



# Infoteca's E-Journal



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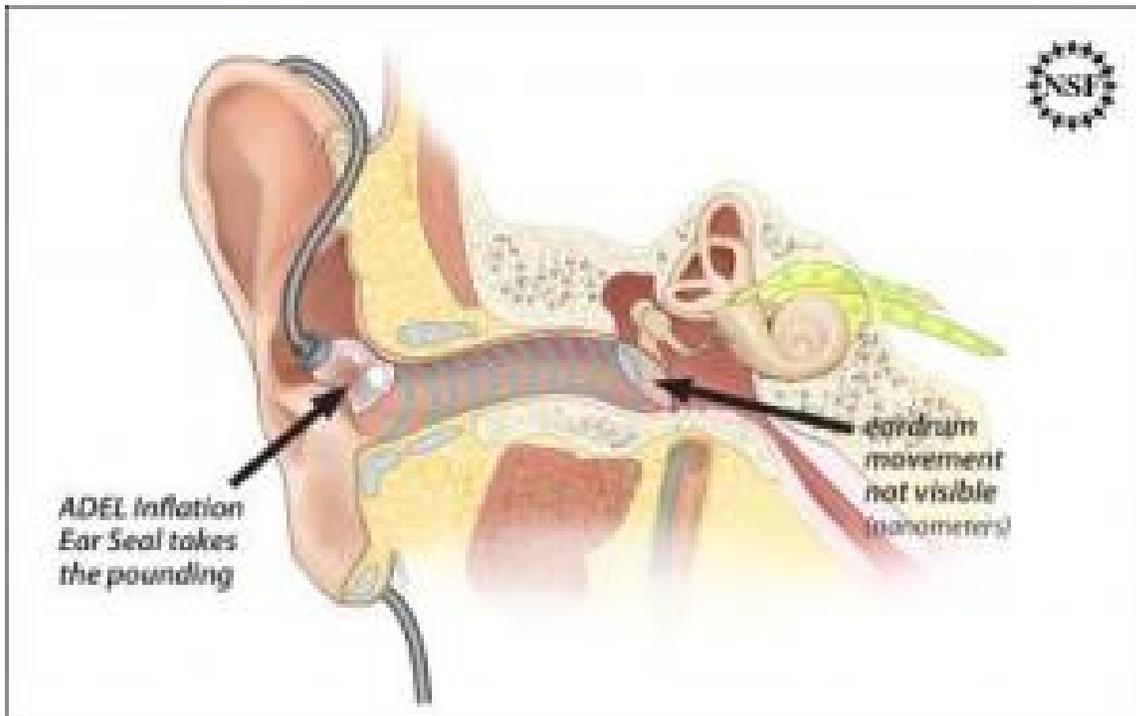
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## Sound Safety: Novel Device With Rock 'N' Roll Roots May Protect Listeners from Potential Dangers of Personal Listening Devices and Hearing Aids



The ADEL(TM), which looks like a tiny ear-sealing balloon, is a sacrificial membrane that disrupts excessive pressure waves, protecting the ear drum when in-ear listening devices are used. (Credit: Zina Deretsky, NSF; Asius)

ScienceDaily (May 15, 2011) — Engineers investigating "listener fatigue"-- the discomfort and pain some people experience while using in-ear headphones, hearing aids, and other devices that seal the ear canal from external sound -- have found not only what they believe is the cause, but also a potential solution.

In two separate papers and a presentation at the 130th Audio Engineering Society convention in London on May 14th, 2011, Stephen Ambrose, Robert Schulein and Samuel Gido of Asius Technologies of Longmont, Colo., describe how sealing a speaker in the ear canal dramatically boosts sound pressures and how a modified ear-tip can help alleviate, or even eliminate, that effect.

"We tried for years to turn down the volume but still experienced audio fatigue, even at the lowest levels we could get by with on stage," says Ambrose, who has been leading the development of in-ear monitors for more than 35 years as a musician and audio engineer for leading artists and film studios. "The fatigue couldn't simply be 'fixed in the [audio] mix' because it now appears to be a physiological phenomenon," he adds. "It wasn't a problem with electronics, but rather mechanics."

Using physical and computational models, the researchers show that sound waves entering a sealed ear canal create an oscillating pressure chamber that can produce a potentially dramatic boost in sound pressure levels.

