondi v. Albrecht Dürer

Artist Albrecht Dürer discovered in the early 1500s that a fellow engraver by the name of Marcantonio Raimondi was copying one of his most famous works, a woodcut series of engravings called the *Life of the Virgin*. To make his prints, Raimondi carved detailed replicas of Dürer's wood blocks. The prints, with Dürer's "A" above "D" signature, could pass as Dürer originals, and Raimondi made considerable profits off of them. Dürer took issue and brought his case to the court of Venice. Ultimately, the court ruled that Raimondi could continue making copies, as long as he omitted the monogram.

5. Mattel Inc. v. MGA Entertainment Inc.

Barbie was 42 years old when the exotic, puffy-lipped Bratz dolls Cloe, Jade, Sasha and Yasmin strolled onto the scene in 2001. Tensions escalated as the Bratz seized about 40 percent of Barbie's turf in just five years. The Bratz struck first. In April 2005, their maker MGA Entertainment filed a lawsuit against toy powerhouse Mattel, claiming that the line of "My Scene" Barbies copied the big-headed and slim-bodied physique of Bratz dolls. Mattel then swatted back, accusing Bratz designer Carter Bryant for having designed the doll while on Mattel's payroll. Bryant worked for Mattel from September 1995 to April 1998 and then again from January 1999 to October 2000, under a contract that stipulated that his designs were the property of Mattel. In July 2008, a jury ruled in favor of Mattel, forcing MGA to pay Mattel $100 million and to remove Bratz dolls from shelves (an injunction that lasted about a year). But the two toy companies continued to duke it out. This April, in yet another court case, underdog MGA prevailed, proving that Mattel was actually the one to steal trade secrets.

6. Campbell v. Acuff-Rose Music, Inc.

"Weird Al" Yankovic has a policy of writing a parody of a song only if he gets permission from the artist. In the late 1980s, the rap group 2 Live Crew attempted to play by the same rules. Luther Campbell, one of the group members, changed the refrain of Roy Orbison's hit "Oh, Pretty Woman" from "pretty woman" to "big hairy woman," "baldheaded woman" and "two-timin' woman." 2 Live Crew's manager sent the bawdy lyrics and a recording of the song to Acuff-Rose Music Inc., which owned the rights to Orbison's music, and noted that the group would credit the original song and pay a fee for the ability to riff off of it. Acuff-Rose objected, but 2 Live Crew included the parody, titled "Pretty Woman," on its 1989 album "As Clean as They Wanna Be" anyway.

Acuff-Rose Music Inc. cried copyright infringement. The case went to the Supreme Court, which, in so many words, said, lighten up. "Parody, or in any event its comment, necessarily springs from recognizable allusion to its object through distorted imitation," wrote Justice David Souter. "Its art lies in the tension between a known original and its parodic twin."

7. Michael Baigent and Richard Leigh v. The Random House Group Limited

Authors Michael Baigent and Richard Leigh surfaced in 2004 with claims that Dan Brown had cribbed the "central theme" and "architecture" of their 1982 book *The Holy Blood and the Holy Grail*. Though Baigent

and Leigh's book was nonfiction and Brown's *The Da Vinci Code* was fiction, they both boldly interpret the Holy Grail as being not a chalice but the bloodline of Jesus and Mary Magdalene, who they alleged had a child together.

Baigent and Leigh accused Random House—ironically, their own publisher, as well as Brown's—for copyright infringement. A London court ruled, in 2006, that historical research (or "historical conjecture," as was the case with *The Holy Blood and the Holy Grail*) is fair game for novelists to explore in fiction. "It would be quite wrong if fictional writers were to have their writings pored over in the way *The Da Vinci Code* has been pored over in this case by authors of pretend historical books to make an allegation of infringement of copyright," wrote Justice Peter Smith in his decision.

8. Lucasfilm Ltd. v. High Frontier and Lucasfilm v. Committee for a Strong, Peaceful America

When politicians, journalists and scientists, in the mid-1980s, nicknamed the Reagan administration's Strategic Defensive Initiative (SDI), the "star wars" program, George Lucas's production company was miffed. It did not want the public's positive associations with the term to be marred by the controversial plan to place anti-missile weapons in space.

In 1985, Lucasfilm Ltd. filed a lawsuit against High Frontier and the Committee for a Strong, Peaceful America—two public interest groups that referred to SDI as "star wars" in television messages and literature. Though Lucasfilm Ltd. had a trademark for Star Wars, the federal district court ruled in favor of the interest groups and their legal right to the phrasing so long as they didn't attach it to a product or service for sale. "Since Jonathan Swift's time, creators of fictional worlds have seen their vocabulary for fantasy appropriated to describe reality," read the court decision.

9. A&M Records, Inc. v. Napster Inc.

In 1999, to the dismay of musicians around the world looking to sell albums, Shawn Fanning, an 18-year-old whiz kid studying computer science at Northeastern University, created Napster, a peer-to-peer music sharing service that allowed users to download MP3s for free. A&M Records, part of Universal Music Group, a heavy hitter in the music industry, as well as several other record companies affiliated with the Recording Industry Association of America slapped Napster with a lawsuit. The plaintiffs accused Napster of contributory and vicarious copyright infringement. The case went from the United States District Court for the Northern District of California to the United States Court of Appeals for the Ninth Circuit, where Napster was found guilty on both counts. In 2002, Napster was shut down. Grokster, another music-sharing site, surged on for a few more years, but it too stopped operating when the Supreme Court ruled against it in MGM v. Grokster in 2005.

10. Adidas America Inc. v. Payless Shoesource Inc.

In 1994, Adidas and Payless got into a scuffle over stripes. Adidas had used its three-stripe mark as a logo of sorts since 1952, and had recently registered it as a trademark. But Payless was selling confusingly similar athletic shoes with two and four parallel stripes. The two companies hashed out a settlement, but by 2001, Payless was again selling the look-alikes. Fearing that the sneakers would dupe buyers and tarnish its name, Adidas America Inc. demanded a jury trial. The trial lasted seven years, during which 268 pairs of Payless shoes were reviewed. In the end, Adidas was awarded $305 million—$100 million for each stripe, as the *Wall Street Journal*'s Law Blog calculated.

Read more: http://www.smithsonianmag.com/history-archaeology/Ten-Famous-Intellectual-Property-Disputes.html#ixzz1QKvvLcno

The Battle of Bull Run: The End of Illusions

Both North and South expected victory to be glorious and quick, but the first major battle signaled the long and deadly war to come

- By Ernest B. Furgurson
- *Smithsonian* magazine, August 2011

Scores of high-spirited civilians carried picnic baskets and champagne to the battlefield to watch what would turn out to be the first major land engagement of the Civil War. Shown here is the battlefield as it appears today

Cannon boomed, brass bands serenaded and ladies tossed bouquets as Jefferson Davis arrived in Richmond on May 29, 1861, to make it the capital of the Confederate States of America. He had set out from the original capital at Montgomery, Alabama, soon after Virginia seceded from the Union six days earlier. Along the way, jubilant well-wishers slowed his train and he crossed the James River into Richmond far behind schedule. It was a scene wholly unlike President-elect Abraham Lincoln's arrival in Washington the previous February, when he sneaked into the city at dawn in a curtained sleeping car because of threats of assassination as he passed through Baltimore. Richmond welcomed Davis as if he personally were going to smite the Yankees and drive them from Virginia soil.

To a cheering crowd, he said, "I know that there beats in the breasts of Southern sons a determination never to surrender, a determination never to go home but to tell a tale of honor....Give us a fair field and a free fight, and the Southern banner will float in triumph everywhere."

Unlike Davis' Mississippi and the other cotton states of the Deep South, Virginia, the most populous state below the Mason-Dixon line, had been reluctant to leave the Union of its fathers. The Richmond convention that debated secession leaned strongly against it; a country lawyer and West Point graduate named Jubal Early spoke for the majority when he warned that the convention could decide "the existence and the preservation of the fairest fabric of government that was ever erected....We ought not to act in hot haste, but coolly deliberate in view of the grave consequences."

But after the first guns at Fort Sumter, when Lincoln called for 75,000 troops to put down the rebellion, the convention reversed itself. Opinion swung so sharply that the result of the May 23 referendum confirming the convention's decision was a foregone conclusion. More than five months after South Carolina became the

first state to depart the Union, Virginia followed. As a result, the proud, conservative Old Dominion would be the bloodiest battleground of the Civil War—and the first and final objective of all that slaughter was the capital, the very symbol of Southern resistance, the city of Richmond.

At first, there had been brave talk in Dixie of making Washington the capital of the Confederacy, surrounded as it was by the slave states of Maryland and Virginia. Federal troops had been attacked by a mob in Baltimore, and Marylanders had cut rail and telegraph lines to the North, forcing regiments headed for Washington to detour by steaming down the Chesapeake Bay. Washington was in a state of nerves; officials fortified the Capitol and the Treasury against feared invasion. Richmond was alarmed by rumors that the Union gunboat *Pawnee* was on its way up the James River to shell the city into flames. Some families panicked, believing an Indian tribe was on the warpath. Militiamen rushed to riverside and aimed cannon downstream. But the *Pawnee* never came.

North and South, such rumors pursued rumors, but soon the preliminaries, real and imagined, were either resolved or laughed away. The stage was set for war, and both sides were eager for a quick and glorious victory.

The society widow Rose O'Neal Greenhow was well known for her Southern sentiments, but in her home just across Lafayette Square from the White House she entertained Army officers and congressmen regardless of their politics. Indeed, one of her favorites was Henry Wilson, a dedicated abolitionist and future vice president from Massachusetts who had replaced Jefferson Davis as chairman of the Senate Committee on Military Affairs. Greenhow, sophisticated and seductive, listened carefully to everything her admirers said. Soon she would be sending notes across the Potomac encoded in a cipher left with her by Thomas Jordan, who had resigned his Army commission and gone south.

As summer began, Jordan was adjutant of the Confederate Army under Brig. Gen. Pierre Gustave Toutant Beauregard, a dashing Louisianan. Beauregard, who had become the Confederacy's premier hero by commanding the bombardment of Fort Sumter in April, was now gathering brigades to protect the vital rail junction at Manassas, little more than 25 miles west-southwest of Washington.

On July 4, Lincoln asked a special session of Congress for 400,000 troops and $400 million, with legal authority "for making this contest a short, and a decisive one." He expressed not only the hope, but also the expectation of most officials in Washington. Many of the militia outfits rolling in from the North had signed on in April for just 90 days, assuming they could deal with the uppity Rebels in short order. Day after day, a headline in the *New York Tribune* blared, "Forward to Richmond! Forward to Richmond!" a cry that echoed in all corners of the North.

The most notable voice urging restraint came from the most experienced soldier in the nation, Winfield Scott, general in chief of the U.S. Army, who had served in uniform since the War of 1812. But at 74, Scott was too decrepit to take the field and too weary to resist the eager amateurs of war as they insisted that the public would not tolerate delay. Scott turned over field command to Brig. Gen. Irvin McDowell, who was headquartered at Robert E. Lee's abandoned Arlington mansion. On July 16, the reluctant McDowell left Arlington and started the Union Army of the Potomac westward.

The Confederates knew what was coming, and when. On July 10, a beautiful 16-year-old girl named Betty Duval had arrived at Beauregard's lines and shaken from her long, dark hair a coded dispatch from Rose Greenhow, saying that McDowell would take the offensive in mid-month. Six days later Greenhow sent another courier with a note reporting that the Union Army was on the march.

Beauregard had grandiose ideas of bringing in reinforcements from west and east to outflank McDowell, attack him from the rear, crush the Yankees and proceed to "the liberation of Maryland, and the capture of Washington." But as McDowell's army advanced, Beauregard faced reality. He had to defend Manassas Junction, where the Manassas Gap Railroad from the Shenandoah Valley joined the Orange & Alexandria, which connected to points south, including Richmond. He had 22,000 men, McDowell about 35,000. He would need help.

At the northern end of the Shenandoah Valley, Brig. Gen. Joseph E. Johnston commanded about 12,000 Confederates blocking Northern entry into that lush farmland and invasion route. He faced some 18,000 Federals under 69-year-old Maj. Gen. Robert Patterson, another veteran of the War of 1812. Patterson's assignment was to prevent Johnston from threatening Washington and from moving to help Beauregard. In early July, Beauregard and Johnston, both expecting attack, were urgently seeking reinforcements from each other.

That contest ended on July 17. Beauregard informed President Davis that after skirmishing along his advance lines, he was pulling his troops back behind the little river called Bull Run, about halfway between Centreville and Manassas. That night, Davis ordered Johnston to hurry "if practicable" to aid Beauregard. Since Patterson had unaccountably pulled his Union force away down the valley, Johnston quickly issued marching orders. Screened by Col. Jeb Stuart's cavalry, Brig. Gen. Thomas J. Jackson led his Virginia brigade out of Winchester at midday on July 18. The imminent battlefield was 57 miles away, and already the first guns had sounded along Bull Run.

Beauregard spread his brigades on a nearly ten-mile front behind the winding stream, from near Stone Bridge on the Warrenton Turnpike down to Union Mills. They concentrated at a series of fords that crossed the 40-foot-wide river. Bull Run has steep banks and is deep in spots, and would have slowed even experienced troops. The soldiers of 1861, and many of their officers, were still novices.

McDowell was 42 years old, a cautious, teetotaling officer who had served in Mexico but spent most of his career on staff duty. With green troops and his first major command, he did not want to attack the Confederates head-on. He intended to swing east and strike Beauregard's right flank, crossing Bull Run where it was closest to the junction. But after reaching Centreville on July 18, he rode out to inspect the ground and decided against it. Before departing, he ordered Brig. Gen. Daniel Tyler, commanding his lead division, to probe the roads ahead—not to start a battle, but to make the Rebels think the army was aiming directly for Manassas. Tyler exceeded his orders: after spotting the enemy across the stream and swapping artillery rounds, he pushed his infantry at Blackburn's Ford, testing the defenses. The Rebels, commanded there by Brig. Gen. James Longstreet, hid until the Federals were close. Then they let loose a storm of musketry that sent Tyler's troops fleeing back toward Centreville.

In both directions, this short, sharp clash was vastly exaggerated. Back in Washington, Southern sympathizers crowding the barrooms along Pennsylvania Avenue celebrated what they already called "the Battle of Bull Run." One Union general told the *Times of London* correspondent William Howard Russell that the news meant "we are whipped," while a senator quoted General Scott as announcing "a great success.... We ought to be in Richmond by Saturday"—just two days later. Swarms of civilians rushed out from the capital in a party mood, bringing picnic baskets and champagne, expecting to cheer the boys on their way. One of the less cheerful scenes they encountered was the Fourth Pennsylvania Infantry and the Eighth New York Battery walking away on the brink of battle because their 90-day enlistments were up. For the next two days, McDowell stayed put, resupplying and planning. It was a fateful delay.

Soon after Johnston's troops departed Winchester on July 18, he issued a communiqué to every regiment. Beauregard was being attacked by "overwhelming forces," he wrote. "Every moment now is precious...for this march is a forced march to save the country." Out front, Jackson's brigade forded the Shenandoah River and toiled up the Blue Ridge through Ashby Gap before bedding down that night at the hamlet of Paris. From there it was six-plus miles downhill to the Manassas Gap Railroad station at Piedmont (now Delaplane). Arriving about 8:30 a.m., the troops jammed into freight cars, and overworked locomotives took eight more hours to bring them the last 34 miles to Manassas Junction.

The rest of Johnston's army straggled in over the next 24 hours. Johnston himself reached Manassas about midday. To head off confusion, he asked President Davis to make clear that he was senior in rank to Beauregard. Later the two officers agreed that since Beauregard was more familiar with the immediate situation, he would retain command at the tactical level while Johnston managed the overall campaign.

That day, July 20, two opposing generals sat writing orders that, if carried through, would send their attacking armies pinwheeling around each other. Beauregard intended to strike McDowell's left, throwing most of his army toward Centreville to cut the Federals off from Washington. McDowell prepared to cross Bull Run above Stone Bridge and come down on Beauregard's left. His plan looked good on paper, but did not account for the arrival of Johnston's reinforcements. Beauregard's plan was sound in concept, but not in detail: it told which brigades would attack where, but not exactly when. He woke Johnston to endorse it at 4:30 a.m. on Sunday, July 21. By then McDowell's army was already moving.

Tyler's division marched toward Stone Bridge, where it would open a secondary attack to distract the Confederates. Meanwhile Union Brig. Gens. David Hunter and Samuel Heintzelman started their divisions along the Warrenton Turnpike, then made a wide arc north and west toward an undefended ford at Sudley Springs, two miles above the bridge. They were to cross Bull Run there and drive down the opposite side, clearing the way for other commands to cross and join a mass assault on Beauregard's unsuspecting left flank.

The going was slow, as McDowell's brigades bungled into each other and troops groped along dark, unscouted roads. McDowell himself was sick from some canned fruit he had eaten the night before. But hopes were high.

In the 11th New York Infantry, known as the Zouaves, Pvt. Lewis Metcalf heard "the latest news, of which the very latest seemed to be that General [Benjamin] Butler had captured Richmond and the Rebels had been surrounded by General Patterson," he later wrote. "All that we had to do was to give Beauregard a thrashing in order to end all the troubles." When they slogged past blankets strewn on the roadside by sweltering troops ahead of them, the Zouaves assumed the bedding had been thrown away by fleeing Confederates and "set up a lively shout."

About 5:30 that morning, the first shell, a massive Federal 30-pounder, whanged through the tent of a Confederate signal station near Stone Bridge without hurting anybody. That round announced Tyler's advance, but the Confederates would not detect McDowell's main effort for three more hours—until Capt. Porter Alexander, far back at Beauregard's command post, spotted through his spyglass a flash of metal far beyond the turnpike. Then he picked out a glitter of bayonets nearing Sudley Springs. He quickly sent a note to Beauregard and flagged a signal to Capt. Nathan Evans, who was posted with 1,100 infantry and two smoothbore cannon at the far end of the Confederate line, watching Stone Bridge. "Look out for your left," he warned. "You are flanked."

Without waiting for orders, Evans rushed across the turnpike with two of his regiments and faced north to block the threatening Federals. Union Col. Ambrose Burnside's brigade, leading Hunter's division, crossed at Sudley Springs near 9:30 after an approach march of more than ten miles. There Burnside ordered a stop for water and rest, giving Evans time to position his skimpy defenders in a strip of woods along Matthews Hill. When the Yankees came within about 600 yards, Evans gave the order to open fire.

Burnside advanced close behind his skirmishers, followed by Col. Andrew Porter's brigade. Soon after the first burst of fire, Burnside encountered David Hunter, riding back seriously wounded, who told him to take command of the division. Evans' men fought doggedly as the much heavier Union force pressed them back toward the turnpike. Confederate Brig. Gen. Barnard Bee, ordered to the left by Beauregard, started setting a defensive line near what is now called the Henry House, on a hill just south of the turnpike. But when Evans pleaded for help, Bee took his brigade forward to join him. Col. Francis Bartow's Georgia brigade moved up beside them. After an hour's hard combat, Heintzelman's Union division arrived. He sent Col. William B. Franklin's brigade ahead, and the Union attack started to stretch around Evans' line. Crossing near Stone Bridge, Col. William Tecumseh Sherman's brigade joined the offensive. Assailed on both sides, Evans, Bee and Bartow's men broke back for nearly a mile, staggering across Henry House Hill.

During this rising tumult, Johnston and Beauregard were near Mitchell's Ford, more than four miles away. For two hours, they waited to hear the planned Confederate move against the Union left flank. But it never materialized. The would-be lead brigade hadn't gotten Beauregard's order, and others listened in vain for its advance. It was about 10:30 when Beauregard and Johnston finally realized the noise on their far left was the real battle.

Quickly directing more troops that way, they galloped toward the firing. When they reached Henry House, Jackson was bringing his brigade up through the disorganized troops falling back. Unless he held here, the Yankees could sweep down into the Confederates' rear and collapse their whole army. Jackson threw up a defensive line just behind the crest of the hill, where the Federals could not see it as they gathered to charge. A bullet or shell fragment painfully wounded his left hand as he rode back and forth steadying his men, siting artillery pieces and asking Jeb Stuart to protect the flank with his cavalry. Barnard Bee, trying to revive his shaken brigade, pointed and shouted words that would live long after him:

"There stands Jackson like a stone wall! Rally behind the Virginians!"

Whether Bee said those exact words or not—they were among his last—there and then Jackson acquired the nickname by which he will always be known. He earned it in the next few hours, as more reinforcements hurried from the rear, sent ahead by Johnston and directed into place by Beauregard. McDowell pushed two batteries of regular U.S. Army cannon far forward to pound Jackson's left. Stuart, watching that flank, warned Jackson and then charged, his horsemen scattering the infantry protecting the Yankee guns. Suddenly the 33rd Virginia regiment came out of the brush and let loose a volley that swept the cannoneers away. "It seemed as though every man and horse of that battery just laid right down and died right off," a civilian witness said.

The Confederates grabbed the Federal guns and turned them against the attackers, but in fierce seesaw fighting, the Yankees temporarily took them back. Beauregard's horse was shot from under him. Heintzelman was wounded as he drove his men ahead. Three times the Federals fought within yards of Jackson's line and were thrown back by a sheet of fire. When that last effort wavered, Beauregard took the offensive. Jackson threw his troops forward, ordering them to "Yell like furies!"—and they did, thus introducing the Rebel yell as a weapon of war. Francis Bartow was killed and Bee was mortally wounded as the Rebels surged ahead. The battle had turned, but it would turn again, and yet again.

In the chaos of driving the Federals downhill toward the turnpike, the Confederates exposed both their flanks. McDowell sent more troops at them, and pushed back up the hill. But in doing so, he exposed his own flank. At about 4 o'clock, two new Rebel brigades, under Brig. Gen. Kirby Smith and Col. Jubal Early, suddenly appeared from the rear. Smith, just arrived from the Shenandoah Valley, was seriously wounded almost immediately. Led by Col. Arnold Elzey, his troops kept moving and stretched the Confederate line to the left. Then came Early—in hot haste, now thoroughly committed to Virginia's cause—swinging his brigade still wider around the Union flank.

That did it.

Struck by this fresh wave of Rebels, McDowell's exhausted troops on that side started falling back. Seeing them, Beauregard raised a cheer and waved his whole line forward. The Confederates charged again, sending the Federals reeling back toward Bull Run. McDowell and Burnside tried and failed to halt them. At first the retreat was deliberate, as if the men were simply tired of fighting—as the historian John C. Ropes wrote, they "quietly but definitively broke ranks and started on their homeward way." But Stuart's cavalry harried them, and as they recrossed beyond Stone Bridge, Rebel cannon zeroed in on the turnpike. Then, according to Capt. James C. Fry of McDowell's staff, "the panic began...utter confusion set in: pleasure-carriages, gun-carriages, and ambulances...were abandoned and blocked the way, and stragglers broke and threw aside their muskets and cut horses from their harness and rode off on them." Congressman Alfred Ely of New York, among the civilians who had come out to enjoy the show, was captured in the stampede and barely escaped execution by a raging South Carolina colonel, who was restrained by Captain Alexander.

As Rebel artillery harassed McDowell's army, men "screamed with rage and fright when their way was blocked up," wrote Russell, the British correspondent. "Faces black and dusty, tongues out in the heat, eyes staring....Drivers flogged, lashed, spurred and beat their horses....At every shot a convulsion...seized upon the morbid mass."

McDowell himself was just as frank, if not as descriptive. After trying to organize a stand at Centreville, he was swept along by his fleeing army. Pausing at Fairfax that night, he fell asleep in the midst of reporting that his men were without food and artillery ammunition, and most of them were "entirely demoralized." He and his officers, he wrote, agreed that "no stand could be made this side of the Potomac."

The dark, stormy morning of July 22 found thousands of McDowell's men stumbling into Washington, soaked and famished, collapsing in doorways. The sight was "like a hideous dream," Mary Henry, daughter of the Secretary of the Smithsonian Institution, wrote in her diary. News of the rout inspired a panic: *Rebels about to march into Washington!* But the Rebels were nowhere near. Beauregard followed the retreat into positions he had held a week earlier, but his army was too disorganized to make a serious effort against the capital itself.

Thus ended the "Forward to Richmond!" campaign of 1861.

Bull Run—or Manassas, as Southerners call it, preferring to name Civil War battles for towns instead of watercourses—was a fierce battle, but not huge compared with those to come later. Counts vary, but the Union lost about 460 men killed, 1,125 wounded and 1,310 missing, most of those captured. The Confederates suffered about 390 killed, 1,580 wounded—and only 13 missing, because they occupied the field. Altogether, both sides lost about 4,900—fewer than a fifth of the casualties counted when they fought on the same ground a year later, and fewer than a tenth of those at Gettysburg in 1863. Regardless of numbers, the psychological effect on both sides was profound.

Jefferson Davis arrived at Manassas after the contest was decided and set off celebrations in Richmond with a message saying, "We have won a glorious though dear-bought victory. Night closed on the enemy in full flight and closely pursued." His speeches en route back, plus rumors from the front, made it sound as if he had gotten there just in time to turn the tide of battle. "We have broken the back bone of invasion and utterly broken the spirit of the North," the *Richmond Examiner* exulted. "Henceforward we will have hectoring,

bluster and threat; but we shall never get such a chance at them again on the field." Some of Beauregard's soldiers, feeling the same way, headed home.

A more realistic South Carolina official said the triumph was exciting "a fool's paradise of conceit" about how one Rebel could lick any number of Yankees. Among Union troops, he told diarist Mary Boykin Chesnut, the rout would "wake every inch of their manhood. It was the very fillip they needed."

Most of the North woke up Monday morning to read that the Union had won: news dispatches filed when McDowell's troops were driving the Confederates back had gone out from Washington, and War Department censors temporarily blocked later accounts. Lincoln, first buoyed and then struck hard by reports from the front, had stayed awake all Sunday night. When the truth came, his cabinet met in emergency session. Secretary of War Simon Cameron put Baltimore on alert and ordered all organized militia regiments to Washington. Generals and politicians competed in finger-pointing. Although McDowell with his green troops had very nearly won at Bull Run, after such a disaster he clearly had to go. To replace him, Lincoln summoned a 34-year-old Maj. Gen. George B. McClellan, who had won a series of minor clashes in western Virginia.

After days of alarm among citizens and public drunkenness among many of the Union's disheartened soldiers, calm returned and the North looked ahead. Few there could agree at first with the anonymous *Atlantic Monthly* correspondent who wrote that "Bull Run was in no sense a disaster...we not only deserved it, but needed it....Far from being disheartened by it, it should give us new confidence in our cause." But no one could doubt the gravity of the situation, that "God has given us work to do not only for ourselves, but for coming generations of men." Thus all the North could join in vowing that "to gain that end, no sacrifice can be too precious or too costly." Not until the following spring would McClellan take the rebuilt Army of the Potomac again into Virginia, and not for another three springs would the immensity of that sacrifice be realized.

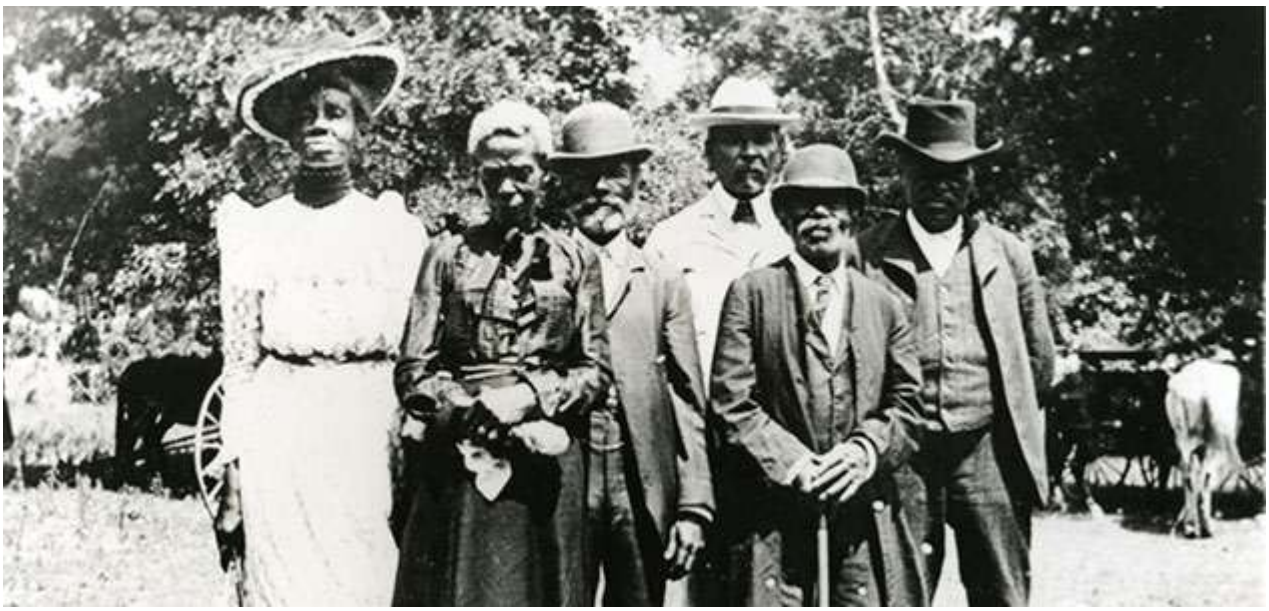
Ernest B. Furgurson has written four books on the Civil War, most recently *Freedom Rising*. He lives in Washington, D.C.

Find this article at:
http://www.smithsonianmag.com/history-archaeology/The-Battle-of-Bull-Run-The-End-of-Illusions.html

Juneteenth: Our Other Independence Day

Two and a half years after the Emancipation Proclamation, American slavery came to an end and a celebration of freedom was born

- By Kenneth C. Davis
- Smithsonian.com, June 16, 2011



The official Juneteenth Committee in East Woods Park, Austin, Texas on June 19, 1900

America's birthday is fast approaching. But let's not wait for July 4th to light the fireworks. There is another Independence Day on the horizon.

Juneteenth falls on June 19 each year. It is a holiday whose history was hidden for much of the last century. But as the nation now observes the 150th anniversary of the Civil War's onset, it is a holiday worth recognizing. In essence, Juneteenth marks what is arguably the most significant event in American history after independence itself—the eradication of American slavery.

For centuries, slavery was the dark stain on America's soul, the deep contradiction to the nation's founding ideals of "Life, liberty and the pursuit of happiness" and "All men are created equal." When Abraham Lincoln issued the Emancipation Proclamation on January 1, 1863, he took a huge step toward erasing that stain. But the full force of his proclamation would not be realized until June 19, 1865—Juneteenth, as it was called by slaves in Texas freed that day.

The westernmost of the Confederate states, Texas did not get news of Gen. Robert E. Lee's surrender at Appomatox that April until two months after the fact. But they heard once Union Gen. Gordon Granger, a New Yorker and West Point graduate with a distinguished wartime service record, arrived in Galveston Bay with more than 2,000 Union troops. It was on June 19 that he publicly read General Order No. 3, which began: "The people of Texas are informed that, in accordance with a proclamation from the Executive of the United States, all slaves are free."

In amazement and disbelief, the 250,000 former slaves in Texas learned that they had been freed by the Emancipation Proclamation, which could not be enforced until the war was over. (It applied only to the states "in rebellion" at the time it was issued.) Shocked, disoriented, most likely fearful of an uncertain future in which they could do as they pleased, the liberated slaves of Texas celebrated. Their moment of jubilee was spontaneous and ecstatic, and began a tradition of marking freedom on Juneteenth.

A grass-roots celebration highlighted by joyous singing, pig roasts, and rodeos, Juneteenth took root in many African-American communities during the late 19th century. But Juneteenth was never accorded official respect or recognition. In the bitterness of the Reconstruction and Jim Crow eras, few states of the former Confederacy had any interest in celebrating emancipation. And as many African-Americans migrated north, especially in the Depression era, Juneteenth became a largely forgotten vestige of the Civil War era.

Over the past few decades, however, there has been a movement to revive this celebration of more complete freedom in America. Today, 39 states and the District of Columbia recognize Juneteenth, although most don't grant it full "holiday" status. A Congressional resolution also underscores the historical significance of "Juneteenth Independence Day." And museums (including some of those that make up the Smithsonian Institution), now mark Juneteenth with annual programming.

Before emancipation, America's slaves and anyone else who prized equality, freedom and liberty knew that the Declaration of Independence only meant equality, freedom, and liberty for some. "What, to the American slave, is your 4th of July?" Frederick Douglass, the abolitionist and escaped slave, asked in his Independence Day oration in 1852. "I answer: a day that reveals to him, more than all other days in the year, the gross injustice and cruelty to which he is constant victim."

This year, let's remember Juneteenth, the holiday that doesn't mark a document, a battle, a birthday or a national tragedy, but the fundamental promise of America being more completely realized—the day on which Thomas Jefferson's rousing rhetoric finally rang true throughout America, for all Americans.

Kenneth C. Davis is the author of *Don't Know Much About History (Anniversary Edition) and A Nation Rising*.

Find this article at:
http://www.smithsonianmag.com/history-archaeology/Juneteenth-Our-Other-Independence-Day.html

Drones are Ready for Takeoff

Will unmanned aerial vehicles—drones—soon take civilian passengers on pilotless flights?

- By Richard Conniff
- Photographs by Robbie McClaran
- *Smithsonian* magazine, June 2011

During a test flight last year off the Pacific coast of Latin America, an aerial drone launched from the USS *McInerney* relayed back to the ship video of an open skiff speeding across the water. The frigate's crew had long experience chasing drug smugglers, so they knew what they were seeing. The skiff was 20 miles ahead of the frigate and moving away as the sun went down. In the flight control room, operators instructed the drone to take up the chase.

Over the next three hours, the skiff stopped twice and shut down its engine—standard practice among smugglers listening for law enforcement aircraft. The drone, a 23-foot-long helicopter trailing a mile or two behind, was quiet enough to evade detection. It also had the range to keep up the pursuit when a manned helicopter, roughly twice its size, would have had to turn back and refuel. By the time the skiff made its rendezvous with a fishing boat under cover of darkness, the *McInerney* was on its tail. A flare went up as a boarding party moved in. The startled suspects began dumping contraband, but 132 pounds of cocaine was recovered when the smugglers were arrested.

Until now, drone aircraft have been confined largely to war zones—most recently in Libya—and they have become controversial for killing civilians along with insurgents. But critics and boosters alike say unmanned aircraft will increasingly be used for peacetime work. They disagree about the likely scale of the industry, but the Federal Aviation Administration is already considering new rules and training staffers to adjust to unmanned aircraft in U.S. airspace. "It's not a matter of if, it's a matter of when," says Peter Singer, an analyst with the Brookings Institution. "Is it going to be 2012 or 2014? The point is, it's going to happen."

In fact, it's happening now. Unarmed versions of the military Predator drone already patrol thinly populated stretches of the nation's borders. Predators have also been flown over cities to assess damage after hurricanes, floods and earthquakes.When smoke grounded other aircraft during a 2009 forest fire in Circle, Alaska, a drone provided infrared imagery that allowed officials to determine that no evacuation was necessary. And

during the accident this spring at Japan's Fukushima Daiichi nuclear power plant, the world's largest drone analyzed the emergency from high altitude, while a backpack-size drone inspected the crippled reactors at close quarters.

Drones will probably move first into jobs deemed "too dull, dirty or dangerous" for humans, says MIT automation expert Mary "Missy" Cummings. To monitor marine mammal populations off Alaska, for instance, oil companies have employed small manned aircraft flying at 300 feet, 200 miles offshore, in icy conditions. But a drone operated by the University of Alaska at Fairbanks recently did the job quietly enough not to scare off the animals. Police agencies are also lobbying for permission to use drones for building searches in hostage situations and for traffic management. With no need to carry people, drones designed for such work come in all sizes and shapes. Some look like a flying engine cowling (minus the rest of the plane) or a laptop with tail fins. Some are as big as a 737; others have the heft, and flapping wings, of a sparrow.

Some drones also look like conventional aircraft, and Cummings believes unmanned systems will ultimately replace even commercial pilots. She first saw the possibilities in the 1990s as a Navy pilot landing a highly automated F-18. "On carrier landings, it always did better than humans," she says. At some airports today, Cummings notes, Boeing and Airbus jets take off, land and brake to a stop without human hands on the controls. She predicts that within ten years cargo planes will fly without human pilots and that passenger jets will ultimately follow.

First, though, somebody will need to work out some glitches: a few months after that drug bust at sea, Navy operators in Maryland experienced a "lost link"—like losing your wireless connection—with the same model drone, a Northrop Grumman Fire Scout, as it was traveling at 70 miles an hour straight toward Washington, D.C. The drone briefly entered restricted air space (within 40 miles of the capital). Military officers contemplated shooting down the 3,000-pound robotic helicopter over a heavily populated metropolis. But before anyone could scramble the F-16 fighter jets, technicians on the ground regained control and turned the drone back to base.

A good place to watch the developing drone revolution, with all its technological, commercial and ethical complications, is an hour east of Portland, Oregon, in the heart of the Columbia River Gorge, an area otherwise known for windsurfing, craft beer and political progressivism. Go almost anywhere on either side of the river—to an old school building in Bingen, Washington, say, or a former Chevy dealership in Hood River, Oregon—and you will find somebody working on drones.

The aeronautical engineer who got the industry started here is a boyish, reclusive character in his mid-50s with the perfect garage-inventor name, Tad McGeer. He runs the Aerovel Corporation, a start-up with nine employees, tucked behind a dense wall of pine trees in the rugged hills above Bingen. The entrance is a narrow gravel driveway with a broken-down gate. A wrecked Cessna sits in a derelict barn, and cars cluster around a big, blocky house at the end of a hayfield.

Inside, a staffer fabricates plane parts in what was once a child's bedroom, where the electronic controls for a coffin-like industrial oven now sit on a dresser decorated with beetles and snails. Aerovel's mechanical engineering laboratory occupies another bedroom, with horses and hearts painted on the walls. Test engines roar in the garages at either end of the house, and if it all looks a little makeshift, that suits McGeer just fine. "Aren't we all amateurs?" he asks, his voice a low murmur that fades in and out like a distant radio station. "There are a lot of people doing what we do, tinkering in a garage."

McGeer's longtime business partner, Andy von Flotow, operates in similar fashion on a farm on the Hood River side of the gorge. But where McGeer tends to be cautious and constrained, von Flotow is about moving obstacles aside and getting business done. He has a gleeful farm boy bearing, with sun-bleached blue eyes and weather-reddened skin. He also has a high regard for calculations scratched on the back of an envelope.

In a pear orchard nearby, von Flotow points out a trailer insulated with five tons of hay. It houses a fan capable of blowing air at 80 miles an hour through a 1,500-foot length of white silage tubing stretched out over a hill. In a meadow on the other side, a cradle built on an old orchard crate is designed to hold a drone running its engine at full speed in the silent wind.

"This is my Mil-14 meadow," von Flotow says, meaning that it meets military specifications for a sound-testing facility. (In addition to his partnership in Aerovel, von Flotow owns Hood Technology Corporation, which makes launchers, camera turrets and other military gear.) He uses the meadow in the dead of night to test different engine and muffler configurations. In springtime, the raucous calling of frogs in a nearby pond

can pose a challenge. “So I phone the sheriff to tell them not to send the police and then I fire a shotgun twice.” That buys him 30 seconds of silence.

McGeer and von Flotow, both Canadians who earned doctorates in aeronautical engineering from Stanford University, have spent much of their careers as seat-of-the-pants inventors, solving problems fast and cheap. Their idea of engineering is making something for a dime that any fool can make for a dollar, and having fun doing it.

McGeer got started in drones working on one of the first civilian models, the Perseus, which made its maiden flight over the Mojave Desert in November 1991. The hole in the ozone layer was a hot issue then, and the idea was that Perseus would take sophisticated measurements of atmospheric chemistry at high altitudes over Antarctica. But McGeer soon split off to develop the Aerosonde, a drone with a ten-foot wingspan that could take routine weather measurements by moving autonomously up and down through the atmosphere. He named the company Insitu, Latin for “in place.” “It would not have been possible to conceive of the idea a few years earlier,” says McGeer, who could take advantage of newly miniaturized technologies, particularly lightweight receivers for the Global Positioning System (GPS).

By 1998, McGeer was regularly flying Aerosondes, often operating out of an old school bus von Flotow owned. But atmospheric research was a niche market at best, with few customers in sight. “Maybe it’s time for a stunt,” von Flotow suggested. He had in mind the first Atlantic crossing by an unmanned aircraft. “I didn’t want to do a stunt,” says McGeer. “I wanted to fix our problems. We needed to test-test-test, break, fix, test-test, but we didn’t have the money to do it.”

He lost four aircraft in 200 hours of flight that spring—an average of 50 hours between failures. But even at $25,000 apiece, his cost at the time, drones are meant to be expendable. McGeer figured that an Atlantic crossing would take about 25 hours, “and I said, ‘OK, so if we send four aircraft across the ocean, our chances that one will make it are better than 90 percent.’ ” A major defense contractor in San Diego was also planning the first Atlantic crossing, with a drone (and a budget) the size of a 737. The *Los Angeles Times* billed it as a David-and-Goliath contest.

That August, on Bell Island in Newfoundland, McGeer sent a rental car racing down the runway with an Aerosonde on top, the first of two launches that day. On South Uist Island in Scotland, a BBC crew set up movie cameras and waited. Back then, says McGeer, ground control could communicate with a drone for only about 50 miles at either end. The team programmed in GPS waypoints and prayed that the planes would find them on their own. The plan, developed with a meteorologist from the University of Washington, was to make the 2,000-mile crossing on 1.5 gallons of fuel. After both drones failed to arrive the next day, the BBC packed up and left.

Three days later, McGeer launched two more. On South Uist the next day, a blip flashed on a laptop screen, then disappeared, leaving the landing crew tensely waiting. Soon after, a drone dropped down from the sky and landed softly in the grass. McGeer got the word by phone, in classic mission control monotone: “We have something you lost.” When he returned his rental, McGeer was thinking, “‘This is a historic car!’ But we had scratched the roof a bit and decided not to mention it.”

The achievement attracted potential customers in the tuna industry, which had suffered a series of deadly crashes of fish-spotting helicopters. The Pentagon also “began to make cooing noises,” says McGeer; drones had been doing military work almost as long as there had been aircraft, with uneven results.

McGeer and von Flotow decided to focus on tuna. “Tad has a basic conflict with the Eisenhower military-industrial complex thing,” says Juris Vagners, a colleague who teaches at the University of Washington. “He wants to do civilian stuff.” For the tuna industry, McGeer and von Flotow developed the SeaScan, a drone with a camera turret. They also had to figure out how to make takeoff and landing user-friendly for fishermen working on the deck of a small ship. For the launch, they devised a catapult powered by a Sears, Roebuck air compressor, with a release mechanism triggered by a man yanking a rope. Recovery was more complicated. McGeer eventually hit on the idea of flying one wing of the drone into a vertical rope, with the rope quickly slipping out along the leading edge of the wing to snag on a hook at the tip. Cutting the rope with the propeller wasn’t an issue because the prop is mounted at the tail, safely out of the way. The problem was developing a hook that would cause the plane to hang in midair, rather than slide down the rope and smash into the ground.

They tested mechanisms on von Flotow’s farm, using a plywood model of a SeaScan at the end of a five-foot rope. “I stood on a trailer and spun it around like a hammer thrower,” recalls Cory Roeseler, who does what

he calls “grunt engineering” for McGeer and von Flotow. But instead of releasing it like an Olympic athlete, he sidled the model over to a vertical line stretched down the corner of a barn. “When you hit the line, you can figure out which hooks snag and which hooks fail. You can do that in an afternoon. Good ideas rise to the top quickly if you have some plywood, a cordless drill and some good thinkers.”

The “skyhook” technology they developed in this fashion is now used a thousand times a month, on land and sea, almost always without incident. But it is still a spectacle. The drone circles for its approach, then comes whining in at about 50 miles an hour. GPS devices on the skyhook and the plane communicate, like air traffic control talking to a pilot, and the plane adjusts to an accuracy of a half-inch or less. Then it slams into the rope and snags 25 feet in the air, causing the skyhook to buck and sway as in an earthquake. “That’s violent,” says a visitor seeing it for the first time. An engineer’s view, says McGeer, with a proud, parental smile, is, “Just violent enough.”