Data from the models coupled with laboratory observations suggest that the boost triggers the acoustic reflex, a defense mechanism in the ear that dampens the transfer of sound energy from the eardrum to the cochlea by as much as 50 decibels, but does not protect the ear drum from the excessive shaking.

"Paradoxically, the protective reflex makes loud volumes seem lower than they really are," adds Gido, "potentially prompting the listener to turn up the volume even more." The ear drum, already shaken by the oscillations of the pressure chamber, is further impacted by the boosted volume.

The resulting physical strain, along with the repeated activation of the tiny muscles involved in the acoustic reflex, are what the researchers believe may lead to listener fatigue.

To counter the oscillations, Ambrose and his colleagues developed a way to use a membrane outside the ear drum to take the brunt of all the pounding. This "sacrificial membrane" disrupts the excessive pressure waves, protecting the ear drum and preventing the triggering of the acoustic reflex, ultimately leading to lower, safer listening volumes.

The papers describe two approaches for introducing the new technology. The simplest involves a retrofit that can be applied to existing in-ear headphones and builds upon earlier studies of hearing aids. For decades, audiologists have known that sealed ear canals create distracting side effects, such as the occlusion effect that causes one's voice to sound muffled. In years past, audiologists drilled small holes to alleviate the pressure; however, the holes also led to squealing feedback effects and diminished sound quality.

Ambrose discovered that stretching a thin film of medical-grade polymer over the pressure-alleviating hole reseals the environment, yet provides a sacrificial membrane to absorb the abusive pressures. Based on the conclusions of the recent papers, the membrane-hole modification appears to eliminate the overpressure effects that impact the users of many headphones, hearing aids and other devices.

For greater sound pressure reduction and potentially improved sound quality, Asius also developed a more advanced corrective device: a small, inflatable seal called an Ambrose Diaphonic Ear Lens (ADELTM). The ADELTM, which looks like a tiny ear-sealing balloon, uses a novel, miniaturized technology called an Asius Diaphonic Pump™ to inflate the polymer membrane.

The pump, developed with support from NSF's Small Business Innovation Research program, converts the alternating, compression-expansion waves of sound into a direct-flowing stream of molecules, filling the membrane using only minimal energy from the headphone speaker. The pump has enough force to both inflate the ear lens and keep the device comfortably in the ear canal for as long as the device is worn.

"The lens maintains desirable audio fidelity, especially at bass frequencies, and prevents feedback," says Gido. "The flexible membrane vibrates with the oscillating sound pressure in the sealed ear canal and radiates excess sound energy out of the closed space in front of the ear drum. In a sense, the flexible polymer membrane behaves like a second ear drum, which is more compliant than the real ear drum, allowing it to direct excess sound energy away from the sensitive structures of the ear."

The pump takes advantage of a physical property called a synthetic jet, a column of fluid that erupts when an acoustic wave passes through a small hole.

Sound waves are compression and rarefaction waves -- specifically, symmetric pulses of alternating compressed and expanded air molecules. Our ears interpret the alternating pulses as sound.

"As sound waves pass through any given small hole, the alternating pulses emerge and retract through the orifice like a small air-piston, hitting and knocking the surrounding air molecules forward like billiard balls," says Ambrose. "Other molecules join in the stream from the sides due to the low pressure created by the flow. This results in a sustained jet of air."

By integrating an inward flowing jet into the side of the sound port, Asius transformed a standard synthetic jet into a real pump capable of harvesting and storing inflation and deflation pressures.

"Our support of the diaphonic valve-on-a-chip and its capabilities for harvesting audio energy to couple communications into the ear arises from both the innovative components of the proposed technology as well as the societal impacts," says Juan Figueroa, the NSF program director who has overseen Asius's grant. "The improvement will allow users improved hearing all the time, rather than being forced to live with reduced hearing again and again due to device-related listener fatigue."

The new technologies emerged from Ambrose's experiences as a recording artist and audio pioneer. In 1976, Ambrose invented what would become the SoundSight MicroMonitor, the first high-fidelity, custom in-ear monitor (IEM), a headphone for monitoring amplified music during concerts.

While the small size, improved sound, and other advantages led to wide adoption of the IEMs, users realized early on that extended listening could result in uncomfortable fatigue in the ear, and sometimes pain. The experiences were not unique -- hearing-aid users, battlefield soldiers using in-ear protection, and others using sealed-ear-canal devices reported similar experiences.

"From the beginning, I knew something would have to be done about this audio fatigue factor," says Ambrose, though he had trouble proving that pressures were so extreme. "I invented the diaphonic pump partly to prove that audio volumes could create static pressures in the ear that no one ever dreamed were possible."