The changes McGeer came up with to attract the tuna industry also suited the military. Steve Sliwa, a college friend McGeer brought in to run Insitu’s business side, was soon steering the company into a closer alliance with Boeing for defense work. McGeer’s SeaScan became the ScanEagle, a 40-pound surveillance drone. During the Battle of Fallujah in 2004, the ScanEagle spotted would-be assailants and sent real-time video to troops on the ground. Military demand rose rapidly. There are now 18 ScanEagles aloft at any moment, according to Insitu, mostly in Iraq or Afghanistan, and the company is the largest employer in the Columbia River Gorge, where the boast is sometimes heard that while the Predator costs millions and works for generals, a ScanEagle costs about $100,000 and works for gunnery sergeants.

The ScanEagle carries no weapons, but its camera helps target military strikes, and videos sent back to Insitu sometimes showed Iraqis being engulfed in flames. McGeer struggled with what he was seeing, then quit the company in 2005. Three years later, Boeing purchased Insitu for about $400 million. According to von Flotow, he and McGeer split about 10 percent of the total. McGeer remains conflicted about it. “If you’re a dead Iraqi,” he says, “you might not think it worked out all that well.”

It’s a sentiment that echoes around the gorge, but quietly. Between them, Hood River and Bingen are home to fewer than 8,000 people, and neighbors inevitably run into one another at Brian’s Pourhouse or the Wednesday night Secret Salsa dance club. Nobody wants to blame the conduct of war on neighbors who build the hardware. “It would be like blaming a bank teller for the financial crisis,” says one local who works in the industry. Von Flotow acknowledges that “nobody’s happy about it.” Then he adds: “Most engineering nerds are basically apolitical.”

The question everyone asks is how quickly unmanned technology can make the leap into the civilian market. The potential seems limitless—handling routine monitoring of pipelines and power lines, for instance, or gathering geomagnetic data about natural resources (a job that entails flying hundreds of miles in a straight line, at low altitude, then moving 50 yards over and flying straight back). Drones could help farmers monitor crops in distant fields, allow real estate developers to perform simple construction jobs in remote or difficult locations or enable environmentalists to spot polluters.

But these applications face major regulatory issues. Drone proponents say that the FAA has limited the domestic market because of safety questions and that the State Department has shut off the international market by restricting the export of defense technologies. New questions about privacy and civil liberties are also certain to arise. For instance, Aurora Flight Sciences, a Virginia firm, is testing a drone to conduct “wide area surveillance” over cities. Where a human observer might detect nothing, says Tom Clancy, the company’s chief technology officer, computer algorithms can “extract behaviors or patterns of movement” suggesting ill intent—for instance, a car passing a bank four times before circling back and stopping. Would a court consider that probable cause for a police search?

The Brookings Institution’s Singer believes that the adjustment to drones will be as challenging as the adjustment to horseless carriages at the start of the 20th century. Regulatory issues are the main reason the Teal Group, aerospace industry analysts, recently estimated that the nonmilitary portion of the drone market will grow only to $500 million a year by 2020, up from $300 million now. Meanwhile, the military market will double, from $5 billion worldwide today.

The problem, says John Allen, the FAA’s director of flight standards, is that “there are too many lost [communications] links now. Some would say it’s not that big a deal—‘The aircraft continues to fly, it’s not going to come plummeting to earth.’ ” Drones are typically programmed to go into a holding pattern—or return to base—when they lose contact with ground control. “Well, that might be fine in a combat

environment," Allen says, "but in a civil environment, with a very congested national airspace, that creates a problem."

Under current FAA rules, operators of unmanned aircraft must have a certificate of authorization; only 264 such certificates are active, most for research and development in remote areas. "What they would like," says Allen, "is to not have to go for that permission every time," and simply file a flight plan and take off, like manned aircraft. But human pilots can see and avoid small planes flying by visual flight rules. Many drones, he says, lack the technology to "sense and avoid."

The FAA is considering rules that would continue to separate unmanned aircraft from conventional air traffic but relax restrictions on drones weighing less than 50 pounds and flying below 400 feet. Allen predicts the change, likely to take effect late next year, will spur entrepreneurs and government agencies to launch thousands of new drone applications. But opening the national airspace to larger drones—some with the wingspan of a passenger jet—will be more complicated, he says, requiring "a lot of cultural change" and more reliable technology.

One watchdog database lists more than 50 accidents involving large military drones since 2007. Most took place in Afghanistan or Iraq, where combat sometimes requires pushing a drone to unsafe extremes. But a Predator providing surveillance along the Mexican border crashed in this country, when an operator accidentally shut off its engine. Officials at U.S. Customs and Border Protection and the FAA disagree about whether the Predator's domestic record adds up to a few minor mistakes over four years of safe civilian operations—or 350 times the accident rate for commercial aviation.

The concern expressed even by some in the drone community is that a careless accident early on could be a disaster for the entire industry. The first fatality involving a civilian drone has already occurred. In August 2009, a Yamaha RMAX helicopter, a commercial drone about the size of a motorcycle, crashed while crop-dusting a field in South Korea. Part of the rotor sheared off and penetrated the abdomen of a bystander, who bled to death. Yamaha has since halted RMAX production.

"We have accidents more often because we're not carrying people," says Sliwa. "The safety systems on manned aircraft are designed for a ten-to-the-minus-six probability of an accident." That's one in a million. For unmanned aircraft, he said, it's more like a ten-to-the-minus-four thing. That's one in 10,000. "But we'll get there. Back when our parents were growing up, there was a form of transport you would not get into without a human operator, and that was an elevator. Now we step in and push a button."

But the real obstacle, McGeer argues, isn't regulation—it's cost. There are a lot of human pilots out there, and they love what they do. So their services come cheap. You can rent a piloted Cessna for as little as $100 an hour, he says.

Unmanned aircraft typically require at least two people, and sometimes many more, doing ground control. The work involves sitting in front of a computer for hours at a time, so no one does it for fun. Drones also represent a relatively new technology, with high research and other start-up costs for a product that's still manufactured in relatively small numbers.

Costs will almost inevitably come down. For instance, it may be possible to develop systems that enable one ground controller to handle four or five drones at a time. To alleviate FAA concerns about that approach, Insitu executive Paul McDuffee suggests, a UPS or FedEx plane might have one human pilot to communicate with air traffic control—and three unmanned planes flying in formation behind. It is, he acknowledges, "a Buck Rogers theoretical concept." McGeer is skeptical. Congressional earmarks may support a few civilian uses, but earmarks are drying up. For now, he believes the military is likely to remain the primary buyer of unmanned aircraft.

In an alley between two vineyards on his farm, von Flotow watches staffers use a catapult launcher to fire a 150-pound hunk of rusting steel up a zip line. They're testing brake systems to stop the hunk of steel before it comes slamming back down. They need to get the braking right because this is how they will soon test a new multimillion-dollar military drone packed with pricey electronics.

To a casual observer, it looks like boys on the farm having fun. But they're working on a joint Navy and Marine contract recently won by Insitu, and, von Flotow says, it is complicating their lives. Instead of getting an idea and trying it out the same afternoon with a cordless drill and some plywood, "we have to wait for hundreds of guys in Maryland to tell us what to do," he says. And instead of working for the fun of it, they must now account for their time in ten-minute increments. What they used to do for a dime can end up costing a dollar.

Over at Aerovel, meanwhile, McGeer is back where he started 20 years ago, thinking about the weather. What he has in mind is a drone that could take off from the West Coast, land itself on a ship in Hawaii to refuel without human assistance, then take off and fly home again, over and over, continuously sending back low-altitude weather data. It is a typically quixotic project. The lack of good storm-intensity forecasts has huge economic costs, but filling that need won't automatically generate big profits because the economic benefits are too widely diffused.

McGeer wants to accomplish the new mission with a drone that can take off and land vertically, eliminating launchers and skyhooks. Vertical takeoff and landing, or VTOL, is "historical snake oil in the aeronautical industry," he admits. For decades, science magazines have conjured up futuristic visions of such vehicles taking off from people's driveways, but the trade-offs required to get both the hovering ability of a helicopter and the forward speed of a fixed-wing aircraft have grounded most such aspirations. McGeer thinks he has a better idea, and new technology to make it happen.

The test drone stands on the driveway outside his garage, its engine roaring. It's just a stripped-down tube, capable only of takeoffs and landings, not horizontal flight. For now, the wings are just a stick, like a scarecrow's arms. Lately, the engine has been dying mysteriously after two or three hours. A staffer has put in an order for a carburetor rebuild kit, but it will take a day or two to arrive. "Isn't it just a chain saw carburetor?" McGeer asks. It starts to rain, which is a problem because they haven't sealed up the avionics yet. McGeer is undaunted. The "test-test-test, break, fix, test-test" mantra is his life.

Better to come back another day, he suggests. He isn't making any promises. But it might just fly.

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Find this article at:
http://www.smithsonianmag.com/science-nature/Drones-are-Ready-for-Takeoff.html

The Giant Squid: Dragon of the Deep

After over 150 years since it was first sighted by the HMS Daedalus, the mysterious creature still eludes scientists

- By Brian Switek
- Smithsonian.com, June 22, 2011

There are few monsters left in the world. As our species has explored and settled the planet, the far-flung areas marked "Here Be Dragons" have been charted, and toothy terrors once thought to populate the globe have turned out to be imaginary or merely unfamiliar animals. Yet some elusive creatures have retained their monstrous reputation. Foremost among them is *Architeuthis dux*—the giant squid.

The creature—likely the inspiration for the legendary kraken—has been said to have terrorized sailors since antiquity, but its existence has been widely accepted for only about 150 years. Before that, giant squid were identified as sea monsters or viewed as a fanciful part of maritime lore, as in the case of a strange encounter shortly before scientists realized just what was swimming through the ocean deep.

At about 5:00 in the afternoon on August 6, 1848, Capt. Peter M'Quhae was guiding the HMS *Daedalus* through the waters between the Cape of Good Hope and the island of St. Helena off the African coast when the crew spotted what they described as a gigantic sea serpent. The beast was unlike anything the sailors had seen before. News of the encounter hit the British newspaper *The Times* two months later, telling of the ship's brush with a nearly 100-foot monster that possessed a maw "full of large jagged teeth … sufficiently capacious to admit of a tall man standing upright between them."

M'Quhae, who was asked by the Admiralty to confirm or deny this sensational rumor, replied that the stories were true, and his account was printed a few days later in the same newspaper. Dark on top with a light underbelly, the sinuous, 60-foot creature had slipped by within 100 yards of the boat, and M'Quhae proffered a sketch of the animal made shortly after the sighting.

Precisely what the sailors had actually seen, though, was up for debate. It seemed that almost everyone had an opinion. A letter to *The Times* signed "F.G.S." proposed that the animal was a dead ringer for an extinct, long-necked marine reptile called a plesiosaur, fossils of which had been discovered in England just a few decades before by fossil hunter Mary Anning. Other writers to the newspapers suggested the animal might be a full-grown gulper eel or even an adult boa constrictor snake that had taken to the sea.

The notoriously cantankerous anatomist Richard Owen said he knew his answer would "be anything but acceptable to those who prefer the excitement of the imagination to the satisfaction of judgment." He believed

that the sailors had seen nothing more than a very large seal and conferred his doubts that anything worthy of the title "great sea serpent" actually existed. It was more likely "that men should have been deceived by a cursory view of a partly submerged and rapidly moving animal, which might only be strange to themselves." M'Quhae objected to Owen's condescending reply. "I deny the existence of excitement, or the possibility of optical illusion," he shot back, affirming that the creature was not a seal or any other readily recognizable animal.

As was the case for other sea monster sightings and descriptions going back to Homer's characterization of the many-tentacled monster Scylla in *The Odyssey*, attaching M'Quhae's description to a real animal was an impossible task. Yet a series of subsequent events would raise the possibility that M'Quhae and others had truly been visited by overly large calamari.

The naturalist credited with giving the giant squid its scientific start was Japetus Steenstrup, a Danish zoologist at the University of Copenhagen. By the mid-19th century, people were familiar with various sorts of small squid, such as species of the small and widespread genus *Loligo* that are often eaten as seafood, and the basics of squid anatomy were well known. Like octopus, squid have eight arms, but they are also equipped with two long feeding tentacles that can be shot out to grasp prey. The head portion of the squid pokes out of a conical, rubbery structure called the mantle, which encloses the internal organs. Inside this squishy anatomy, the squid has two hard parts: a tough internal "pen" that acts as a site for muscle attachment, and a stiff beak that is set in the middle of the squid's ring of sucker-tipped arms and used to slice prey. Since naturalists were only just beginning to study life in the deep sea, relatively few of the approximately 300 squid species now known had been discovered.

In 1857, Steenstrup combined 17th century reports of sea monsters, tales of many-tentacled giant creatures washed up on European beaches, and one very large squid beak to establish the reality of the giant squid. He called the animal *Architeuthis dux*. His only physical evidence was the beak, collected from the remains of a stranded specimen that had recently washed ashore. Steenstrup concluded: "From all evidences the stranded animal must thus belong not only to the large, but to the really gigantic cephalopods, whose existence has on the whole been doubted."

Subsequent run-ins would leave no doubt as to the giant squid's reality. In November 1861, the French warship *Alecton* was sailing in the vicinity of the Canary Islands in the eastern Atlantic when the crew came upon a dying giant squid floating at the surface. Eager to acquire the strange animal, but nervous about what it might do if they came too close, the sailors repeatedly fired at the squid until they were sure it was dead. They then tried to haul it aboard, unintentionally separating the tentacled head from the rubbery tail sheath. They wound up with only the back half of the squid, but it was still large enough to know that this animal was far larger than the familiar little *Loligo*. The ensuing report to the French Academy of Sciences showed that the *poulpe* could grow to enormous size.

Encounters in North American waters added to the body of evidence. A dead giant squid was discovered off the Grand Banks by sailors aboard the *B.D. Haskins* in 1871, and another squid washed up in Fortune Bay, Newfoundland.

The naturalist Henry Lee suggested in his 1883 book *Sea Monsters Unmasked* that many sea monsters — including the one seen by the crew of the *Daedalus*—were actually giant squid. (Accounts of M'Quhae's monster are consistent with a giant squid floating at the surface with its eyes and tentacles obscured underneath the water.) The numerous misidentifications were simply attributable to the fact that no one actually knew such creatures existed!

Instead of being tamed through scientific description, though, the giant squid seemed more formidable than ever. It was cast as the villain in Jules Verne's 1869 novel *20,000 Leagues Under the Sea*, and in 1873 news spread of a giant squid that had allegedly attacked fishermen in Conception Bay, Newfoundland. The details are a little murky due to some creative retelling over the years, but the basic story is that two or three fishermen came upon an unidentified mass in the water. When they tried to gaff it, they discovered that the thing was a giant squid—which then tried to sink their boat. Some quick hatchet work sent the monster jetting away in a cloud of dark ink, and the proof of their encounter was a 19-foot-long tentacle. The fishermen gave it to the Rev. Moses Harvey, who was given the body of another giant squid by a different group of Newfoundland fishermen soon afterward. He photographed the latter specimen before sending it on to naturalists in New Haven, Connecticut, for study. The fame and reputation of the "devil fish" was at its

acme—so much so that the showman P.T. Barnum wrote to Harvey requesting a pair of giant squid of his own. His order was never filled.

The giant squid was transformed into a real monster, and one whose unknown nature continues to frighten us. Not long after giving sharks a bad rap with *Jaws*, Peter Benchley made a particularly voracious giant squid the villain of his 1991 novel Beast. The second *Pirates of the Caribbean* film in 2006 transformed the squid into the gargantuan, ship-crunching kraken.

The enormous cephalopod still seems mysterious. *Architeuthis* inhabit the dark recesses of the ocean, and scientists are not even sure how many species are in the giant squid genus. Most of what we know comes from the unfortunate squid that have been stranded at the surface or hauled up in fishing nets, or from collections of beaks found in the stomachs of their primary predator, the sperm whale.

Slowly, though, squid experts are piecing together the natural history of *Architeuthis*. The long-lived apex predators prey mainly on deep-sea fish. Like other ocean hunters, they accumulate high concentrations of toxins in their tissues, especially those squid that live in more polluted areas. Marine biologists say that giant squid therefore can act as an indicator of deep-sea pollution. Giant squid strandings off Newfoundland are tied to sharp rises in temperature in the deep sea, so giant squid may similarly act as indicators of how human-driven climate change is altering ocean environments. There are two giant squid, measuring 36- and 20-feet long, on display in the National Museum of Natural History's Sant Ocean Hall. As NMNH squid expert Clyde Roper points out, they are "the largest invertebrate ever to have lived on the face of the earth."

In 2005, marine biologists Tsunemi Kubodera and Kyoichi Mori presented the first underwater photographs of a live giant squid in its natural habitat. For a time it was thought that squid might catch their prey through trickery—by hovering in the water column with tentacles extended until some unwary fish or smaller squid stumbled into their trap. But the images show the large squid aggressively attacking a baited line. The idea that *Architeuthis* is a laid-back, deep-sea drifter began to give way to an image of a quick and agile predator. The first video footage came in December of the following year, when scientists from the National Science Museum of Japan recorded a live giant squid that had been hauled up to the surface next to the boat. Video footage of giant squid in their natural, deep-sea environment is still being sought, but the photos and video already obtained give tantalizing glimpses of an enigmatic animal that has inspired myths and legends for centuries. The squid are not man-eating ship sinkers, but capable predators in an utterly alien world devoid of sunlight. No new images have surfaced since 2006, which seems typical of this mysterious cephalopod. Just when we catch a brief glimpse, the giant squid retreats back into the dark recesses of its home, keeping its mysteries well guarded.

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The Top Ten Deadliest Animals of Our Evolutionary Past

Humans may be near the top of the food chain now, but who were our ancestors' biggest predators?

One of the most famous hominid fossils is the skull of a 3-year-old child found in Taung, South Africa. The child lived about three million to two million years ago. The skull has holes punched into its eye sockets; they were made by the talons of a large bird akin to an African crowned eagle.

Read more: http://www.smithsonianmag.com/science-nature/The-Top-Ten-Deadliest-Animals-of-Our-Evolutionary-Past.html#ixzz1QKzOIyTm

- By Rob Dunn
- Smithsonian.com, June 21, 2011

If you live in a developed country, odds are you are going to die of a heart attack, stroke, cancer or an accident. But it was not always this way. For most of our evolutionary history as primates, one of the most common causes of death, perhaps *the* most common cause, was, well, being eaten.

Starting with the first primates, which evolved about 65 million years ago, our ancestors were about the size of a monkey, if not smaller. Larger apes evolved about 13 million years ago, eventually producing today's gorillas, chimpanzees, orangutans, bonobos and us. Hominids, including our direct ancestors, split from chimps and bonobos about seven million years ago, and our own species, *Homo sapiens*, is only about 200,000 years old. Evidence of our historic fates comes from knowing what eats monkeys or apes today, and from studying what ate now-extinct species. For example, many of the best fossils of hominids come from piles of bones near places where predators ate lunch.

Here then are ten of the animals likely to have killed our ancient and not so ancient kin. The fact that you are alive means your direct ancestors escaped these fates, if not forever then at least long enough to reproduce.

1. Lions and tigers and leopards, oh #$*@!

Leopards are extraordinarily good at eating primates. They are stealthy. They run fast (at least faster than our ancestors). They leap powerfully (up into primates' sleeping trees). And they can carry great weights (our bodies) to wherever it might be safe for them to pause and dine. With this combination of traits, leopards have been breathing down our necks for as long as 10 million years.

Today's leopards show what our ancestors had to contend with. In one study in South Africa's Kruger National Park, 70 percent of baboon deaths were attributed to African leopards. In another study, half of the mammals that leopards killed were monkeys or chimpanzees; they also kill young gorillas. When scientists pick through leopard scat, many of the bones they find are from primates—ribs, fingers, toes and skulls, all of them remarkably similar to our own skeleton. Baboons seem to get eaten by leopards at night, monkeys during the day. Scientists, on the other hand, are most likely to get eaten when they pause while picking through leopard scat to say, "Hey, I think this looks fresh!"
Primates, including humans, are also eaten by lions in Africa, tigers in the Asian tropics, and cougars and jaguars in the Americas. A single troop of chimpanzees in Tanzania had four of its members eaten by lions in just a few days in 1989. The authors of that study reported, a bit somberly, that the "responses of chimpanzees to lions included alarm calls, whimpers, climbing into trees, and silence." We have no reason to believe our ancestors' responses were any different.

2. The first humans to fly
I tease my neighbor because she worries about red-tailed hawks carrying off her small dog, but the truth is that not so long ago, eagles would have carried off our small children. One of the most famous hominid fossils is the skull of a 3-year-old child found in Taung, South Africa. The Taung child was a member of the *Australopithecus africanus* species, which lived in Africa from about three million to two million years ago. The skull has holes neatly punched into its eye sockets; they were made by the talons of a large bird akin to an African crowned eagle. The skull was found among other bones under what has been interpreted as a nest. More recently, great piles of roughly five-million-year-old fossil monkey skulls, many of them with talon holes, were discovered in Angola under what appear to have been four separate eagle nests.
Today, 90 percent or more of the prey of crowned eagles in Kibale National Park in Uganda are primates, mostly cercopithecoid monkeys. Primates are also the favorite prey of harpy eagles in the tropical forests of the Americas. Perhaps the clearest indication of just how important predation, and predation by birds in particular, is in primate evolution comes from the lexicon of monkeys. Monkeys have distinct calls for different predators. Those terms include, "cat," "snake" and, to paraphrase, "oh crap, eagle." "Ohcrapeagle" may well have been one of the first human words.

3. Snakes
Snakes have long influenced our fate and evolution. In parts of Africa, venomous snakebites are common, and many of those bites prove deadly. Venomous snakes aren't the only kind that kill humans and other primates today and might have killed our ancestors—constrictors can also do a fine job. New observations by Cornell University biologist Harry Greene even suggest that in some indigenous populations today, constricting snakes may be one of the most common causes of death.

4. A primate-eat-primate world
Anthropologists have argued, variously, that early hominids were aggressive hunters, peaceful foragers, hairless swimmers, sneaky scavengers and a dozen other things. Time may or may not tell. But some of our ancestors were almost certainly food for other primates. Today, some chimpanzees are, in effect, monkeyvores. In Uganda, chimps preferentially eat red colobus monkeys, which are said to taste like chicken. In other regions, chimps prefer black and white colobus monkeys. There is, as they say, no accounting for taste. Orangutans eat gibbons. Blue monkeys eat bush babies, squirrel-size nocturnal primates. Capuchin monkeys, those adorable organ grinders, eat owl monkeys and so on. Primates eat primates, and this has long been the case.

5. Dog days
There is a reason why the author of *Little Red Riding Hood* chose a wolf to put in Grandma's bed. Wolves do occasionally kill humans, particularly in parts of Eastern Europe. Deaths seem to be more likely in the spring when mothers are hunting for food for their cubs. Data are sparse, but historic predation by wolves on young humans may once have been common—common enough to influence our stories and fears.
6. Nothing to laugh about

Spotted hyenas regularly prey on baboons and, in some regions, people. In the 1950s, hyenas ate 27 people in Malawi. But the real primate eaters are hyenas' extinct relatives. As many as 100 hyena species have existed alongside primates. Many of those hyenas were big, mean brutes, including the short-faced hyena, *Pachycrocuta*, which was the size of a lion. It lived from three million to 500,000 years ago alongside the first hominids, such as *Australopithecus*, and more recent species in our lineage. It had a mouth capable of fully enveloping a hominid's head, which it did. A treasure trove of skulls of "Peking man" (*Homo erectus*) found in China prior to World War II appears to have been from the waste pile of a *Pachycrocuta*.

7. Extinct monsters

Some of the most ferocious animals that once ate our kind are unlike any predators we contend with today. Even when they are reconstructed in museum exhibits, they appear more imaginary than real: giant hyenas, as mentioned, but also giant bears (*Agriotherium*), saber-toothed cats (*Homotherium, Machairodus, Megantereon*) and "false" saber-toothed cats (*Dinofelis*). In Australia, the first aboriginal colonists would have encountered giant, predatory kangaroos. Whether those roos proved deadly, we do not know. But imagine being chased by a giant hopping animal with six-inch-long teeth. Saber-toothed cats used their teeth to cut flesh, like pulling barbecue off a rib. In all likelihood, that flesh would have included that of our ancestors and kin, though the only evidence of their effects is from a single hominid skull bearing two holes, one for each saber.

8. Dragons, sharks and other local specialties

As *Homo sapiens* moved around the world, some of us ended up on lush islands with abundant fruit and no predators. Others ended up in the Komodo Islands, alongside Komodo dragons. These monitor lizards, weighing as much as 300 pounds, sometimes eat people, even today, especially tourists. Locals are said to have learned to avoid the monitors, but one imagines that this involved trial and—fatal—error. Many predators may have had big effects on human populations in specific regions, even if they did not affect our species' fate more generally. For people who live near the sea, sharks have left their mark. In some regions, swimming is avoided for the simple reasons that swimmers get eaten. People in the Arctic are constantly on guard against polar bears. There were many different ways to be eaten by a predator, a true measure of earth's biodiversity of claws and teeth.

9. In cold blood

Orangutan researchers Birute Galdikas and Carey Yeager were working in Indonesia when they observed a kind of crocodile in action. "At approximately 0730 h a false gavial shot from the water, grasped the macaque's back, and, with the monkey in its jaws, resubmerged," they wrote. "Some macaques vocalized immediately afterwards, and the victim's nearest neighbor ran about 5 m away from the river edge." This moment may have been a kind of reenactment of earlier such events, with slightly different protagonists (sometimes African crocodiles and humans, for example). Galdikas thinks that predation by gavials may account for a learned wariness of water among crab-eating macaques. Proboscis monkeys are also eaten by crocodilians.

Our ancestors had to worry about crocodilians, too. A new species of extinct crocodile was recently found in Kenya's Olduvai Gorge, where many hominid fossils have been collected. It was named *Crocodylus anthropophagus*. "Anthropophagus" means human- or hominid-eating, and it earned the name in part because skeletons of both *Homo habilis* and *Australopithecus bosiei* were discovered not far from the crocodile bones. The skeletons bear the marks of what appear to be crocodile teeth and are missing their left feet.

10. The deadly now

The species listed so far were some of the most likely agents of our demise during our distant evolutionary history. As human populations grew and developed new technologies, predators became more rare because we killed them or ate their other prey. Eventually, a new "most deadly animal" emerged: the mosquito. Malaria, yellow fever and dengue, among other mosquito-borne diseases, evolved with agriculture and the expansion of civilization. Billions of humans have died because of mosquitoes, influencing our genes and even our behavior.

Even where we have beaten back our ancestral predators, we bear their mark. Our brains are wired for fight and flight because of predators. We are anxious. We readily fear what used to threaten us, such as snakes. We are who we were, but more so than that, we are what we wanted to escape. Our first words may have been uttered to warn our family of cats, snakes or eagles. Even our screams, those wordless sounds we make when we are afraid, are an echo of the ghosts of our pasts. Whether we notice or not, our bodies remember those days in which the wolf in Grandma's bed may really have been a wolf; they remember the species we ran from, screaming as we tried to flee.

Rob Dunn is a biologist at North Carolina State University. His new book, The Wild Life of Our Bodies, *is being published this week. It tells the stories of our changing relationships with other species (be they worms, bacteria or tigers). In doing so, it considers questions such as what our appendix does, why we suffer anxiety, why human babies tend to be born at night and whether tapeworms are good for us, all from an ecological perspective.*

Find this article at:
http://www.smithsonianmag.com/science-nature/The-Top-Ten-Deadliest-Animals-of-Our-Evolutionary-Past.html

Sewage Epidemiology Not Just a Pipe Dream

Before wastewater is treated, scientists can look for traces of illegal drugs. (photo courtesy of flickr user DefMo)

Archaeologists often talk about the importance of trash—you can learn a lot about a culture by looking at what it threw away. Chemists may say the same thing about another kind of waste: sewage. Throughout last year, researchers at the Norwegian Institute for Water Research monitored the illegal drug habits of half a million people in Oslo by chemically sifting through the sewers. The work is an example of the emerging field of "sewage epidemiology."

The research field has developed over the past decade (*Popular Science* has a good article on the early days). The idea is that screening for drugs that pass through the body and then get flushed down the toilet may be one of the fastest, most accurate ways to assess a community's drug use. After all, people can lie in surveys, and segments of the population can be overlooked. It's harder to manipulate what goes into the sewers (although I can imagine that if sewage epidemiology really takes off, paranoid drug users may look for alternative ways to get rid of their personal waste).

In the Norwegian study, published online in the journal *Environmental Science & Technology*, Christopher Harman, Malcolm Reid and Kevin Thomas placed chemical samplers in a wastewater treatment plant and, over the course of a year, looked for cocaine, amphetamine, methamphetamine, Ecstasy and the chemicals that these drugs break down into during digestion.

They found some interesting results. For example, concentrations of cocaine went up on the weekends, and Ecstasy spiked in the month of May. The researchers note that this peak coincided with "russefeiring," a two-week celebration for recent high school graduates.
Based on the concentrations of each drug—and knowing certain factors like how much of a drug gets excreted by the body—the team calculated backward to figure out drug usage. For cocaine, daily consumption averaged between 0.31 and 2.8 grams per 1,000 inhabitants. The researchers say this is in line with estimates from Spain.

The Norwegian study looked only at one wastewater treatment plant that serves much of Oslo and three neighboring areas, but other studies have tracked drug usage over a much larger area. In 2008, researchers collected samples from 96 municipalities in Oregon, accounting for 65 percent of the state's population. They found that cocaine use was much higher in urban areas whereas methamphetamine was found everywhere. The Oregon study was only a one-day snapshot of drug habits. But if such a study were maintained over time, sewage epidemiology could be a powerful drug-tracking tool for law enforcement. As the *Popular Science* article points out, such analyses could allow officials to evaluate the effectiveness of anti-drug campaigns or follow drug supply lines.

The possibility of constant wastewater monitoring may make some people uncomfortable, but I find it fascinating that scientists can track a range of behaviors—from prescription drug use to preferences in cosmetics—with a test tube of sewer water. I wonder what sewage epidemiologists will be looking for next.

http://blogs.smithsonianmag.com/science/2011/06/sewage-epidemiology-not-just-a-pipe-dream/

Ranking the Online Colleges

June 30, 2011

U.S. News & World Report, which in the last three decades has become one of the most successful and controversial kingmakers in higher education, is taking preliminary steps to apply its rankings to the increasingly important realm of online colleges.

Meanwhile, a *U.S. News* spin-off site accidentally profiled a new program at an online institution considered by some authorities to be a "degree mill" — a mistake that, while it was swiftly corrected when brought to the attention of the editors, highlighted just how difficult it can be to size up online institutions in the current environment.

Brian Kelly, editor of *U.S. News,* this week sent out a memo to more than 1,000 officials at online colleges and university-based online programs notifying them that, over the next few weeks, the publication would be soliciting data from their institutions with an eye to ranking programs that are delivered at least 80 percent online. The target for release of the inaugural *U.S. News* online program rankings is mid-October.

"With the rapid growth of online programs in higher education, prospective students are asking for more, and more useful, data to make informed choices," Kelly wrote in the memo. "We are creating a site that will bring the same quality of information to online consumers, and the same opportunity for schools to connect with those students, that we've brought to brick and mortar institutions over the last three decades."

U.S. News is taking aim at just a few types of online programs this time around: master's programs in business, computer information technology, education, engineering, and nursing; and baccalaureate programs. (These are the programs with the highest online enrollments, according to *U.S. News.*) The publication will not be sizing up any online associate or doctoral degree programs, nor will it be ranking institutions overall, as it does with traditional colleges and universities.

The formulas for these rankings have not been determined. But the online versions could differ from the traditional rankings in several ways, said *U.S. News* officials. For example, the initial rankings will not include peer-assessment scores, in which college presidents rank institutions that are similar to their own -- historically one of the publication's most controversial metrics.

The rankings arrive at a time when typing "best online colleges" into an Internet search engine is more likely to bring a potential student to a lead-generation website — a site that collects their contact information and educational interests and sells it to recruiters — than any kind of rigorous, data-driven assessor of various online options.

U.S. News hopes to provide a tool for evaluating online programs based on "old-fashioned" data collection and analysis, said Robert Morse, the director of the rankings.

In interviews on Wednesday, Morse did not want to talk about specific rankings methodologies because they have not yet come up with criteria for assessing the different types of online programs — and also because they do not want respondents to withhold certain information because they think it might result in a bad ranking. The plan is to solicit a wide range of data, and then decide on criteria based on a combination of what makes sense, according to scholarly research into online course effectiveness and interviews with online education authorities, and what comes back, said Morse.

However, the rankings director did give some indications of what data *U.S. News* is seeking. For example, there are questions about the degree to which faculty members are trained to teach online; whether the same

faculty members who teach the online version of a course teach the traditional classroom version; what proportion of faculty are adjuncts; the extent to which a program polices cheating on online tests; how much debt the average student takes on and job placement and salary upon graduation (it will not be asking about program-level loan default rates); and a number of traditional metrics, such as graduation and retention rates.

Both Kelly and Morse acknowledged that one of the biggest challenges of compiling the rankings will be getting cooperation from for-profit colleges, which make up a significant part of the online sector but generally shy away from giving up data they are not required by law to disclose.

But many traditional institutions were no different when *U.S. News* first began soliciting them for rankings data in 1983, said Kelly. Eventually, many "realized it was in their interest, and it became a national standard," he said. He said he hopes proprietary online institutions will arrive at the same conclusion. "Our feeling is the good institutions will want to share these data," Kelly said. "And that we're going to work with them to make sure we get accurate info in people's hands."

Morse emphasized that the initial survey and methodologies will not be perfect. "Any ranking or evaluative list that we do is going to be our first attempt," he said, "and we know as data get better they'll evolve over time to become more robust and sophisticated."

The upside is especially high with online institutions, said Kelly, since they have more data on student outcomes than do traditional colleges and universities. With the amount of data programs are collecting through their online learning environments, *U.S. News* believes it can not only match the reliability of its current rankings with the online version, but exceed it. Online programs "are about data and measurement," said Kelly. "And when you have great data and measurement ability you can create great rankings."

Generation Gap

At the same time that *U.S. News* was promoting its expansion into online college ranking, a spin-off site it opened two years ago unwittingly wrote a plug for a new program at an online institution, Almeda University, that is not recognized as a legitimate degree-granting university by the U.S. Department of Education or any mainstream accrediting agency, and which has been flagged as a "degree mill" by the Oregon state government.

"Working adults who want to pursue a psychology master's degree can benefit from the flexibility of online programs, such as the one offered by Almeda University's School of Psychology," said a news brief posted Monday on U.S. News University Directory.

The editors of the site took down the posting after it was brought to their attention by *Inside Higher Ed*, which was tipped off by the watchdog site GetEducated.com. "As a matter of principle we generally focus on accredited colleges and universities and the programs they offer," the University Directory editors wrote in an e-mail. "On the rare occasion, such as this, when we learn that the institution's accreditation is in question, we take appropriate action."

The publication opened University Directory two years ago in bid to move into the business of lead generation through a partnership with Bisk Education, Inc.

The move raised eyebrows among some critics, who wondered whether *U.S. News'*s attempts to capitalize on its authority in the higher education world might in fact compromise its credibility as a disinterested observer of the industry.

Kelly said the news brief about Almeda's psychology program was the result of simple editorial oversight, not any kind of advertising deal with Almeda.

Press releases might be parroted in the pages of University Directory, not always with attribution, said Kelly; not because universities are paying for the exposure, but because such releases are just "part of the news flow" in the content-obsessed world of the modern news industry. Another effect of the push for more content is that errors are more common than they were before — at *U.S. News* as elsewhere, Kelly said.

Indeed, the gaffe suggests that the opportunities and demands of the Internet age complicate matters both for higher education institutions and for those who cover them.

"As our model has changed to a digital model, we are publishing so much more content in so many different areas," said Kelly. "The demand for the information we publish is enormous — it's bottomless. And we are continuing to experiment and monitor the best ways to produce that information."

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— Steve Kolowich

http://www.insidehighered.com/news/2011/06/30/u_s_news_and_world_report_announces_plan_for_best_online_colleges_rankings

Plan to Restructure British Higher Ed

June 29, 2011

LONDON -- The British government released its long-awaited "white paper" on the future of higher education, offering a sweeping set of proposals that would produce dramatic changes in how the country would educate students and fund institutions.

Under the plan, for example, a quarter of all student places are to be open to full competition in 2012-13, in a government bid to force higher education institutions to vie for the brightest and best applicants at one end of the sector, and to compete on price at the other. And for-profit providers of higher education would be given full access to the student loan system on condition that they agree to follow the same rules on standards, quality and fair access as publicly funded institutions.

The reform plan released by British government's Department for Business Innovation and Skills says that in the first year of the new funding regime, around 65,000 high-achieving students will be able to go to whichever university will have them. This represents a change from the present strict controls on the number of students each university can accept. It raises the prospect of some elite institutions expanding their intake to vacuum up more top students.

The government's aim is to ensure that students with very high grades -- AAB or above -- on the country's college entrance exams will have a better chance of reaching their first choice of university.

The white paper has also set out plans to make a further 20,000 student places contestable in a different way, allowing institutions that charge tuition fees of less than £7,500 to bid for them on the basis of "quality, value for money and student demand."

These institutions could include not only further education colleges (roughly equivalent to American community and technical colleges), but also private providers, with the government taking steps to ensure that such institutions are operating on a more "level playing field" (see below).

Taken together, the government expects the changes to make a total of 85,000 student places open to competition between institutions -- around one in four of the total number. It has indicated that this proportion may increase over time.

However, this new contestability will sit within an overall cap on the total number of student places in the sector. Consequently if some elite institutions expand their intake, it will be at the expense of others, which will necessarily have to shrink.

It also means that highly selective institutions, such as those in the 1994 and Russell Groups (consortiums of elite universities), will have to compete for a large proportion of their students, many of whom already achieve AAB or above on the "A level" exams.

Speaking to *Times Higher Education*, David Willetts, the government's universities and science minister, said the aim was to "dynamize the [British higher education] system."

"It's a very fine judgment we've had to reach," he said. "On the one hand I was very keen … not to break down the old quota system, [but] we wanted something that was more open and liberal. On the other hand, there's quite a lot of change happening in 2012, and the last thing I want is a kind of change so disruptive that our universities can't handle it.

"We think that these two proposals, adding up to 85,000 places, get the balance about right. And then, after we've seen how it works in the first year, we aim gradually to increase that."

Willetts denied that the government's aim was to create an elite set of institutions in which all the top-achieving students were concentrated.

"I'm not trying to plan the system. The whole point about this is we're taking some steps back and it will be the choices of students and the reaction of institutions – I have no view on that," he said.

He argued that with funding following the student, and universities and colleges forced to compete for those students, the quality of teaching and learning, and the student experience, would rise.

"We've got very strong incentives to reward research, and the intense competition through the [research excellence framework] and research councils has yielded an incredibly strong research [base]. We haven't had comparable incentives on teaching," he said.

Expanded Role for For-Profit Providers

In addition to changing how students compete for spaces in British universities, the White Paper would shake up the regulatory regime governing higher education in the country. All providers, including those with for-profit status, would be subject to the same oversight if they have loan-funded students.

The new regime is likely to include a transformed, but not renamed, Higher Education Funding Council for England, which would become a "consumer champion" with beefed-up powers to act on concerns raised by other bodies such as the Quality Assurance Agency for Higher Education, which is designed to regulate institutional quality and student qualifications.

Meanwhile, the QAA would move toward a more "risk-based" approach to inspection that makes it easier for student complaints to trigger an audit, as well as reducing the burden for universities with a good track record.

Willetts, the universities and science minister, said the "conceptual shift" was that the whole framework of regulation needed to focus on "the student in receipt of the loan, rather than a group of institutions in receipt of [a government] grant."

He said: "You have to think of a regulator protecting students as consumers, ensuring they have access to what is still a very significant amount of public money and being clear about what happens in return."

There are no plans to create a single "super quango" to regulate the sector -- as proposed in another government review released last fall -- but Willetts envisaged that the government funding agency could ultimately have the power to stop institutions accessing the student loan system if they run foul of the rules.

"I would say that [HEFCE's] powers will be linked ultimately to whether it will [allow money to be loaned] to students to pay the fees to go to institutions.

"Some of the conditions that are currently attached to [teaching] grants -- in a modernized, light-touch way -- will be attached to eligibility to student support," he said.

There are also proposals to allow the Office for Fair Access to impose new fines if a university or other provider fails to keep to agreements on helping poorer students.

Meanwhile, the white paper says the government will look at the rules governing degree-awarding powers and university title, which could make it easier for companies, further education colleges and providers from overseas to enter the market. On university title, the government aims to look at the rules specifying how many students an institution must have before applying for use of the term.

With degree-awarding powers, there are proposals to remove the barriers that can prevent non-teaching institutions such as examining boards from offering degrees that can then be taught by institutions such as further education colleges.

— John Morgan and Simon Baker for Times Higher Education

http://www.insidehighered.com/news/2011/06/29/british_government_releases_white_paper_proposing_major_changes_in_higher_education_funding_and_admissions

Dealing With the Depressed

June 29, 2011

SAN FRANCISCO — How far can colleges go to stop students who are threatening to commit suicide?

It's a fundamental question for college and university officials who work in the fields of student affairs, counseling and mental health -- and for the lawyers who may have to deal with the aftermath, and sometimes see mental health issues as a minefield of potential litigation.

At a session Tuesday here at the annual meeting of the National Association of College and University Attorneys, experts in legal affairs and mental health urged colleges to do all they can to get students who are threatening to harm themselves into treatment, or to get them off campus if the situation continues to deteriorate.

In the past decade, the number of college students with severe mental health issues has climbed. The development is often attributed to better early intervention and psychiatric drugs that enable students to function normally and attend college who wouldn't have been able to do so in the past. "That's a wonderful thing," said Paul Lannon, an outside lawyer for several New England colleges who moderated the session.

But the increase has also been accompanied by several high-profile lawsuits, and the conclusion colleges and universities draw from those could be "damned if you do, damned if you don't."

After a Massachusetts Institute of Technology sophomore, Elizabeth Shin, committed suicide by setting her dorm room on fire in 2000, her family sued MIT for $28 million. They argued that the university's counseling system failed Shin, who had a documented history of depression and threats before she killed herself. The suit was eventually settled confidentially.

In 2006, Jordan Nott, a former student, sued George Washington University, claiming that he had been forced to withdraw from the university after seeking help for depression. Nott also reached a confidential settlement.

The federal government has intervened in some similar cases through complaints students filed with the Department of Education's Office of Civil Rights, which has come out against universities who force students to leave campus because of mental illness, including a case at Bluffton University, in Ohio, in 2004.

In their presentation, three legal and mental health experts emphasized that a tough approach could have its place, as long as due process procedures are followed. Their advice included suggestions for ways to make sure students get needed care on campus, and for procedures university officials can follow if they believe a leave of absence is in the student's, or the institution's, best interest.

They cited as an example the University of Illinois at Urbana-Champaign, which instituted a suicide-prevention program in the 1980s after a study of 19 students who had killed themselves between 1977 and 1984. Most had previously worked with psychologists or psychiatrists, but not on the campus, and had a history of suicide attempts, said Paul Joffe, a clinical psychologist at the university's counseling center.

The program required reporting of any suicide threats or attempts to the counseling center. The students who had made the threats, or who had tried to kill themselves, were required to attend four "assessment sessions," arranged through the campus counseling office. Students who did not comply could be withdrawn from classes.

The result shifted the followup on suicidal behavior from the mental health system into the judicial affairs system. Students weren't punished for being suicidal, but the university set the expectation that they would seek help and try to improve the situation, including attending the required assessment sessions, Joffe said. A mental health court was created to deal solely with suicidal threats and attempts, and students were given due process rights and sanctions if they did not comply with the assessment requirement. “In an instant, everything changed, as soon as we mentioned consequences,” Joffe said.

In the 21 years that followed, the suicide rate dropped 45 percent, and those students who killed themselves did so “out of the blue,” with no recorded previous attempts or threats.

From the legal perspective, litigation is far more likely in cases of students who threaten or attempt to commit suicide before actually doing so, as was the case with Shin at MIT, Joffe noted in a written handout distributed to attendees. “Out of the blue” suicides are far less likely to lead to lawsuits because they are less foreseeable. And requiring students to do something to help themselves, such as attending counseling, is less likely to lead to litigation than is withdrawing the students from classes, he said. A clear policy with requirements, like the assessment sessions, also puts institutions on more solid legal ground if they choose to force a student to withdraw.