The researchers corroborated observational data with a computer simulation of the effect, incorporating data from functioning ear canals, cadavers and fluid dynamics models.

Because the reflex is muscular, the researchers believe the repeated engagement and disengagement causes the tiny muscles to fatigue, leading to much of the pain and discomfort associated with listener fatigue. The researchers have submitted applications to conduct extensive studies to determine the role these factors play in contributing to hearing loss.

"With the help of Jay Kadis from Stanford University, we confirmed that the our devices prevented the acoustic reflex from triggering, and the lower volume levels merely sounded louder because the ear was now more sensitive -- more sensitive, yet less prone to higher volumes. And, without the reflex, the stapedius muscle was no longer being constantly tired out from overuse. We knew we had a discovery and a solution that would help everyone from professional performers to hearing-aid wearers."

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#### Story Source:

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<http://www.sciencedaily.com/releases/2011/05/110513064347.htm>



## Heart Failure Patients' Osteoporosis Often Undiagnosed, Untreated

ScienceDaily (May 15, 2011) — One in 10 heart failure patients had compression fractures in the spine that could have been detected by a chest X-ray, but few are receiving treatment to help prevent such fractures, according to a Canadian study published in the American Heart Association journal *Circulation: Heart Failure*.

Among 623 heart failure patients, researchers found that 12 percent had moderate to severe vertebral compression fractures and 55 percent of those had multiple fractures. These fractures are a sign of osteoporosis, a condition in which bones become less dense and have a high risk of breaking. Only 15 percent of the heart failure patients with spinal fractures were being treated for osteoporosis, despite having a higher risk for fractures.

After adjusting for other risk factors for osteoporosis, heart failure patients who also had atrial fibrillation were twice as likely to have vertebral fractures as those with normal heart rhythms.

"Osteoporosis is an infrequently recognized and undertreated comorbidity of heart failure," said Kristin J. Lyons, M.D., C.M., lead author of the study and chief medical resident in the Department of Medicine at the University of Alberta in Edmonton, Canada. "Fortunately, the chest X-ray can be used as a case-finding tool to increase fracture identification."

Physicians' attention to the chest X-ray findings of their heart failure patients are key, said Justin A. Ezekowitz, M.D., senior author of the study and assistant professor at the Mazankowski Alberta Heart Institute in the University of Alberta in Edmonton. "While reviewing chest X-rays to look at the heart and lungs, physicians also need to look carefully at the bones. If fractures are found, patients need to be treated with dietary modification, exercise and, if indicated, osteoporosis medications. Treatment can reduce future fractures by as much as 50 percent."

Participants in the study were average age 69, 32 percent were 75 years or older and 31 percent were women. Average left ventricular ejection fraction was 32 percent in about half, 38 percent had atrial fibrillation and 65 percent had ischemic cardiomyopathy.

Heart failure patients with spinal fractures were older, more likely to be female, weighed less and more likely to have atrial fibrillation, the researchers found.

"As the population ages, two of the most prevalent diseases are heart disease and osteoporosis," Ezekowitz said. "While hip fractures are the most devastating complication of osteoporosis, vertebral compression fractures are by far the most common. Unfortunately, 60 percent to 70 percent of spinal fractures are initially asymptomatic, escaping clinical detection yet placing the patients at higher risk for another vertebral fracture and subsequent hip fractures."

Researchers found a higher incidence of fractures than in previous studies because many of the spinal fractures were asymptomatic and undiagnosed, he said.

In the past, treatments for osteoporosis, such as bisphosphonate drugs, have been reported to lead to atrial fibrillation; however, the Canadian researchers found no association.

The researchers hypothesize that hyperaldosteronism (high levels of the hormone aldosterone) may provide a plausible explanation for the relationship between chronic heart failure, osteoporosis and atrial fibrillation. Aldosterone, a hormone made in the adrenal gland, helps regulate blood pressure, the balance of fluids and electrolytes.

High levels of aldosterone in past studies have been shown to play a role in osteoporosis related fractures and also have led to atrial fibrillation, Ezekowitz said. "Further study is needed, but it could be that treatment with an aldosterone antagonist like spironolactone could lower the incidence of fractures and atrial fibrillation in these patients."

Further studies also are needed to either confirm or refute a link with hyperaldosteronism, Ezekowitz said.