Joffe disputed the common description of suicide attempts as a “cry for help,” recasting them as a type of violence where a university zero-tolerance policy should apply. Before the 1984 study and the assessment requirement, suicide had been considered in a different category from other problems with students, he said. In cases like campus drinking, the university didn't hesitate to look at the individual students and the context, or to apply expectations for future behavior and next steps, he said.

But suicidal students were treated as victims, and they weren't given any expectations for how they should behave to improve the situation. “Is it in anyone’s interest to do that?” he said. The new procedures gave students more responsibility.

Few students were withdrawn because of the University of Illinois policy. For campuses with a less thorough prevention system, Linda Schutjer, the senior associate legal counsel for the Colorado State University System, offered advice on dealing with students who pose immediate problems and are less forthcoming.

“You’ve got to do what you’ve got to do,” said Schutjer, who was an associate general counsel at George Washington University when Nott was withdrawn. (She did not discuss that case during the session.) Even if a student doesn’t want to leave campus, or if parents are adamant that they don’t want the student to come home, the university should force the issue if officials believe it will save the student’s life, she said.

She provided the college lawyers in the audience with an overview of due process proceedings for students who could be sent home for mental health reasons. Students whose psychological problems can’t be helped through “reasonable accommodation” can be withdrawn from school, she said, but they must be notified and have an opportunity to respond. Minimal due process can be taken under exceptional circumstances, she said.

“It may well be, unfortunately, that someone is in a psych ward in the hospital, and you have to deliver a letter to someone who’s in the psych ward to say, ‘We’re going to put you out involuntarily,’ ” she said, adding that the student might have 24 hours after release to respond.

Universities should seek as much information about students’ mental states as they can, she said. But in cases when documentation is incomplete or students refuse to have the records released, officials can make a decision with the information they have.

When students are asked to leave, there should be a clear process for determining when they are ready to return, said Richard Kadison, chief of mental health services at Harvard University. The more specific and individualized those requirements are, the more likely they are to succeed, Schutjer added.

All three members of the panel emphasized that as many officials as possible should play a role in getting students psychological or psychiatric help when they need it, but that sometimes that help might not take place on campus. "Academic institutions aren't designed to be halfway houses and partial hospital programs," Kadison said.

— Libby A. Nelson

http://www.insidehighered.com/news/2011/06/29/lawyers_discuss_issues_of_suicidal_students

Corporations, Meet Transparency

Most major companies around the world have embraced the linked ideas of sustainability and responsibility. More of them need to embrace a sustainable and responsible reality.

By Christine MacDonald

A disconnect exists between corporations embracing sustainability and responsibility, and actually doing it. (Illustration by Mark McGinnis)

The international commodities trader Cargill Inc. has unveiled a prototype: a kite-powered cargo ship that could reduce by as much as a third the amount of fossil fuel it takes to operate the enormous vessels that move the world's goods.

Alcoa Inc., one of the world's biggest aluminum makers, gives away a cellphone app that tallies the cash to be made from recycling beer and soft drink cans.

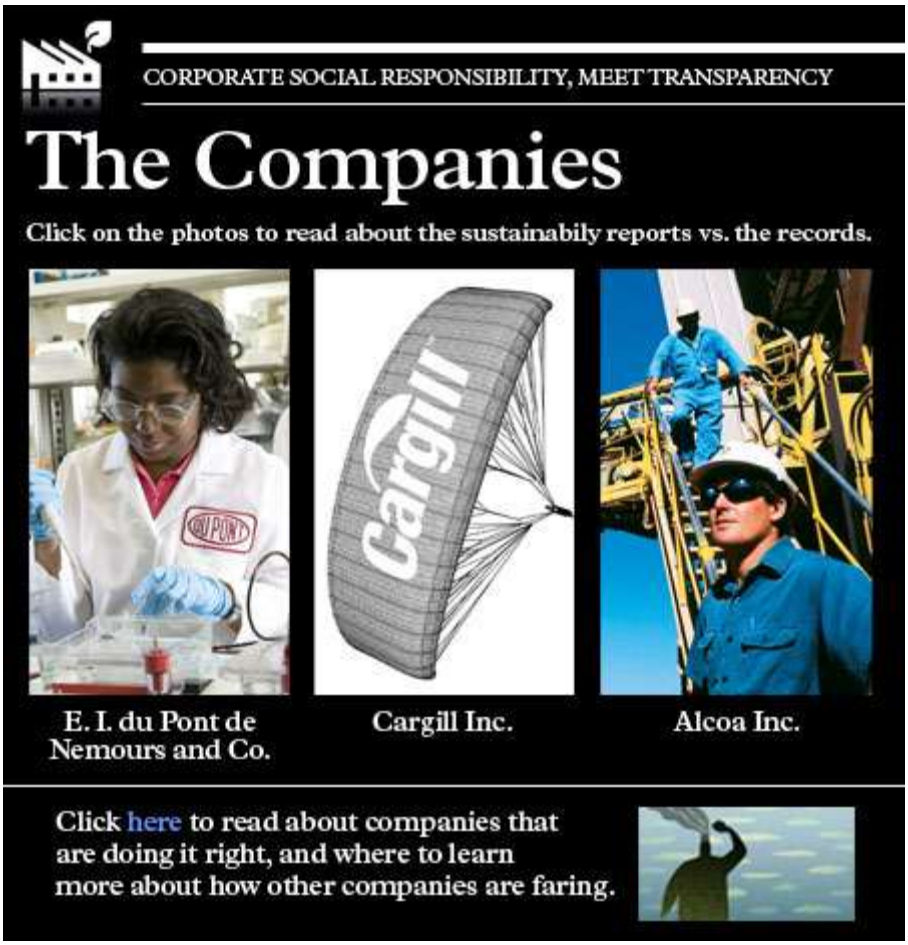
The chemical giant E.I. du Pont de Nemours and Co. says it not only has made impressive strides in improving its environmental performance, it is also building a lucrative new revenue stream from helping other companies reduce their carbon footprints.

A sea change washed over the corporate world gradually during the last two decades — and then rapidly in the last few years — as concerns about global warming, environmental degradation and resource scarcity intensified. Companies across the economy have embraced sustainability, launching social and environmental welfare projects, greening their supply chains, cutting energy use, developing environment-friendly products and — perhaps most noticeably — churning out sustainability reports that chronicle their good works.

While some critics complain that corporate sustainability and responsibility programs waste resources and hurt shareholder value, the battle of the boardroom has been won at most big companies. About 80 percent of the *Fortune 500* issue sustainability reports, according to a 2008 survey. A report published last December found that 73 percent of 378 large and medium-sized companies around the globe had a sustainability program in place or were developing one.

Huge efforts in corporate self-improvement — for example, the $10 million deal Dow Chemical Co. inked in January to have The Nature Conservancy evaluate Dow's impact on the environment —have become almost commonplace. Within the past year, General Motors has moved half of its plants to "zero waste" operations, meaning they don't send anything to the landfill. Procter & Gamble has pledged to start making the packaging for its 23 brands of consumer goods from renewable or recycled materials. Even Koch Industries, known as a corporate leader of climate change denial, counts its carbon emissions these days.

Just the same, many corporations appear to be living double lives in regard to sustainability and social responsibility. "A lot of what we see corporations doing is really greenwashing, or in the case of water, bluewashing," says Wenonah Hauter, the executive director of Food & Water Watch, a Washington, D.C.-based nonprofit watchdog group. "You can just look at what's taking place in Congress right now with the attacks on EPA regulations and health and safety rules. It's these multinationals who are doing the heavy lobbying and influence peddling."



The list of corporate misdeeds that belie sustainability rhetoric is long. In the last two years alone, *Corporate Responsibility Magazine*, which publishes one of the more widely accepted corporate citizenship rankings, "The 100 Best Corporate Citizens," has issued eight yellow and three red "penalty cards" to companies in the competition. A yellow card is meant to signal "caution" but doesn't impact the ranking. A red card, on the other hand, disqualifies a company from the list for three years.

3M, for example, received a yellow card and ExxonMobil was red carded this year for contaminating groundwater. Occidental Petroleum Corp. received a yellow card over a human rights and environmental contamination lawsuit regarding the alleged pollution of indigenous land and the Amazon River in Peru.

All the "carded" companies have issued reports, press releases and other pronouncements detailing their corporate good deeds. In fact, companies rarely mention controversies in their corporate citizenship missives. (But some do: Johnson & Johnson lists its recall of Motrin as one of "Our 2009 Successes," while also expressing regret over the episode.)

Such moves highlight one of the biggest complaints from critics of the corporate sustainability movement: Companies often use the reports to pat themselves on the back for merely complying with the law or taking advantage of government incentives.

To illustrate the sometimes incomplete transparency of the glossy, full-color sustainability report, we examined the records of three venerable U.S. companies — Alcoa Inc., Cargill Inc. and E. I. du Pont de Nemours and Co. All three firms are formidable competitors and among the biggest players in their respective fields. Each has shown extraordinary dexterity, staying in business for more than a century (and in DuPont's case, 209 years). And all three have sought the spotlight for their sustainability efforts with splashy and positive reports and advertising. These companies have not gone to the same pains to publicize the federal investigations they have attracted for environmental and other misdeeds. (See our reports on Alcoa, Cargill and du Pont for more details.)

The rosy outlook of many corporate sustainability reports doesn't just aim at good public relations. Increasingly, it has a direct business function, because the financial markets now include measures of sustainability.

Dow Jones has a family of sustainability indexes, including the Dow Jones Sustainability North American Index and the Dow Jones Sustainability World Index. Other such ratings include KLD Global Sustainability Index, launched by Boston-based KLD Research & Analytics Inc. in 2007 "in response to the growing demand from institutional investors for global sustainability investment options" and the FTSE4Good Index, operated by a company jointly owned by *The Financial Times* and the London Stock Exchange. These new indexes lend prestige to companies that make the cut.

Meanwhile, financial media firms and stock market analysts have begun factoring environmental and social performance into corporate stock valuations. Some research even suggests that the companies embracing corporate responsibility outperform their competitors, says Joel Makower, chairman and executive editor of GreenBiz Group Inc., an online news service. "Companies certainly have the potential to change the social fabric," says Makower, who thinks most corporations are "walking the walk" more than they get credit for.

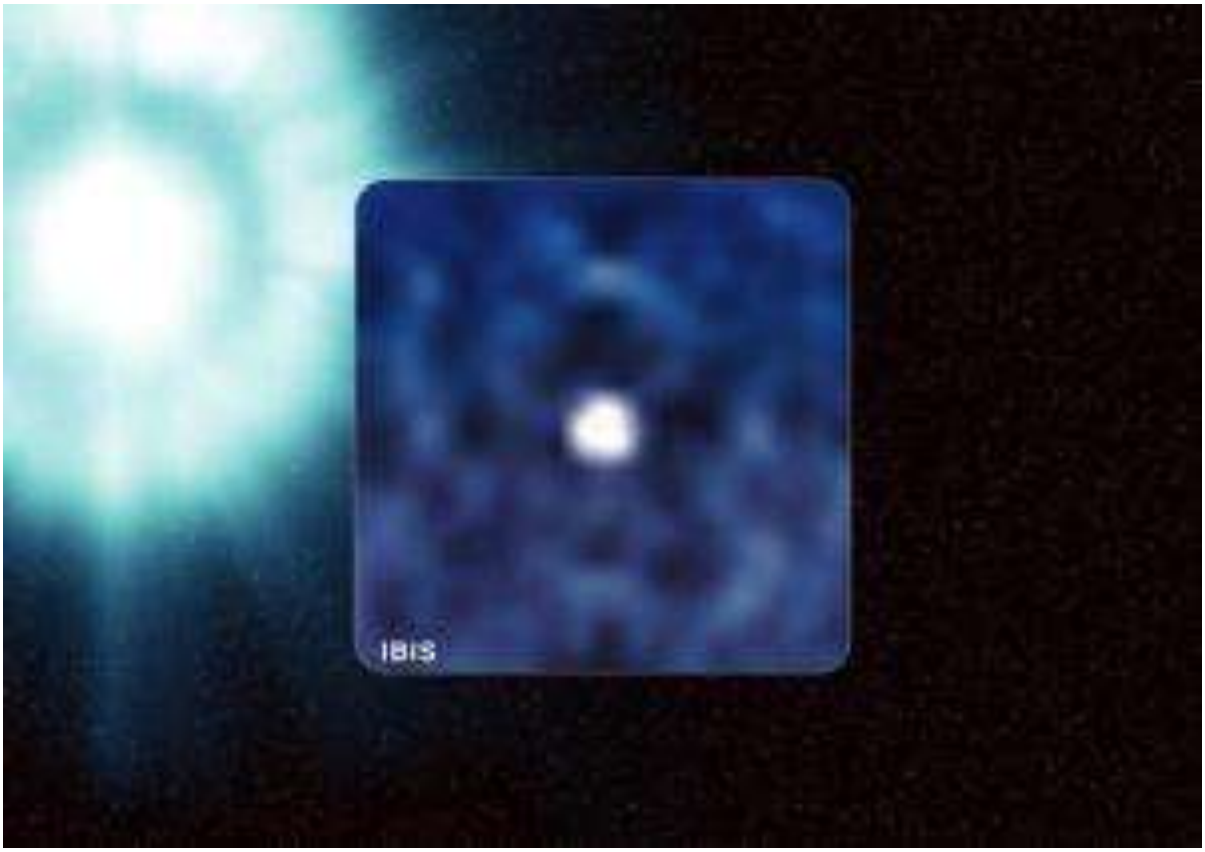
"Some of the companies that are the most progressive are in the worst reputational binds" because of the difficulty of communicating their policies, he says. "Doing something less bad – those are hard stories to tell. You might reduce toxins in your product by 30 percent, but that leaves 70 percent that is bad. … Often when you talk about doing right, you illuminate problems."

Others observers, however, fear all this reporting about and rating of supposedly well-behaved companies undermines support for government regulation that is needed, regardless of the progress of the corporate sustainability/responsibility movement. Aneel Karnani, a business professor at the University of Michigan, stirred uproar in corporate responsibility circles last year with an article in *The Wall Street Journal* that asserted: "In circumstances in which profits and social welfare are in direct opposition, an appeal to corporate social responsibility will almost always be ineffective, because executives are unlikely to act voluntarily in the public interest and against shareholder interests."

In a recent phone interview, Karnani elaborated: "Let's not delude ourselves; the only way to get companies to do something is to pass laws that force them to do it."

http://www.miller-mccune.com/business-economics/corporate-social-responsibility-meet-transparency-32613/?utm_source=Newsletter167&utm_medium=email&utm_content=0628&utm_campaign=newsletters

Quantum 'Graininess' of Space at Smaller Scales? Gamma-Ray Observatory Challenges Physics Beyond Einstein



Gamma-ray burst captured by Integral's IBIS instrument. (Credit: ESA/SPI Team/ECF)

ScienceDaily (July 1, 2011) — The European Space Agency's Integral gamma-ray observatory has provided results that will dramatically affect the search for physics beyond Einstein. It has shown that any underlying quantum 'graininess' of space must be at much smaller scales than previously predicted.

Einstein's General Theory of Relativity describes the properties of gravity and assumes that space is a smooth, continuous fabric. Yet quantum theory suggests that space should be grainy at the smallest scales, like sand on a beach.

One of the great concerns of modern physics is to marry these two concepts into a single theory of quantum gravity.

Now, Integral has placed stringent new limits on the size of these quantum 'grains' in space, showing them to be much smaller than some quantum gravity ideas would suggest.

According to calculations, the tiny grains would affect the way that gamma rays travel through space. The grains should 'twist' the light rays, changing the direction in which they oscillate, a property called polarisation.

High-energy gamma rays should be twisted more than the lower energy ones, and the difference in the polarisation can be used to estimate the size of the grains.

Philippe Laurent of CEA Saclay and his collaborators used data from Integral's IBIS instrument to search for the difference in polarisation between high- and low-energy gamma rays emitted during one of the most powerful gamma-ray bursts (GRBs) ever seen.

GRBs come from some of the most energetic explosions known in the Universe. Most are thought to occur when very massive stars collapse into neutron stars or black holes during a supernova, leading to a huge pulse of gamma rays lasting just seconds or minutes, but briefly outshining entire galaxies.

GRB 041219A took place on 19 December 2004 and was immediately recognised as being in the top 1% of GRBs for brightness. It was so bright that Integral was able to measure the polarisation of its gamma rays accurately.

Dr Laurent and colleagues searched for differences in the polarisation at different energies, but found none to the accuracy limits of the data.

Some theories suggest that the quantum nature of space should manifest itself at the 'Planck scale': the minuscule 10^{-35} of a metre, where a millimetre is 10^{-3} m.

However, Integral's observations are about 10 000 times more accurate than any previous and show that any quantum graininess must be at a level of 10^{-48} m or smaller.

"This is a very important result in fundamental physics and will rule out some string theories and quantum loop gravity theories," says Dr Laurent.

Integral made a similar observation in 2006, when it detected polarised emission from the Crab Nebula, the remnant of a supernova explosion just 6500 light years from Earth in our own galaxy.

This new observation is much more stringent, however, because GRB 041219A was at a distance estimated to be at least 300 million light years.

In principle, the tiny twisting effect due to the quantum grains should have accumulated over the very large distance into a detectable signal. Because nothing was seen, the grains must be even smaller than previously suspected.

"Fundamental physics is a less obvious application for the gamma-ray observatory, Integral," notes Christoph Winkler, ESA's Integral Project Scientist. "Nevertheless, it has allowed us to take a big step forward in investigating the nature of space itself."

Now it's over to the theoreticians, who must re-examine their theories in the light of this new result.

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Story Source:

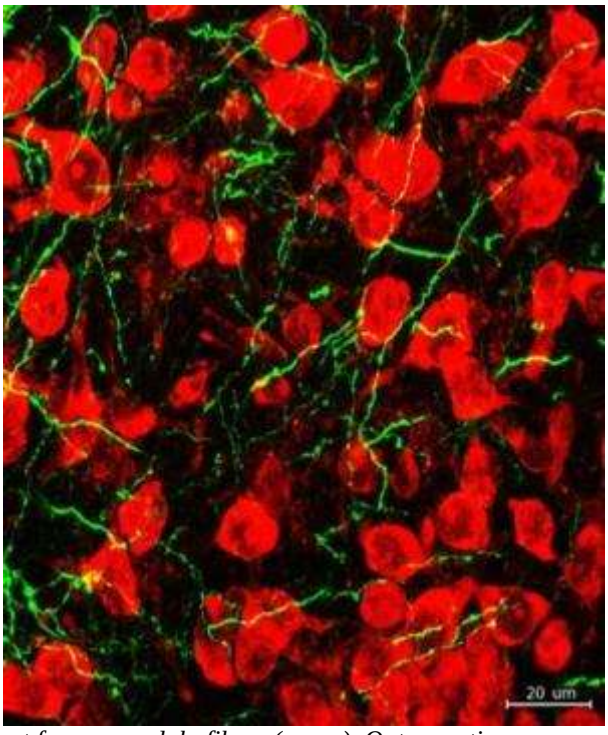
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **European Space Agency (ESA)**.

Journal Reference:

1. P. Laurent, D. Götz, P. Binétruy, S. Covino, A. Fernandez-Soto. **Constraints on Lorentz Invariance Violation using integral/IBIS observations of GRB041219A**. *Physical Review D*, 2011; 83 (12) DOI: 10.1103/PhysRevD.83.121301

http://www.sciencedaily.com/releases/2011/06/110630111540.htm

Scientists Use 'Optogenetics' to Control Reward-Seeking Behavior



Nerve cells in the nucleus accumbens (red) receive input from amygdala fibers (green). Optogenetic stimulation of these nerve fibers produces a rewarding effect in mice. (Credit: Stuber lab/UNC-Chapel Hill)

ScienceDaily (July 1, 2011) — Using a combination of genetic engineering and laser technology, researchers at the University of North Carolina at Chapel Hill have manipulated brain wiring responsible for reward-seeking behaviors, such as drug addiction. The work, conducted in rodent models, is the first to directly demonstrate the role of these specific connections in controlling behavior.

The UNC study, published online on June 29, 2011, by the journal *Nature*, uses a cutting-edge technique called "optogenetics" to tweak the microcircuitry of the brain and then assess how those changes impact behavior. The findings suggest that therapeutics targeting the path between two critical brain regions, namely the amygdala and the nucleus accumbens, represent potential treatments for addiction and other neuropsychiatric diseases.

"For most clinical disorders we knew that one region or another in the brain was important, however until now we didn't have the tools to directly study the connections between those regions," said senior study author Garret D. Stuber, PhD, assistant professor in the departments of cell and molecular physiology, psychiatry and the Neuroscience Center in UNC School of Medicine. "Our ability to perform this level of sophistication in neural circuit manipulation will likely to lead to the discovery of molecular players perturbed during neuropsychiatric illnesses."

Because the brain is composed of diverse regions, cell types and connections in a compact space, pinpointing which entity is responsible for what function can be quite tricky. In the past, researchers have tried to get a glimpse into the inner workings of the brain using electrical stimulation or drugs, but those techniques couldn't quickly and specifically change only one type of cell or one type of connection. But optogenetics, a technique that emerged six years ago, can.

In the technique, scientists transfer light-sensitive proteins called "opsins" -- derived from algae or bacteria that need light to grow -- into the mammalian brain cells they wish to study. Then they shine laser beams onto the genetically manipulated brain cells, either exciting or blocking their activity with millisecond precision.

In Stuber's initial experiments, the target was the nerve cells connecting two separate brain regions associated with reward, the amygdala and the nucleus accumbens. The researchers used light to activate the connections between these regions, essentially "rewarding" the mice with laser stimulations for performing the mundane task of poking their nose into a hole in their cage. They found that the opsin treated mice quickly learned to "nosepoke" in order to receive stimulation of the neural pathway. In comparison, the genetically untouched control mice never caught onto the task.

Then Stuber and his colleagues wanted to see whether this brain wiring had a role in more natural behavioral processes. So they trained mice to associate a cue -- a light bulb in the cage turning on -- to a reward of sugar water. This time the opsin that the researchers transferred into the brains of their rodent subjects was one that would shut down the activity of neural connections in response to light. As they delivered the simple cue to the control mice, they also blocked the neuronal activity in the genetically altered mice. The control mice quickly began responding to the cue by licking the sugar-producing vessel in anticipation, whereas the treated mice did not give the same response.