Limitations of the study include that chest X-rays weren't performed specifically to diagnose spinal fractures and bone mineral density tests were not performed. The study's strengths were the completeness of the description of the patients and that all the chest X-rays were performed at one center where the radiologists were board certified, and the chest X-rays have been evaluated and found to be very specific for spinal fractures.

The researchers are studying whether atrial fibrillation should be considered as a risk factor for fractures in heart failure patients.

Sumit R. Majumdar, M.D., M.P.H., was also a co-author of the study. Author disclosures are on the manuscript.

Anonymous donations to the Heart Function Clinic via University Hospital Foundation in Edmonton, Canada funded the study.

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## Controlling Robotic Arms Is Child's Play



*The robotic arm can be controlled with an input device. When the hand holding the device is moved, the robot emulates the movement. (Credit: © Fraunhofer IPA)*

ScienceDaily (May 15, 2011) — Catching a ball is no problem for most people. Getting a robotic arm to catch a ball using a catcher attachment is a bit trickier. To find out just how tricky it is -- or to see if it's easier than they think -- visitors to the Sensor+Test trade fair in Nuremberg should head for the Fraunhofer booth. There, researchers will be presenting an industrial robotic arm with six joints, at the end of which is a catcher. Visitors can control the arm using a hand-held input device: When they move the hand holding the device, the robot emulates their movement.

"The input device contains various movement sensors, also called inertial sensors," says Bernhard Kleiner of the Fraunhofer Institute for Manufacturing Engineering and Automation IPA in Stuttgart, who leads the project. The individual micro-electromechanical systems themselves are not expensive. What the scientists have spent time developing is how these sensors interact. "We have developed special algorithms that fuse the data of individual sensors and identify a pattern of movement. That means we can detect movements in free space," summarizes Kleiner.

What may at first appear to be a trade show gimmick, is in fact a technology that offers numerous advantages in industrial production and logistical processes. The system could be used to simplify the programming of industrial robots, for example. To date, this has been done with the aid of laser tracking systems: An employee demonstrates the desired motion with a hand-held baton that features a white marker point. The system records this motion by analyzing the light reflected from a laser beam aimed at the marker. Configuring and calibrating the system takes a lot of time. The new input device should eliminate the need for these steps in the future -- instead, employees need only pick up the device and show the robot what it is supposed to do.

The system has numerous applications in medicine, as well. Take, for example, gait analysis. Until now, cameras have made precise recordings of patients as they walk back and forth along a specified path. The films reveal to the physician such things as how the joints behave while walking, or whether incorrect posture in the knees has been improved by physical therapy. Installing the cameras, however, is complex and costly, and patients are restricted to a predetermined path. The new sensor system can simplify this procedure: Attached to the patient's upper thigh, it measures the sequences and patterns of movement -- without limiting the patient's motion in any way.

"With the inertial sensor system, gait analysis can be performed without a frame of reference and with no need for a complex camera system," explains Kleiner. In another project, scientists are already working on

comparisons of patients' gait patterns with those patterns appearing in connection with such diseases as Parkinson's.

Another medical application for the new technology is the control of active prostheses containing numerous small actuators. Whenever the patient moves, the prosthesis in turn also moves; this makes it possible for a leg prosthesis to roll the foot while walking. Here, too, the sensor could be attached to the patient's upper thigh and could analyze the movement, helping to regulate the motors of the prosthesis. Research scientists are currently working on combining the inertial sensor system with an electromyographic (EMG) sensor. Electromyography is based on the principle that when a muscle tenses, it produces an electrical voltage which a sensor can then measure by way of an electrode. If the sensor is placed, for example, on the muscle responsible for lifting the patient's foot, the sensor registers when the patient tenses this muscle -- and the prosthetic foot lifts itself. EMG sensors like this are already available but are difficult to position.

"While standard EMG sensors consist of individual electrodes that have to be positioned precisely on the muscle, our system is made up of many small electrodes that attach to a surface area. This enables us to sense muscle movements much more reliably," says Kleiner.