The researchers are now exploring how changes to this segment of brain wiring can either make an animal sensitized to or oblivious to rewards. Stuber says their approach presents an incredibly useful tool for studying basic brain function, and could one day provide a powerful alternative to electrical stimulation or pharmacotherapy for neuropsychiatric illnesses like Parkinson's disease.

"For late-stage Parkinson's disease it has become more routine to use deep brain stimulation, where electrodes are chronically implanted into brain tissue, constantly stimulating the tissue to alleviate some of the disease symptoms," said Stuber. "From the technical perspective, implanting our optical fibers is not going to be more difficult than that. But there is quite a bit of work to be done before we get to that point."

The research was funded by NARSAD: The Brain & Behavior Research Fund; ABMRF/ The Foundation for Alcohol Research; The Foundation of Hope; and the National Institute on Drug Abuse, a component of NIH.

Study co-authors from Stuber's laboratory at UNC include Dennis R. Sparta, PhD, postdoctoral fellow, and Alice M. Stamatakis, graduate student.

Story Source:

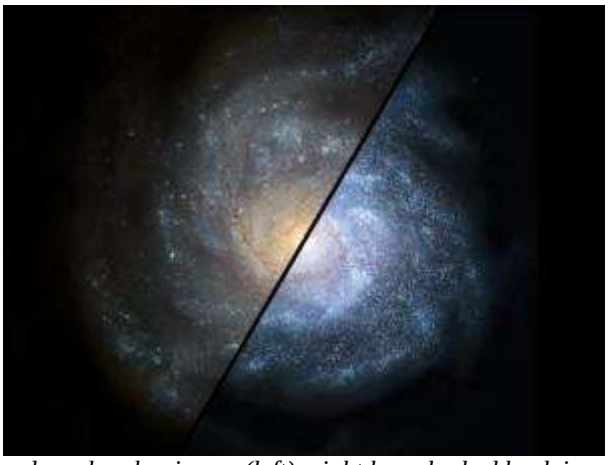
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of North Carolina School of Medicine**.

Journal Reference:

1. Garret D. Stuber, Dennis R. Sparta, Alice M. Stamatakis, Wieke A. van Leeuwen, Juanita E. Hardjoprajitno, Saemi Cho, Kay M. Tye, Kimberly A. Kempadoo, Feng Zhang, Karl Deisseroth, Antonello Bonci. **Excitatory transmission from the amygdala to nucleus accumbens facilitates reward seeking**. *Nature*, 2011; DOI: 10.1038/nature10194

http://www.sciencedaily.com/releases/2011/06/110629132541.htm

NASA's Spitzer Finds Distant Galaxies Grazed On Gas



This split view shows how a normal spiral galaxy around our local universe (left) might have looked back in the distant universe, when astronomers think galaxies would have been filled with larger populations of hot, bright stars (right). (Credit: NASA/JPL-Caltech/STScI)

ScienceDaily (June 30, 2011) — Galaxies once thought of as voracious tigers are more like grazing cows, according to a new study using NASA's Spitzer Space Telescope.

Astronomers have discovered that galaxies in the distant, early universe continuously ingested their star-making fuel over long periods of time. This goes against previous theories that the galaxies devoured their fuel in quick bursts after run-ins with other galaxies.

"Our study shows the merging of massive galaxies was not the dominant method of galaxy growth in the distant universe," said Ranga-Ram Chary of NASA's Spitzer Science Center at the California Institute of Technology in Pasadena, Calif. "We're finding this type of galactic cannibalism was rare. Instead, we are seeing evidence for a mechanism of galaxy growth in which a typical galaxy fed itself through a steady stream of gas, making stars at a much faster rate than previously thought."

Chary is the principal investigator of the research, appearing in the Aug. 1 issue of the *Astrophysical Journal*. According to his findings, these grazing galaxies fed steadily over periods of hundreds of millions of years and created an unusual amount of plump stars, up to 100 times the mass of our sun.

"This is the first time that we have identified galaxies that supersized themselves by grazing," said Hyunjin Shim, also of the Spitzer Science Center and lead author of the paper. "They have many more massive stars than our Milky Way galaxy."

Galaxies like our Milky Way are giant collections of stars, gas and dust. They grow in size by feeding off gas and converting it to new stars. A long-standing question in astronomy is: Where did distant galaxies that formed billions of years ago acquire this stellar fuel? The most favored theory was that galaxies grew by merging with other galaxies, feeding off gas stirred up in the collisions.

Chary and his team addressed this question by using Spitzer to survey more than 70 remote galaxies that existed 1 to 2 billion years after the Big Bang (our universe is approximately 13.7 billion years old). To their surprise, these galaxies were blazing with what is called H alpha, which is radiation from hydrogen gas that has been hit with ultraviolet light from stars. High levels of H alpha indicate stars are forming vigorously.

Seventy percent of the surveyed galaxies show strong signs of H alpha. By contrast, only 0.1 percent of galaxies in our local universe possess this signature.

Previous studies using ultraviolet-light telescopes found about six times less star formation than Spitzer, which sees infrared light. Scientists think this may be due to large amounts of obscuring dust, through which infrared light can sneak. Spitzer opened a new window onto the galaxies by taking very long-exposure infrared images of a patch of sky called the GOODS fields, for Great Observatories Origins Deep Survey.

Further analyses showed that these galaxies furiously formed stars up to 100 times faster than the current star-formation rate of our Milky Way. What's more, the star formation took place over a long period of time, hundreds of millions of years. This tells astronomers that the galaxies did not grow due to mergers, or collisions, which happen on shorter timescales. While such smash-ups are common in the universe -- for example, our Milky Way will merge with the Andromeda galaxy in about 5 billion years -- the new study shows that large mergers were not the main cause of galaxy growth. Instead, the results show that distant, giant galaxies bulked up by feeding off a steady supply of gas that probably streamed in from filaments of dark matter.

Chary said, "If you could visit a planet in one of these galaxies, the sky would be a crazy place, with tons of bright stars, and fairly frequent supernova explosions."

NASA's Jet Propulsion Laboratory in Pasadena, Calif., manages the Spitzer Space Telescope mission for the agency's Science Mission Directorate in Washington. Science operations are conducted at the Spitzer Science Center at Caltech. Caltech manages JPL for NASA.

For more information about Spitzer, visit http://www.nasa.gov/spitzer and http://spitzer.caltech.edu/ .

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NASA/Jet Propulsion Laboratory**.

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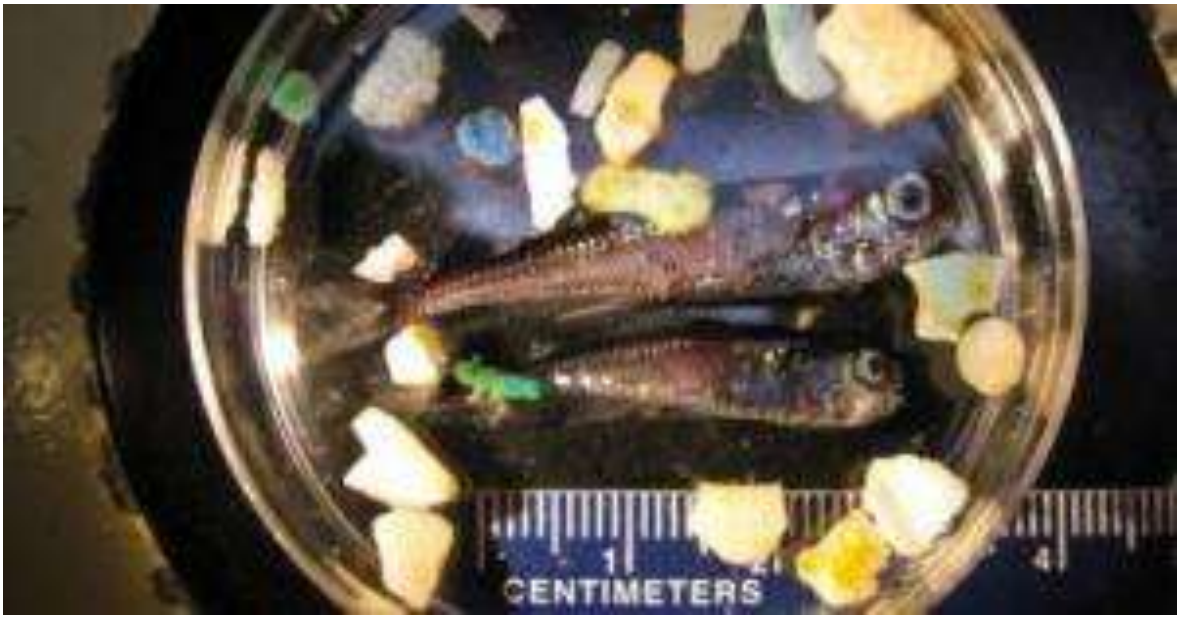
http://www.sciencedaily.com/releases/2011/06/110630162444.htm

Plastic Found in Nine Percent of 'Garbage Patch' Fishes: Tens of Thousands of Tons of Debris Annually Ingested



These are two lanternfish and several bits of plastic collected during the SEAPLEX voyage. (Credit: J. Leicther)

ScienceDaily (June 30, 2011) — The first scientific results from an ambitious voyage led by a group of graduate students from Scripps Institution of Oceanography at UC San Diego offer a stark view of human pollution and its infiltration of an area of the ocean that has been labeled as the "Great Pacific Garbage Patch."

Two graduate students with the Scripps Environmental Accumulation of Plastic Expedition, or SEAPLEX, found evidence of plastic waste in more than nine percent of the stomachs of fish collected during their voyage to the North Pacific Subtropical Gyre. Based on their evidence, authors Peter Davison and Rebecca Asch estimate that fish in the intermediate ocean depths of the North Pacific ingest plastic at a rate of roughly 12,000- to 24,000 tons per year.

Their results were published June 27 in the journal *Marine Ecology Progress Series*.

During the SEAPLEX voyage in August 2009, a team of Scripps graduate students traveled more than 1,000 miles west of California to the eastern sector of the North Pacific Subtropical Gyre aboard the Scripps research vessel New Horizon. Over 20 days the students, New Horizon crew and expedition volunteers conducted comprehensive and rigorous scientific sampling at numerous locations. They collected fish specimens, water samples and marine debris at depths ranging from the sea surface to thousands of feet depth.

Of the 141 fishes spanning 27 species dissected in the study, Davison and Asch found that 9.2 percent of the stomach contents of mid-water fishes contained plastic debris, primarily broken-down bits smaller than a human fingernail. The researchers say the majority of the stomach plastic pieces were so small their origin could not be determined.

"About nine percent of examined fishes contained plastic in their stomach. That is an underestimate of the true ingestion rate because a fish may regurgitate or pass a plastic item, or even die from eating it. We didn't measure those rates, so our nine percent figure is too low by an unknown amount," said Davison.

The authors say previous studies on fish and plastic ingestion may have included so-called "net-feeding" biases. Net feeding can lead to artificially high cases of plastic ingestion by fishes while they are confined in a net with a high concentration of plastic debris. The Scripps study's results were designed to avoid such bias. The highest concentrations of plastic were retrieved by a surface collecting device called a "manta net," which sampled for only 15 minutes at a time. The short sampling time minimizes the risk of net feeding by preventing large concentrations of plastic from building up, and also by reducing the amount of time that a captured fish spends in the net. In addition to the manta net, the fishes were also collected with other nets that sample deeper in the water column where there is less plastic to be ingested through net feeding.

The new study focused on the prevalence of plastic ingestion, but effects such as toxicological impacts on fish and composition of the plastic were outside of the study's goals.

The majority of fish examined in the study were myctophids, commonly called lanternfish because of their luminescent tissue. Lanternfishes are hypothesized to use luminescence for several purposes, including counter-illumination (thwarts predators attempting to silhouette the lanternfish against sunlight), mate attraction and identification and illumination of prey. Such fish generally inhabit the 200- to 1,000-meter (650- to 3,280-foot) depth during the day and swim to the surface at night.

"These fish have an important role in the food chain because they connect plankton at the base of the food chain with higher levels. We have estimated the incidence at which plastic is entering the food chain and I think there are potential impacts, but what those impacts are will take more research," said Asch.

Rather than a visible "patch" or "island" of trash, marine debris is highly dispersed across thousands of miles of the North Pacific Subtropical Gyre. The debris area cannot be mapped from air or space, so SEAPLEX researchers collected samples in 132 net tows (130 of which contained plastic) across a distance of more than 2,375 kilometers (1,700 miles) in an attempt to find the boundaries of the patch. The region, a "convergence zone" where floating debris in water congregates, is generally avoided by mariners due to its calm winds and mild currents. The North Pacific Subtropical Gyre has been understudied by scientists, leaving many open questions about marine debris in the area and its long-term effects on the marine environment.

"This study clearly emphasizes the importance of directly sampling in the environment where the impacts may be occurring," said James Leichter, a Scripps associate professor of biological oceanography who participated in the SEAPLEX expedition but was not an author of the new paper. "We are seeing that most of our prior predictions and expectations about potential impacts have been based on speculation rather than evidence and in many cases we have in fact underestimated the magnitude of effects. SEAPLEX also clearly illustrates how relatively small amounts of funding directed for novel field sampling and work in remote places can vastly increase our knowledge and understanding of environmental problems."

SEAPLEX was supported by the UC Ship Funds program, Project Kaisei/Ocean Voyages Institute and the National Science Foundation.

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - San Diego**. The original article was written by Mario Aguilera.

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1. P Davison, RG Asch. **Plastic ingestion by mesopelagic fishes in the North Pacific Subtropical Gyre**. *Marine Ecology Progress Series*, 2011; DOI: 10.3354/meps09142

http://www.sciencedaily.com/releases/2011/06/110630161837.htm

Takeoffs and Landings Cause More Precipitation Near Airports, Researchers Find

NASA's Terra satellite captured this image of hole-punch and canal clouds on Jan. 29, 2007. These unusual gaps in clouds are often caused by aircraft under certain atmospheric conditions. (Credit: NASA image by Jeff Schmaltz, MODIS Rapid Response Team, Goddard Space Flight Center)

ScienceDaily (June 30, 2011) — Researchers have found that areas near commercial airports sometimes experience a small but measurable increase in rain and snow when aircraft take off and land under certain atmospheric conditions.

The new study led by the National Center for Atmospheric Research (NCAR), is part of ongoing research that focuses on so-called hole punch and canal clouds that form when planes fly through certain mid-level clouds, forcing nearby air to rapidly expand and cool. This causes water droplets to freeze to ice and then turn to snow as they fall toward the ground, leaving behind odd-shaped gaps in the clouds.

The research team used satellite images and weather forecasting computer models to examine how often this type of inadvertent cloud seeding may occur within 62 miles (100 kilometers) of six commercial airports: London Heathrow, Frankfurt, Charles De Gaulle (Paris), Seattle-Tacoma, O'Hare (Chicago), and Yellowknife (Northwest Territories, Canada), as well as Byrd Station in Antarctica. They found that, depending on the airport and type of plane, the right atmospheric conditions typically exist up to 6 percent of the time, with somewhat more frequency in colder climates.

The lead author, NCAR scientist Andrew Heymsfield, says this phenomenon likely occurs at numerous other airports, especially in mid- and high-latitude areas during colder months. The key variable is whether there are cloud layers in the vicinity that contain water droplets at temperatures far below freezing, which is a common occurrence.

He adds that more research is needed before scientists can determine whether the precipitation produced by this effect is significant. The inadvertent cloud seeding may increase the need to de-ice planes more often, he adds.

"It appears to be a rather widespread effect for aircraft to inadvertently cause some measureable amount of rain or snow as they fly through certain clouds," Heymsfield says. "This is not necessarily enough precipitation to affect global climate, but it is noticeable around major airports in the midlatitudes."

The researchers did not estimate the total amount of rain or snow that would result from such inadvertent cloud seeding. However, they analyzed radar readings that, in one case, indicated a snowfall rate of close to an inch an hour after several planes had passed through.

The study is being published this week in the journal *Science*. Researchers from NASA Langley Research Center and the University of Wyoming, Laramie, co-authored the paper. Funding came from the National Science Foundation, which is NCAR's sponsor, and from NASA.

Solving a cloud mystery

Scientists for decades have speculated about the origins of mysterious holes and canals in clouds. Heymsfield led a study last year establishing that the gaps, which sometimes look as though a giant hole punch was applied to a cloud, are caused when aircraft fly through midlevel clouds that contain supercooled droplets.

When a turboprop plane flies through such a cloud layer with temperatures about 5 degrees Fahrenheit or lower (about -15 degrees Celsius or lower), the tips of its propellers can cause the air to rapidly expand. As the air expands, it cools and causes the supercooled droplets to freeze into ice particles that evaporate the droplets and grow, falling out of the clouds as snow or rain.

Jet aircraft need colder temperatures (below about -4 to -13 degrees F, or -20 to -25 degrees C) to generate the seeding effect. Air forced to expand over the wings as the aircraft moves forward cools and freezes the cloud droplets.

The effect is unrelated to the trails of condensed water vapor known as contrails made by the exhaust of jet engines.

In the new research, the study team used cloud measurements taken by the NASA CALIPSO satellite to quantify how often such conditions exist within about 62 miles of several airports located in relatively cloudy areas. They chose the 62-mile radius because that is approximately the distance it takes for a commercial aircraft to climb above about 10,000 feet, where many of the supercooled cloud layers are located.

Of the major, mid-latitude airports studied, they found that the Frankfurt, DeGaulle, and O'Hare airports most frequently experienced the right conditions for propeller aircraft to generate precipitation. In each case, the conditions existed more than 5 percent of the time over the course of a year. The researchers found that the right conditions existed more than 3 percent of the time for jets at Heathrow, Frankfurt, and Seattle-Tacoma.

Yellowknife experienced such conditions more often, about 10 percent of the time for propeller planes and 5 percent for jets, presumably because of colder cloud conditions at higher latitudes. Byrd often experienced the very cold conditions that enable jets to cause inadvertent cloud seeding.

The researchers also found that a diverse range of aircraft can induce precipitation. By comparing observations of hole-punch and canal clouds made by a National Oceanic and Atmospheric Administration (NOAA) satellite with flight path records from the Federal Aviation Administration, they confirmed that commercial jets (such as Boeing 757s and the McDonnell Douglas MD-80 series of jets), military aircraft (B-52s), various regional and private jets, turboprops, and prop/piston planes all can induce precipitation.

"It appears that virtually any airplane that flies through clouds containing liquid water at temperatures much below freezing can cause this effect," Heymsfield says.

Satellite readings analyzed by the team showed that holes and canals generated by aircraft can occur with some frequency. For example, an extensive cloud layer over Texas on January 29, 2007, contained 92 such gaps, some of which persisted for more than four hours and reached lengths of 60 miles or more.

Heymsfield and his colleagues also used a powerful software tool, known as the Weather and Research Forecasting model, to learn more about how the holes form and develop. They found that the hole rapidly spreads about 30 to 90 minutes after an aircraft passes through. This would be the peak time for precipitation associated with the cloud-seeding effect. After about 90 minutes, ice and snow begin to dissipate.

The University Corporation for Atmospheric Research manages the National Center for Atmospheric Research under sponsorship by the National Science Foundation. Any opinions, findings and conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Center for Atmospheric Research/University Corporation for Atmospheric Research**.

Journal Reference:

1. Andrew J. Heymsfield, Gregory Thompson, Hugh Morrison, Aaron Bansemer, Roy M. Rasmussen, Patrick Minnis, Zhien Wang, Damao Zhang. **Formation and Spread of Aircraft-Induced Holes in Clouds**. *Science*, 2011; 333 (6038): 77-81 DOI: 10.1126/science.1202851

http://www.sciencedaily.com/releases/2011/06/110630142847.htm

How Social Pressure Can Affect What We Remember: Scientists Track Brain Activity as False Memories Are Formed

New research reveals a unique pattern of brain activity when false memories are formed -- one that hints at a surprising connection between our social selves and memory. (Credit: Image courtesy of Weizmann Institute of Science)

ScienceDaily (June 30, 2011) — How easy is it to falsify memory? New research at the Weizmann Institute shows that a bit of social pressure may be all that is needed. The study, which appears in the journal *Science*, reveals a unique pattern of brain activity when false memories are formed -- one that hints at a surprising connection between our social selves and memory.

The experiment, conducted by Prof. Yadin Dudai and research student Micah Edelson of the Institute's Neurobiology Department with Prof. Raymond Dolan and Dr. Tali Sharot of University College London, took place in four stages. In the first, volunteers watched a documentary film in small groups. Three days later, they returned to the lab individually to take a memory test, answering questions about the film. They were also asked how confident they were in their answers.

They were later invited back to the lab to retake the test while being scanned in a functional MRI (fMRI) that revealed their brain activity. This time, the subjects were also given a "lifeline": the supposed answers of the others in their film viewing group (along with social-media-style photos). Planted among these were false answers to questions the volunteers had previously answered correctly and confidently. The participants conformed to the group on these "planted" responses, giving incorrect answers nearly 70% of the time.

But were they simply conforming to perceived social demands, or had their memory of the film actually undergone a change? To find out, the researchers invited the subjects back to the lab to take the memory test once again, telling them that the answers they had previously been fed were not those of their fellow film watchers, but random computer generations. Some of the responses reverted back to the original, correct ones, but close to half remained erroneous, implying that the subjects were relying on false memories implanted in the earlier session.

An analysis of the fMRI data showed differences in brain activity between the persistent false memories and the temporary errors of social compliance. The most outstanding feature of the false memories was a strong co-activation and connectivity between two brain areas: the hippocampus and the amygdala. The hippocampus is known to play a role in long-term memory formation, while the amygdala, sometimes known as the emotion center of the brain, plays a role in social interaction. The scientists think that the amygdala may act as a gateway connecting the social and memory processing parts of our brain; its "stamp" may be

needed for some types of memories, giving them approval to be uploaded to the memory banks. Thus social reinforcement could act on the amygdala to persuade our brains to replace a strong memory with a false one.

An accompanying video is available at:
http://www.youtube.com/user/WeizmannInstitute#p/u/0/bKCCYhHUTPE

Prof. Yadin Dudai's research is supported by the Norman and Helen Asher Center for Human Brain Imaging, which he heads; the Nella and Leon Benoziyo Center for Neurological Diseases; the Carl and Micaela Einhorn-Dominic Institute of Brain Research, which he heads; the Marc Besen and the Pratt Foundation, Australia; Lisa Mierins Smith, Canada; Abe and Kathryn Selsky Memorial Research Project; and Miel de Botton, UK. Prof. Dudai is the incumbent of the Sara and Michael Sela Professorial Chair of Neurobiology.