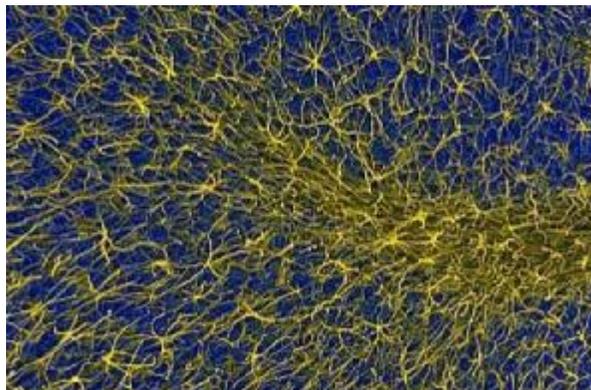
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## Hormone Precursor Inhibits Brain Inflammation: Molecule Moderates Condition Linked to Neurodegenerative Diseases



*These are glial cells in the cerebellum, magnified 400 times. (Credit: Thomas Deerinck, National Center for Microscopic Imaging Research, UC San Diego)*

ScienceDaily (May 15, 2011) — Researchers at the University of California, San Diego School of Medicine have discovered a steroid hormone that inhibits inflammation in the brain. The findings, to be published in the May 13 issue of the journal *Cell*, have implications for understanding the exaggerated inflammatory responses that are characteristic features of numerous neurodegenerative diseases.

The discovery that the steroid hormone ADIOL, (5-androsten-3B-17B-diol), a precursor of androgens and estrogens, modulates inflammation induced by microglia cells could eventually lead to new treatments for patients with neurodegenerative conditions in which inflammation plays a pathogenic role. In addition, levels of ADIOL in blood or other body fluids might be useful for predicting risk or responses to drugs that mimic its actions.

The senior author of the paper is Christopher Glass, MD, PhD, professor of the department of cellular and molecular medicine and the department of medicine. Lead author is Kaoru Saijo, MD, PhD, and an associate project scientist in the Glass lab.

Though neurons get the headlines, they thrive only with the support of other cell types, among them microglia and astrocyte cells. Microglial cells help the central nervous system respond to infection and injury. Under normal conditions, they exist in a resting state, quietly but constantly surveying their surrounding environment for tell-tale indications of microbial invasion or tissue damage. Once detected, microglia initiate an inflammatory response, kick-starting immune system and tissue repair processes. Astrocytes amplify the immune reaction launched by microglia.

The microglia-astrocyte activation is vital to an effective immune response and damage repair, but if the resulting inflammation induced by these cells is not controlled or goes on too long, it can result in damage and death to neurons. Inflammation run amok is linked to many neurodegenerative diseases, such as Parkinson's disease, HIV-associated dementia, Alzheimer's disease and amyotrophic lateral sclerosis (ALS or Lou Gehrig's disease), and some inflammatory diseases like multiple sclerosis (MS).

The new findings suggest that in healthy brains, microglia inflammation is modulated by the production of the steroid hormone ADIOL, which instructs support cells to calm down and return to their quiescent state. ADIOL works by binding to a transcription factor called estrogen receptor B, which gets its name because of its similarity to estrogen receptor B and its ability to bind to the female sex hormone estrogen. Unexpectedly, while ADIOL binding causes estrogen receptor  $\alpha$  to execute an anti-inflammatory set of instructions to

microglia and astrocytes, estrogen binding does not. Because of this, estrogens can actually antagonize the anti-inflammatory actions of ADIOL.

Glass and Saijo made their discovery based upon initial studies with John Katzenellenbogen, PhD, at the University of Illinois, Urbana-Champaign. Katzenellenbogen's laboratory developed a number of synthetic small molecules that could bind very tightly and specifically to estrogen receptor

Saijo at UC San Diego tested each of these compounds and found that some were potent inhibitors of inflammatory responses of microglia and astrocytes, while others were not. When one of these compounds was tested in vivo, it was found to strongly inhibit inflammation in the brain and to induce remission in a mouse model of multiple sclerosis.

Although estrogen itself can be neuroprotective, its lack of ability to induce the anti-inflammatory activity of estrogen receptor led to search for endogenous or internal molecules that might have similar activities to the synthetic compounds. Saijo worked with Andrew Li, MD, assistant adjunct professor of medicine at UC San Diego, to ultimately identify ADIOL as the endogenous regulator of estrogen receptor activity. Notably, Saijo and Li found that the amount of ADIOL that could be produced by microglia was regulated by signals that control the magnitude and duration of inflammatory responses

"We think it possible that mutations in the genes encoding the key enzymes for the generation of ADIOL, or their inappropriate down-regulation, could contribute to pathological forms of inflammation," Glass said.

These findings raise the possibility that women are more susceptible to certain inflammatory diseases, such as MS, because their higher levels of estrogens potentially antagonize the anti-inflammatory actions of ADIOL in the brain. A similar argument might also help explain some of the adverse effects of estrogen administration on the brain in post-menopausal women.