Story Source:

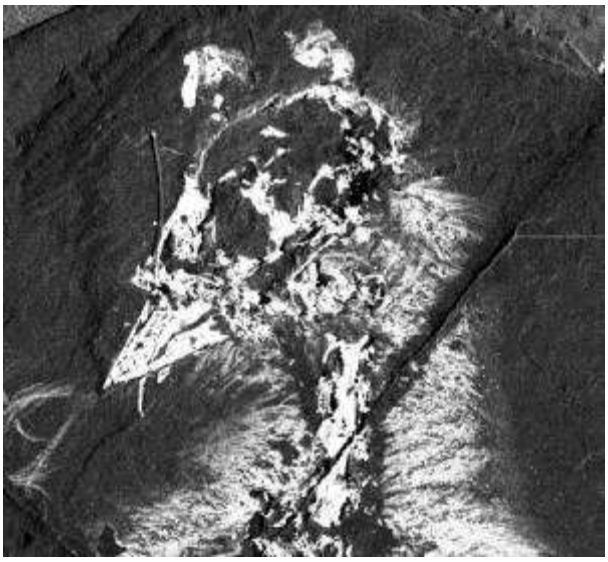
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Weizmann Institute of Science**.

Journal Reference:

1. Micah Edelson, Tali Sharot, Raymond J. Dolan, Yadin Dudai. **Following the Crowd: Brain Substrates of Long-Term Memory Conformity**. *Science*, 2011; 333 (6038): 108-111 DOI: 10.1126/science.1203557

http://www.sciencedaily.com/releases/2011/06/110630142845.htm

X-Rays Reveal Patterns in the Plumage of the First Birds



Researchers report today in Science Express that they have taken a big step in determining what the first birds looked like more than 100 million years ago, when their relatives, the dinosaurs, still ruled the Earth. At the Department of Energy's SLAC National Accelerator Laboratory, they discovered chemical traces of a pigment, an important component of color, that once formed patterns in the feathers of the fossilized birds. Pictured here is a synchrotron rapid scanning x-ray fluorescence image of the calcium distribution in a fossil specimen of Confuciusornis sanctus, an ~120 million year old avian species, the oldest documented to display a fully derived beak. Calcium is high in the bones as shown by the bright white areas, but calcium is also high in the areas corresponding to residue of downy feathers in the neck region. This is interpreted to be due to the distribution of calcium being controlled by eumelanin chelates in the neck feathers, indicating that these soft tissues were originally darkly pigmented. (Credit: Data were collected at SLAC's Stanford Synchrotron Radiation Lightsource, image created by Gregory Stewart (SLAC))

ScienceDaily (June 30, 2011) — Scientists report that they have taken a big step in determining what the first birds looked like more than 100 million years ago, when their relatives, the dinosaurs, still ruled Earth. At the Department of Energy's SLAC National Accelerator Laboratory, they discovered chemical traces of a pigment, an important component of color, that once formed patterns in the feathers of the fossilized birds.

The pigment, eumelanin, is one of the coloring agents responsible for brown eyes and dark hair in many modern species, including humans. It would have been one of the factors that determined the birds' color patterns, along with structural properties of the birds' feathers and other pigments they ingested as part of their diets.

The discovery, reported June 30 in *Science* Express, will help give textbook illustrators, diorama makers and Hollywood special-effects artists a more realistic palette for their depictions of ancient animals. Understanding these pigment patterns is important for science, too, since they play a role in a wide range of behaviors that are important in evolution such as camouflage, communication and selecting mates.

"This is a pigment that evolved a very, very long time ago but is still actively synthesized by organisms on the planet, and we found a way to map it and show its presence over 120 million years of geological time passing," said geochemist Roy Wogelius of the University of Manchester, one of the leaders of an international team that reported the discovery. "It is a direct relationship between you, me, and some extremely old organisms."

Said report co-author Uwe Bergmann of SLAC, "If we could eventually give colors to long extinct species, that in itself would be fantastic. Synchrotron radiation has revolutionized science in many fields, most notably in molecular biology. It is very exciting to see that it is now starting to have an impact in paleontology, in a way that may have important implications in many other disciplines."

Working at SLAC's Stanford Synchrotron Radiation Lightsource, the researchers examined two fossilized birds. *Confuciusornis sanctus*, which lived 120 million years ago, was one of many evolutionary links between dinosaurs and birds, sporting the first known bird-like beak. *Gansus yumenensis*, considered the oldest modern bird, lived more than 100 million years ago and looked a bit like a modern grebe.

Scientists had previously found melanosomes -- the biological "paint pots" where melanin pigments are made and stored -- in both ancient and living organisms. They used information about the structures of the melanosomes to make an educated guess about the colors of the pigments inside. But the newly published research shows that this prior approach has limitations. The team looked instead for chemical traces of the pigments themselves with two sophisticated X-ray techniques developed at SSRL.

The first technique identifies specific chemicals or elements in a sample, and it can examine whole fossils rather than the tiny fragments used in previous methods, revealing pigment patterns across the whole specimen. With it, the researchers unveiled traces of specific elements in and around the tissues, bones and surrounding rock of *Confuciusornis sanctus*. These traces provide an image of the pigmentation patterns from this long-dead bird in eerie detail.

The most striking of these trace elements was copper. As Bergmann points out, copper, which can be toxic in high levels, has persisted in the fossil in significant amounts, appearing in the images as a ghostly glow in places where feathers remained. What was it doing there? Before they could answer that, the researchers had to determine what chemical form the copper took.

SSRL staff scientist Sam Webb used the second X-ray imaging technique to study the fossil of a single feather from Gansus yumenensis. His analysis revealed that the copper in the fossil took the same form as copper trapped by eumelanin pigment. What's more, Webb said, "When we looked outside the feather we didn't see the copper at all."

Couple that chemistry with the way the copper was distributed, and the research team was faced with a mind-boggling conclusion: They had seen actual color patterns in the fossil bird feathers. "There is a stunningly remarkable preservation of pigments," Wogelius said. The team found the same relationship between copper and pigments in samples from modern feathers and squid.

"These new techniques for teasing out evidence of pigmentation will take a lot of the guesswork out of reconstructing the appearance of extinct dinosaurs and birds," said renowned dinosaur illustrator James Gurney, author of the best-selling *Dinotopia* series.

The discovery opens a window on the biochemistry of ancient creatures, and could lead to a far greater understanding of what they ate and the chemistry of their surroundings.

"The fossils we excavate have vast potential to unlock many secrets about the original organism's life, death and subsequent events impacting its preservation," said paper co-author Phil Manning, a paleontologist at the University of Manchester. "In doing this, we unlock much more than just paleontological information. We now have a chemical roadmap to track similar pigments in all life."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/SLAC National Accelerator Laboratory**.

Journal Reference:

1. R. A. Wogelius, P. L. Manning, H. E. Barden, N. P. Edwards, S. M. Webb, W. I. Sellers, K. G. Taylor, P. L. Larson, P. Dodson, H. You, L. Da-Qing, U. Bergmann. **Trace Metals as Biomarkers for Eumelanin Pigment in the Fossil Record**. *Science*, 2011; DOI: 10.1126/science.1205748

http://www.sciencedaily.com/releases/2011/06/110630142839.htm

New Fossils Demonstrate That Powerful Eyes Evolved in a Twinkling

A half-billion-year-old fossil compound eye, showing exquisite detail of the visual surface (the individual lenses can be seen as darker spots). (Credit: Photo by John Paterson (University of New England).)

ScienceDaily (June 30, 2011) — Palaeontologists have uncovered half-a-billion-year-old fossils demonstrating that primitive animals had excellent vision. An international team led by scientists from the South Australian Museum and the University of Adelaide found the exquisite fossils, which look like squashed eyes from a recently swatted fly.

This discovery will be published on June 30, 2011) in the journal *Nature*. The lead author is Associate Professor Michael Lee from the South Australian Museum and the University of Adelaide's School of Earth & Environmental Sciences.

Compound Eyes

Modern insects and crustaceans have "compound eyes" consisting of hundreds or even thousands of separate lenses. They see their world as pixels -- each lens produces a pixel of vision. More lenses mean more pixels and better visual resolution. (Each lens does *not* form a miniature image -- a myth often perpetuated by Hollywood.)

Evolutionary Advantage

The fossil compound eyes were found on Kangaroo Island, South Australia and are 515 million years old. They have over 3000 lenses, making them more powerful than anything from that era, and probably belonged to an active predator that was capable of seeing in dim light.

Their discovery reveals that some of the earliest animals possessed very powerful vision; similar eyes are found in many living insects, such as robber flies. Sharp vision must therefore have evolved very rapidly, soon after the first predators appeared during the 'Cambrian Explosion' of life that began around 540 million years ago.

Given the tremendous adaptive advantage conferred by sharp vision for avoiding predators and locating food and shelter, there must have been tremendous evolutionary pressure to elaborate and refine visual organs.

Who owned them?

As the fossil eyes were found isolated, it's not certain what animal they came from, but they probably belonged to a large shrimp-like creature. The rocks containing the eyes also preserve a dazzling array of ancient marine creatures, many new to science. They include primitive trilobite-like creatures, armored worms, and large swimming predators with jointed feeding appendages.

More pixels: more chance of survival

The recently discovered fossil eyes would have seen the world with over 3000 pixels, giving its owner a huge visual advantage over its contemporaries, which would have seen a very blurry world with about 100 pixels. This is much better than the living horseshoe crab, which sees the world as 1000 pixels, but not as good as living dragonflies, which have the best compound eyes and see the world as ~28 000 pixels.

Story Source:

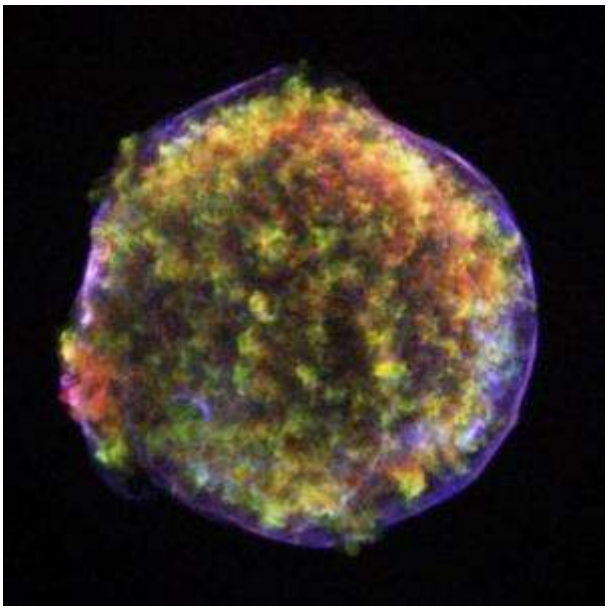
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Adelaide**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Michael S. Y. Lee, James B. Jago, Diego C. García-Bellido, Gregory D. Edgecombe, James G. Gehling, John R. Paterson. **Modern optics in exceptionally preserved eyes of Early Cambrian arthropods from Australia**. *Nature*, 2011; 474 (7353): 631 DOI: 10.1038/nature10097

http://www.sciencedaily.com/releases/2011/06/110629132546.htm

'Zombie' Stars Key to Measuring Dark Energy



This is a Chandra X-ray image of Tycho's supernova remnant. This Type Ia sueprnova was observed by Tycho Brahe in 1572, and today is just an expanding ball of gas. Astronomers used to have to wait years for a close, bright supernova to learn about them. Today big surveys are discovering supernovae by the thousands. (Credit: NASA/Chandra X-ray Observatory)

ScienceDaily (June 30, 2011) — "Zombie" stars that explode like bombs as they die, only to revive by sucking matter out of other stars. According to an astrophysicist at UC Santa Barbara, this isn't the plot for the latest 3D blockbuster movie. Instead, it's something that happens every day in the universe -- something that can be used to measure dark energy.

This special category of stars, known as Type Ia supernovae, help to probe the mystery of dark energy, which scientists believe is related to the expansion of the universe.

Andy Howell, adjunct professor of physics at UCSB and staff scientist at Las Cumbres Observatory Global Telescope (LCOGT), wrote a review article about this topic, published recently in *Nature Communications*. LCOGT, a privately funded global network of telescopes, works closely with UCSB.

Supernovae are stars that have been observed since 1054 A.D., when an exploding star formed the crab nebula, a supernova remnant.

More recently, the discovery of dark energy is one of the most profound findings of the last half-century, according to Howell. Invisible dark energy makes up about three-fourths of the universe. "We only discovered this about 20 years ago by using Type Ia supernovae, thermonuclear supernovae, as standard or 'calibrated' candles," said Howell. "These stars are tools for measuring dark energy. They're all about the same brightness, so we can use them to figure out distances in the universe."

These supernovae are so bright that they shine with the approximate power of a billion suns, noted Howell.

He calls Type Ia supernovae "zombie" stars because they're dead, with a core of ash, but they come back to life by sucking matter from a companion star. Over the past 50 years, astrophysicists have discovered that

Type Ia supernovae are part of binary systems -- two stars orbiting each other. The one that explodes is a white dwarf star. "That's what our sun will be at the end of its life," he said. "It will have the mass of the sun crammed into the size of the Earth."

The white dwarf stars that tend to explode as Type Ia supernovae have approximately the same mass. This was considered a fundamental limit of physics, according to Howell. However, in an article in Nature about five years ago, Howell reported his discovery of stars that go beyond this limit. These previously unknown Type Ia supernovae have more than typical mass before they explode -- a fact that confounds scientists.

Howell presented a hypothesis to understand this new class of objects. "One idea is that two white dwarfs could have merged together; the binary system could be two white dwarf stars," he said. "Then, over time, they spiral into each other and merge. When they merge, they blow up. This may be one way to explain what is going on."

Astrophysicists are using Type Ia supernovae to build a map of the history of the universe's expansion. "What we've found is that the universe hasn't been expanding at the same rate," said Howell. "And it hasn't been slowing down as everyone thought it would be, due to gravity. Instead, it has been speeding up. There's a force that counteracts gravity and we don't know what it is. We call it dark energy."

The new findings relate to Einstein's concept of the cosmological constant. This is a term he added into his equations to make them valid. However, Einstein did it because he thought the universe was static; he didn't know the universe was expanding. When it was revealed that the universe is expanding, Einstein believed this concept was his biggest blunder. "It turns out that this cosmological constant was actually one of his greatest successes," said Howell. "This is because it's what we need now to explain the data."

He said that dark energy is probably a property of space. "Space itself has some energy associated with it," said Howell. "That's what the results seem to indicate, that dark energy is distributed everywhere in space. It looks like it's a property of the vacuum, but we're not completely sure. We're trying to figure out how sure are we of that -- and if we can improve Type Ia supernovae as standard candles we can make our measurements better."

Throughout history, people have noticed a few supernovae so bright they could be seen with the naked eye. With telescopes, astronomers have discovered supernovae farther away. "Now we have huge digital cameras on our telescopes, and really big telescopes," said Howell, "We've been able to survey large parts of the sky, regularly. We find supernovae daily." Astronomers have discovered thousands of supernovae in recent years.

During his career, Howell has used these powerful telescopes to study supernovae. Currently, besides teaching at UCSB, he is involved in LCOGT's detailed study of supernovae that is aimed at helping to understand dark energy. With this extensive network of observatories, it will be possible to study the night sky continuously.

"The next decade holds real promise of making serious progress in the understanding of nearly every aspect of supernovae Ia, from their explosion physics, to their progenitors, to their use as standard candles," writes Howell in Nature Communications. "And with this knowledge may come the key to unlocking the darkest secrets of dark energy."

Story Source:

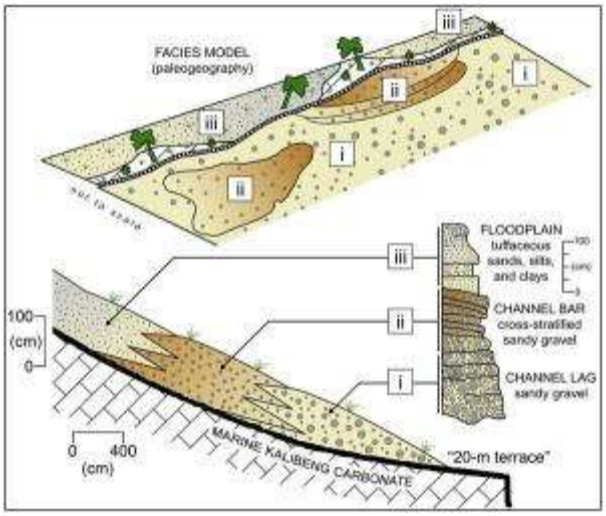
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Santa Barbara**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. D. Andrew Howell. **Type Ia supernovae as stellar endpoints and cosmological tools**. *Nature Communications*, 2011; 2: 350 DOI: 10.1038/ncomms1344

http://bluegrasscountry.org/?p=live&format=asx

Human Ancestor Older Than Previously Thought; Finding Offers New Insights Into Evolution



Generalized composite sedimentary geology of the Ngandong and Jigar "20 meter terrace" denoting stratigraphic positions of Homo erectus fossil material and dated pumices. (Credit: Etty Indriati, Carl C. Swisher, Christopher Lepre, Rhonda L. Quinn, Rusyad A. Suriyanto, Agus T. Hascaryo, Rainer Grün, Craig S. Feibel, Briana L. Pobiner, Maxime Aubert, Wendy Lees, Susan C. Antón. The Age of the 20 Meter Solo River Terrace, Java, Indonesia and the Survival of Homo erectus in Asia. PLoS ONE, 2011; 6 (6): e21562 DOI: 10.1371/journal.pone.0021562)

ScienceDaily (June 30, 2011) — Modern humans never co-existed with Homo erectus -- a finding counter to previous hypotheses of human evolution -- new excavations in Indonesia and dating analyses show. The research, reported in the journal *PLoS ONE*, offers new insights into the nature of human evolution, suggesting a different role for Homo erectus than had been previously thought.

The work was conducted by the Solo River Terrace (SoRT) Project, an international group of scientists directed by anthropologists Etty Indriati of Gadjah Mada University in Indonesia and Susan Antón of New York University.

Homo erectus is widely considered a direct human ancestor -- it resembles modern humans in many respects, except for its smaller brain and differently shaped skull -- and was the first of our ancestors to migrate out of Africa, approximately 1.8 million years ago. Homo erectus went extinct in Africa and much of Asia by about 500,000 years ago, but appeared to have survived in Indonesia until about 35,000 to 50,000 years ago at the site of Ngandong on the Solo River. These late members of Homo erectus would have shared the environment with early members of our own species, Homo sapiens, who arrived in Indonesia by about 40,000 years ago.

The existence of the two species simultaneously has important implications for models about the origins of modern humans. One of the models, the Out of Africa or replacement model, predicts such overlap. However, another, the multiregional model, which posits that modern humans originated as a result of genetic contributions from hominin populations all around the Old World (Africa, Asia, Europe), does not. The late survival of Homo erectus in Indonesia has been used as one line of support for the Out of Africa model.

However, findings by the SoRT Project show that Homo erectus' time in the region ended before modern humans arrived there. The analyses suggest that Homo erectus was gone by at least 143,000 years ago -- and likely by more than 550,000 years ago. This means the demise of Homo erectus occurred long before the arrival of Homo sapiens.

"Thus, Homo erectus probably did not share habitats with modern humans," said Indriati.

The SoRT Project's investigations occurred in Ngandong and Jigar, two sites in the "20-meter terrace" of the Solo River, Indonesia. The sediments in the terrace were formed by the flooding of the ancient river, but currently sit above the Solo River because the river has cut downward through time. The terrace has been a rich source for the discovery of Homo erectus and other animal fossils since the 1930s.

As recently as 1996, a research team dated these sites of hominin, or early human, fossils to as young as 35,000-50,000 years old. The analyses used a technique that dates teeth, and thus provided ages for several animals discovered at the sites. However, other scholars suggested the sites included a mixture of older hominins and younger animals, raising questions about the true age of the hominin remains.

The goal of the SoRT team, which included both members of the 1996 group and its critics, was to understand how the sites in the terrace formed, whether there was evidence for mixing of older and younger remains, and just how old the sites were.

Since 2004, team members have conducted analyses of animal remains, geological surveys, trenching, and archaeological excavations. The results from all of these provide no evidence for the mixing of older and younger remains. All the evidence suggests the sites represent just a short time period.

"The postmortem damage to the animal remains is consistent and suggests very little movement of the remains by water," explained Briana Pobiner, the project's archaeologist and a paleoanthropologist at the Smithsonian Institution's National Museum of Natural History. "This means that it is unlikely that very old remains were mixed into younger ones."

In addition, clues from the sediments exposed during excavation suggest to the projects' geoarchaeologists, Rhonda Quinn, Chris Lepre, and Craig Feibel, of Seton Hall, Columbia, and Rutgers universities, that the deposits occurred over a short time period. The teeth found in different excavation layers at Jigar are also all nearly identical in age, supporting the conclusion that mixing across geological periods did not occur.

"Whatever the geological age of the sites is, the hominins, animals, and sediments at Ngandong and Jigar are all the same age," said project co-leader Susan Antón.

The team applied two different dating techniques to the sites. Like earlier work, they used the techniques -- U-series and Electron Spin Resonance, or ESR -- that are applied to fossilized teeth. They also used a technique called argon-argon dating that is applied to volcanic minerals in the sediments. All three methods use radioactive decay in different ways to assess age and all yielded robust and methodologically valid results, but the ages were inconsistent with one another.

The argon-argon results yielded highly precise ages of about 550,000 years old on pumices -- very light, porous volcanic products found at Ngandong and Jigar.

"Pumices are hard to rework without breaking them, and these ages are quite good, so this suggests that the hominins and fauna are this old as well," said project geochronologist Carl Swisher of Rutgers University.

By contrast, the oldest of the U-series and ESR ages, which were conducted at Australian National University by Rainer Grün, are just 143,000 years.

The difference in the ages means that one of the systems is providing an age for something other than the formation of the sites and fossils in them. One possibility is that the pumices are, in fact, reworked, or mixed

in, from older rocks. The other possibility is that the ESR and U-series ages are dating an event that occurred after the sites were formed, perhaps a change in the way groundwater moved through the sites.

Either way, the ages provide a maximum and a minimum for the sites -- and both of these ages are older than the earliest Homo sapiens fossils in Indonesia. Thus, the authors concluded that the idea of a population of Homo erectus surviving until late in time in Indonesia and potentially interacting with Homo sapiens seems to have been disproven.

The study's other co-authors included: Rusyad Suriyanto and Agus Hascaryo of Indonesia's Gadjah Mada University and Wendy Lees and Maxime Aubert of the Australian National University.

The National Science Foundation sponsored field and laboratory work by the Solo River Terrace Project.

Story Source:

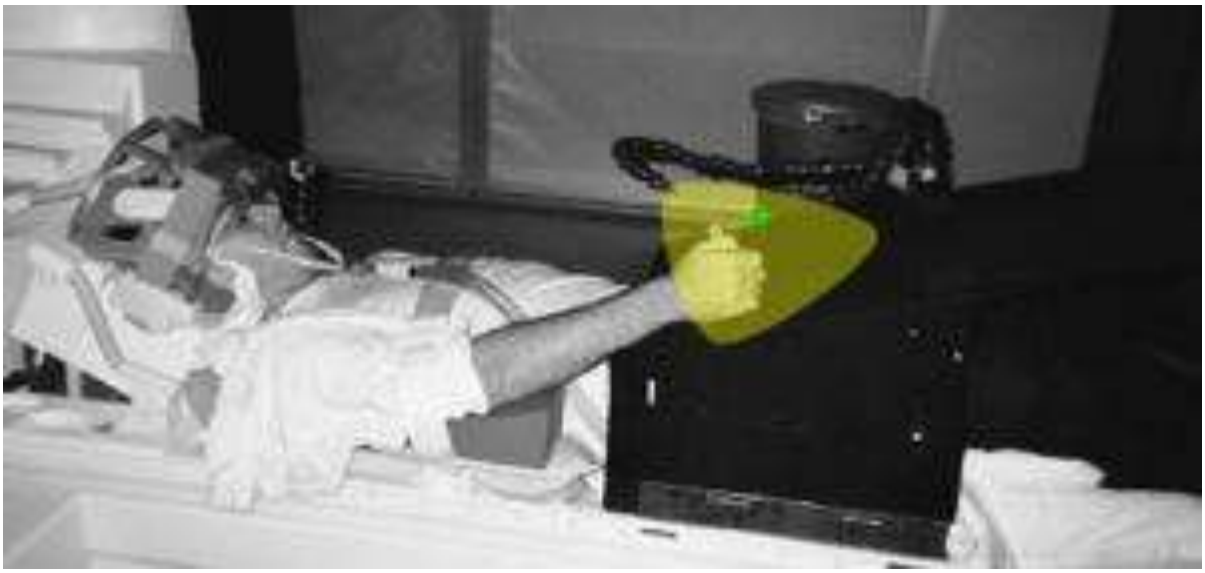
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **New York University**.

Journal Reference:

1. Etty Indriati, Carl C. Swisher, Christopher Lepre, Rhonda L. Quinn, Rusyad A. Suriyanto, Agus T. Hascaryo, Rainer Grün, Craig S. Feibel, Briana L. Pobiner, Maxime Aubert, Wendy Lees, Susan C. Antón. **The Age of the 20 Meter Solo River Terrace, Java, Indonesia and the Survival of Homo erectus in Asia**. *PLoS ONE*, 2011; 6 (6): e21562 DOI: 10.1371/journal.pone.0021562

http://www.sciencedaily.com/releases/2011/06/110629181853.htm

Researchers Can Predict Future Actions from Human Brain Activity



A volunteer completes tasks while in the functional magnetic imaging (fMRI) machine. This research project focuses on understanding how the human brain plans actions. (Credit: Image courtesy of University of Western Ontario)

ScienceDaily (June 30, 2011) — Bringing the real world into the brain scanner, researchers at The University of Western Ontario from The Centre for Brain and Mind can now determine the action a person was planning, mere moments before that action is actually executed.

The findings were published this week in the *Journal of Neuroscience*.

"This is a considerable step forward in our understanding of how the human brain plans actions," says Jason Gallivan, a Western Neuroscience PhD student, who was the first author on the paper.

Over the course of the one-year study, human subjects had their brain activity scanned using functional magnetic resonance imaging (fMRI) while they performed one of three hand movements: grasping the top of an object, grasping the bottom of the object, or simply reaching out and touching the object. The team found that by using the signals from many brain regions, they could predict, better than chance, which of the actions the volunteer was merely intending to do, seconds later.

"Neuroimaging allows us to look at how action planning unfolds within human brain areas without having to insert electrodes directly into the human brain. This is obviously far less intrusive," explains Western Psychology professor Jody Culham, who was the paper's senior author.

Gallivan says the new findings could also have important clinical implications: "Being able to predict a human's desired movements using brain signals takes us one step closer to using those signals to control prosthetic limbs in movement-impaired patient populations, like those who suffer from spinal cord injuries or locked-in syndrome."

This research is funded by the Canadian Institutes of Health Research (CIHR). A past recipient of the CIHR Brain Star Award, Gallivan is funded by a Natural Sciences and Engineering Research Council of Canada (NSERC) graduate scholarship.

Story Source:

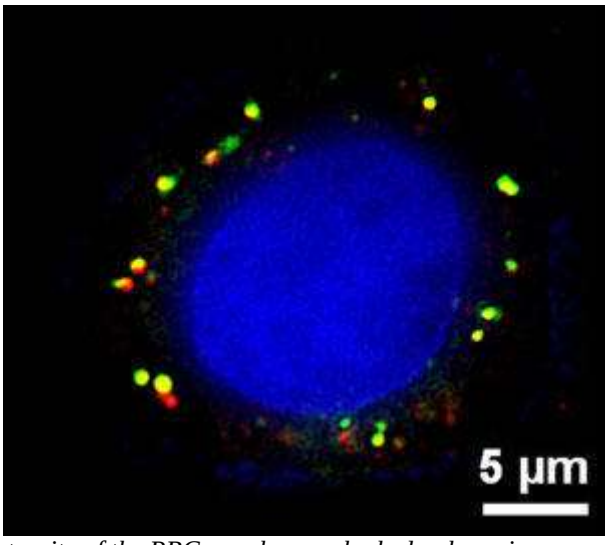
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Western Ontario**.

Journal Reference:

1. J. P. Gallivan, D. A. McLean, K. F. Valyear, C. E. Pettypiece, J. C. Culham. **Decoding Action Intentions from Preparatory Brain Activity in Human Parieto-Frontal Networks**. *Journal of Neuroscience*, 2011; 31 (26): 9599 DOI: 10.1523/JNEUROSCI.0080-11.2011

http://www.sciencedaily.com/releases/2011/06/110629171228.htm

Nanoparticles Disguised as Red Blood Cells to Deliver Cancer-Fighting Drugs



Scanning fluorescence microscopy image shows the integrity of the RBC-membrane-cloaked polymeric nanoparticles after being taken up by a cancer cell. The RBC membrane was visualized with green dye, polymeric core with red dye, and cancer cell with blue dye. (Credit: Proceedings of the National Academy of Sciences)

ScienceDaily (June 30, 2011) — Researchers at the University of California, San Diego have developed a novel method of disguising nanoparticles as red blood cells, which will enable them to evade the body's immune system and deliver cancer-fighting drugs straight to a tumor. Their research will be published next week in the online Early Edition of the *Proceedings of the National Academy of Sciences.*

The method involves collecting the membrane from a red blood cell and wrapping it like a powerful camouflaging cloak around a biodegradable polymer nanoparticle stuffed with a cocktail of small molecule drugs. Nanoparticles are less than 100 nanometers in size, about the same size as a virus.

"This is the first work that combines the natural cell membrane with a synthetic nanoparticle for drug delivery applications." said Liangfang Zhang, a nanoeningeering professor at the UC San Diego Jacobs School of Engineering and Moores UCSD Cancer Center. "This nanoparticle platform will have little risk of immune response."

Researchers have been working for years on developing drug delivery systems that mimic the body's natural behavior for more effective drug delivery. That means creating vehicles such as nanoparticles that can live and circulate in the body for extended periods without being attacked by the immune system. Red blood cells live in the body for up to 180 days and, as such, are "nature's long-circulation delivery vehicle," said Zhang's student Che-Ming Hu, a UCSD Ph.D. candidate in bioengineering, and first author on the paper.

Stealth nanoparticles are already used successfully in clinical cancer treatment to deliver chemotherapy drugs. They are coated in a synthetic material such as polyethylene glycol that creates a protection layer to suppress the immune system so that the nanoparticle has time to deliver its payload. Zhang said today's stealth nanoparticle drug delivery vehicles can circulate in the body for hours compared to the minutes a nanoparticle might survive without this special coating.

But in Zhang's study, nanoparticles coated in the membranes of red blood cells circulated in the bodies of lab mice for nearly two days. The study was funded through a grant from the National Institute of Health.

A shift towards personalized medicine

Using the body's own red blood cells marks a significant shift in focus and a major breakthrough in the field of personalized drug delivery research. Trying to mimic the most important properties of a red blood cell in a synthetic coating requires an in-depth biological understanding of how all the proteins and lipids function on the surface of a cell so that you know you are mimicking the right properties. Instead, Zhang's team is just taking the whole surface membrane from an actual red blood cell.

"We approached this problem from an engineering point of view and bypassed all of this fundamental biology," said Zhang. "If the red blood cell has such a feature and we know that it has something to do with the membrane -- although we don't fully understand exactly what is going on at the protein level -- we just take the whole membrane. You put the cloak on the nanoparticle, and the nanoparticle looks like a red blood cell."

Using nanoparticles to deliver drugs also reduces the hours it takes to slowly drip chemotherapy drug solutions through an intravenous line to just a few minutes for a single injection of nanoparticle drugs. This significantly improves the patient's experience and compliance with the therapeutic plan. The breakthrough could lead to more personalized drug delivery wherein a small sample of a patient's own blood could produce enough of the essential membrane to disguise the nanoparticle, reducing the risk of immune response to almost nothing.

Zhang said one of the next steps is to develop an approach for large-scale manufacturing of these biomimetic nanoparticles for clinical use, which will be done through funding from the National Science Foundation. Researchers will also add a targeting molecule to the membrane that will enable the particle to seek and bind to cancer cells, and integrate the team's technology for loading drugs into the nanoparticle core so that multiple drugs can be delivered at the same time.

Zhang said being able to deliver multiple drugs in a single nanoparticle is important because cancer cells can develop a resistance to drugs delivered individually. By combining them, and giving the nanoparticle the ability to target cancer cells, the whole cocktail can be dropped like a bomb from within the cancer cell.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - San Diego**. The original article was written by Catherine Hockmuth.

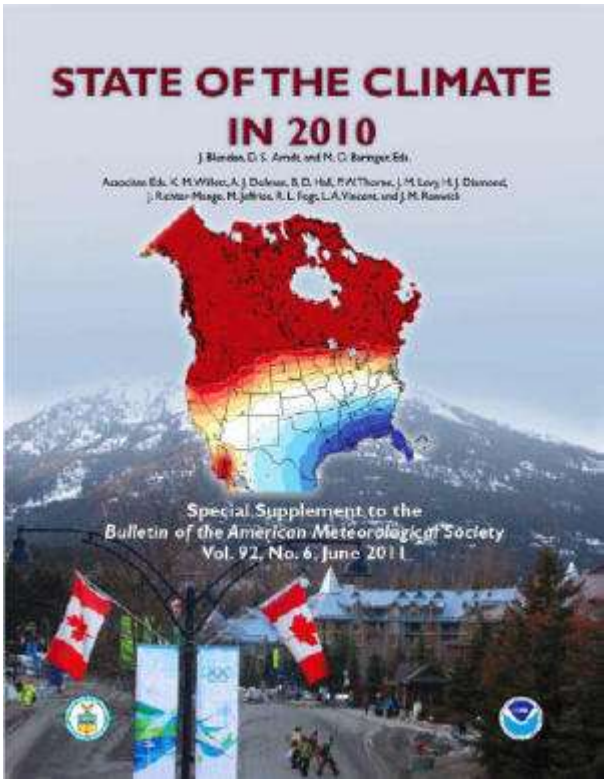
Journal Reference:

1. Che-Ming J. Hu, Li Zhang, Santosh Aryal, Connie Cheung, Ronnie H. Fang and Liangfang Zhang. **Erythrocyte membrane-camouflaged polymeric nanoparticles as a biomimetic delivery platform**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1106634108

http://www.sciencedaily.com/releases/2011/06/110620161300.htm

2010 One of Two Warmest Years On Record; El Niño-Southern Oscillation and Other Climate Patterns Play Major Role

State of the Climate in 2010 report cover. (Credit: NOAA)



ScienceDaily (June 30, 2011) — Worldwide, 2010 was one of the two warmest years on record, according to the 2010 *State of the Climate* report, which NOAA has just released. The peer-reviewed report, issued in coordination with the American Meteorological Society, was compiled by 368 scientists from 45 countries. It provides a detailed, yearly update on global climate indicators, notable climate events and other climate information from every continent.

This year's report tracks 41 climate indicators — four more than last year — including temperature of the lower and upper atmosphere, precipitation, greenhouse gases, humidity, cloud cover, ocean temperature and salinity, sea ice, glaciers, and snow cover. Each indicator includes thousands of measurements from multiple independent datasets that allow scientists to identify overall trends.

While several well-known cyclical weather patterns had a significant influence on weather and climate events throughout the year, the comprehensive analysis of indicators shows a continuation of the long-term trends scientists have seen over the last 50 years, consistent with global climate change.

"We're continuing to closely track these indicators because it is quite clear that the climate of the past cannot be assumed to represent the climate of the future. These indicators are vital for understanding and making reliable projections of future climate," said Thomas R. Karl, L.H.D, director of NOAA's National Climatic Data Center in Asheville, N.C.

Last year was marked by important climate oscillations like the El Niño-Southern Oscillation and the Arctic Oscillation, which affected regional climates and contributed to many of the world's significant weather events in 2010.

Highlights of some of the climate indicators include:

- **Temperature:** Three major independent datasets show 2010 as one of the two warmest years since official record-keeping began in the late 19th century. Annual average temperatures in the Arctic continued to rise at about twice the rate of the lower latitudes.
- **Sea Ice & Glaciers:** Arctic sea ice shrank to the third smallest area on record, and the Greenland ice sheet melted at the highest rate since at least 1958. The Greenland ice sheet melt area was approximately 8 percent more than the previous record set in 2007. Alpine glaciers shrank for the

20th consecutive year. Meanwhile, average sea ice extent in the Antarctic grew to an all-time record maximum in 2010.

- **Sea Surface Temperature and Sea Level:** Even with a moderate-to-strong La Niña in place during the latter half of the year, which is associated with cooler equatorial waters in the tropical Pacific, the 2010 average global sea surface temperature was third warmest on record and sea level continued to rise.
- **Ocean Salinity:** Oceans were saltier than average in areas of high evaporation and fresher than average in areas of high precipitation, suggesting that the water cycle is intensifying.
- **Greenhouse Gases:** Major greenhouse gas concentrations continued to rise. Carbon dioxide increased by 2.60 ppm, which is more than the average annual increase seen from 1980-2010.

Several major cyclical weather patterns played a key role in weather and climate in 2010:

- **El Niño-Southern Oscillation:** A strong warm El Niño climate pattern at the beginning of 2010 transitioned to a cool La Niña by July, contributing to some unusual weather patterns around the world and impacting global regions in different ways. Tropical cyclone activity was below normal in nearly all basins around the globe, especially in much of the Pacific Ocean. The Atlantic basin was the exception, with near-record high North Atlantic basin hurricane activity. Heavy rains led to a record wet spring (September -- November) in Australia, ending a decade-long drought.
- **Arctic Oscillation:** In its negative phase for most of 2010, the Arctic Oscillation affected large parts of the Northern Hemisphere causing frigid arctic air to plunge southward and warm air to surge northward. Canada had its warmest year on record while Britain had its coldest winter at the beginning of the year and coldest December at the end of the year. The Arctic Oscillation reached its most negative value in February, the same month several cities along the U.S. East Coast had their snowiest months ever.
- **Southern Annular Mode:** An atmospheric pattern related to the strength and persistence of the storm track circling the Southern Hemisphere and the Antarctic led to an all-time maximum in 2010 of average sea ice volume in the Antarctic.

The *State of the Climate* report is peer-reviewed and published annually as a special supplement to the Bulletin of the American Meteorological Society. The 2010 report is edited by J. Blunden, D.S. Arndt, and M.O. Baringer. The full report and a highlights document are available online (http://www.ncdc.noaa.gov/bams-state-of-the-climate).

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Oceanic and Atmospheric Administration**.

http://www.sciencedaily.com/releases/2011/06/110629204702.htm

Rockin' Tortoises: A 150-Year-Old New Species

This is a specimen of the new species, Morafka's Desert Tortoise (Gopherus morafkai), from Tiburon Island, Sonora, Mexico. (Credit: Photo courtesy of Taylor Edwards, 2010)

ScienceDaily (June 29, 2011) — A team of researchers investigated a desert tortoise from the United States Southwest and northwestern Mexico. What was thought to be a simple problem in species identification turned out to be a very complex matter. Their investigations required forensic genetics and several other methods. In the end, they found it necessary to describe a new species. More than that, the discovery has very important implications for conservation and the development of the deserts of southern California.

Since the original description of Agassiz's Land Tortoise, scientifically called *Gopherus agassizii*, facts have been nothing less than Dazed and Confused. One hundred and fifty years ago in 1861, James Graham Cooper described a new species of tortoise from the deserts of California. From the get-go, factual confusion has been more common than not. The publication date has consistently been inappropriately attributed to 1863, and even the original common name, Agassiz Land Tortoise, was inexplicably changed to the Desert Tortoise, a moniker that is commonly used today. But there's more than just a new name.

For 150 years, Agassiz's Land Tortoise has been masking the existence of at least two species whose distributions are restricted to either side of the Colorado River. Prof. Bob Murphy of the Royal Ontario Museum, Toronto, Canada and the Kunming Institute of Zoology, Chinese Academy of Sciences, and colleagues from the US Geological Survey, Arizona Research Laboratories, California Academy of Sciences, and Lincoln University have now started to unravel a Gordian knot. As if coming straight out of an episode of the TV series CSI, they went into the laboratory and obtained DNA data from the original 150-year-old type specimen, as well as from a more recently described species inhabiting the tip of the Baja California peninsula. The effort in forensic genetics documented that the named species was from California, and not Arizona as sometimes claimed. The enigmatic species from Baja California was previously thought to be a transplant from Tiburon Island, Sonora, Mexico, but turns out to be from California, or at least its founding mother was from there. All of this meant that the population in Arizona and adjacent Mexico was an unnamed, new species, one whose identity had been hidden for more than a century.

The new rock-dwelling species, *Gopherus morafkai*, is named for the late Prof. David J. Morafka, a pioneer in tortoise research. The results of the research are published in the open access journal *ZooKeys*.

The recognition of Morafka's Desert Tortoise means that Agassiz's Desert Tortoise has lost a whopping 70 percent of its range! Arizona and adjacent Mexico can no longer serve as a genetic reservoir for the Western species. And given that the Western species was already listed as being threatened because of drastic decline in the number of individuals -- a consequence of disease, urban expansion and habitat destruction -- the

description of the new species may turn up the heat on politicians and developers with respect to the massive construction of solar energy sites in prime Desert Tortoise habitat in the Mojave Desert. Perhaps this flagship centurion of the Southwest should be upgraded to Endangered status? Because Morafka's Desert Tortoise has lost 30% of its range, perhaps protection for this species should be fast-tracked? Only time will tell.

The complete story remains untold. The knot remains untied. It is possible that Morafka's Desert Tortoise may consist of two species. And so, back to the field and lab goes the team, inspired by knowing that Dave Morafka would be very pleased with the progress.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Pensoft Publishers**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Robert Murphy, Kristin Berry, Taylor Edwards, Alan Leviton, Amy Lathrop, J. Daren Riedle. **The dazed and confused identity of Agassiz's land tortoise, Gopherus agassizii (Testudines: Testudinidae) with the description of a new species and its consequences for conservation**. *ZooKeys*, 2011; DOI: 10.3897/zookeys.1131353

http://www.sciencedaily.com/releases/2011/06/110628132555.htm

Who's Happy? How Long We Look at Happy Faces Is in Our Genes

Researchers have found variations of the cannabinoid receptor gene that alter the amount of time people spend looking at happy faces. (Credit: iStockphoto/Özgür Donmaz)

ScienceDaily (June 29, 2011) — Though we all depend on reading people's faces, each of us sees others' faces a bit differently. Some of us may gaze deeply into another's eyes, while others seem more reserved. At one end of this spectrum people with autism spectrum conditions (ASC) look less at other people's faces, and have trouble understanding others people's feelings. New research published in BioMed Central's open-access journal *Molecular Autism* has found variations of the cannabinoid receptor (CNR1) gene that alter the amount of time people spend looking at happy faces.

The new research was led by Dr Bhismadev Chakrabarti at the University of Reading and Professor Simon Baron-Cohen at the University of Cambridge. Their earlier research had shown that polymorphisms (naturally occurring mutations) in CNR1 were associated with altered activity within the striatum (a region of the brain involved in emotion and reward behavior) in response to happy faces.

In the new study the researchers analyzed the DNA from 28 adult volunteers and tested (using a "gaze tracker") how long the volunteers looked at eyes and mouths of faces in video clips showing different emotions. The team found variations within two of the four polymorphisms in CNR1 correlated with a longer gaze at happy faces but not with faces showing disgust. Both of these genomic sites involved for happy faces were within part of the DNA which does not code for protein but instead may be involved in regulating protein production.

Dr Chakrabarti commented, "This is the first study to have shown that how much we gaze at faces is influenced by our genetic make-up. If replicated it has profound implications for our understanding of the drive to socialize, and in turn, the atypical use of gaze in autism."

Funding sources: Research grants from the Medical Research Council (UK); Target Autism Genome; the Nancy Lurie Marks Family Foundation; NIHR CLAHRC for Cambridgeshire and Peterborough NHS Foundation Trust, Trinity College, Cambridge.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **BioMed Central**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Bhismadev Chakrabarti, Simon Baron-Cohen. **Variation in the human Cannabinoid Receptor (CNR1) gene modulates gaze duration for happy faces**. *Molecular Autism*, 2011; 2: 10 DOI: 10.1186/2040-2392-2-10

http://www.sciencedaily.com/releases/2011/06/110628234831.htm