Glass noted, however, that much research remains to be done. The precise relationship between brain inflammation and neurodegenerative disease, for example, is not fully understood. Similarly, it's not known whether people naturally produce different amounts of ADIOL. And researchers have only identified the ADIOL-estrogen connection in an MS mouse model. Glass said he and colleagues will next look at animal models for Alzheimer's, Parkinson's and HIV-dementia.

Co-authors of the study include Jana G. Collier, UCSD Department of Cellular and Molecular Medicine.

Funding for this study was provided by the National Institutes of Health.

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#### Journal Reference:

1. Kaoru Saijo, Jana G. Collier, Andrew C. Li, John A. Katzenellenbogen, Christopher K. Glass. **An ADIOL-ER $\beta$ -CtBP Transrepression Pathway Negatively Regulates Microglia-Mediated Inflammation.** *Cell*, 2011; 145 (4): 584-595 DOI: [10.1016/j.cell.2011.03.050](https://doi.org/10.1016/j.cell.2011.03.050)

<http://www.sciencedaily.com/releases/2011/05/110512132410.htm>

## Crowdsourcing Science: Researcher Uses Facebook to Identify Thousands of Fish



*PhD student Devin Bloom holds a specimen of *Pseudoplatystoma fasciatum*, one of over 5,000 fish Bloom and his colleagues caught earlier this year during the first ichthyological survey of Guyana's Cuyuni River. (Credit: Photo by Whit Bronaugh)*

ScienceDaily (May 15, 2011) — Devin Bloom is not your typical Facebook user. The Ph.D. candidate in evolutionary biology at the University of Toronto Scarborough (UTSC) only posts sporadically to the site, and he wouldn't even have a personal Facebook page if his little sister hadn't secretly set one up for him. But recently, while on a scientific expedition to the remote jungles of Guyana, Bloom helped illuminate a powerful new use for the social networking tool. As a result, technology-averse biologists around the world may soon be flocking to the site.

In January and February, Bloom helped conduct the first ichthyological survey on Guyana's Cuyuni River. The trip was funded through the Biological Diversity of the Guiana Shield program at the Smithsonian Institution's National Museum of Natural History and was led by Dr. Brian Sidlauskas, assistant professor of fisheries at Oregon State University (OSU). The goal was to find out which species of fish live in the Cuyuni and get a good estimate of their abundance.

The Cuyuni is bisected by the Guyana/Venezuela border and extends 210 kilometres into the thick jungles of western Guyana. The region is under intense ecological pressure from the artisanal gold mining operations that pepper the Guyanese hinterland. This mining has terrible impacts on the surrounding environment. Chief among these are the increase in sedimentation in the rivers and the release of elemental mercury directly into the food chain. "That's why it's important we get there now, to find out what's there," says Bloom. "Because in 30 years, who knows what the Cuyuni will look like?"

For two weeks, Bloom, Sidlauskas and the rest of the team spent day and night catching as many fish as they could with various nets. They slept in makeshift jungle camps. In two weeks, the team had collected more than 5,000 fish specimens. Then they realized they had a big problem.

"In order to get the fish out of the country," says Bloom, "we needed an accurate count of each species." The team's research permit required them to report this information to the Guyanese government. "We couldn't leave the country until we turned over our data to the authorities."

Time was of the essence, as Sidlauskas, Bloom and OSU graduate student Whit Bronaugh had to return to North America as soon as possible. But how could a handful of people possibly identify 5,000 fish in just a few days? "A lot of people think fish experts know hundreds and hundreds of species," says Bloom. "But they really don't. We're all specialists on one particular group or another." The last thing the team wanted was to

fudge the data, because the whole point of the project was to gather accurate information for the Guyanese government to use in its conservation and development planning.

That's when Bloom made a great suggestion. "Let's just put them up on Facebook and see if our friends can help." Sidlauskas loved the idea, so he uploaded the photos that Bronaugh had meticulously taken of each species. "The network of fish experts is pretty small," says Bloom, "and fish people can be real fanatics. Once a fish pops up on Facebook, they get very excited and start arguing. So next thing we knew, we had a really interesting intellectual debate going on between various world experts on fish, sort of like a real-time peer review that reached across continents and around the world." In less than 24 hours, their network of friends -- many of whom hold Ph.D.s in ichthyology and whom Bloom refers to as "diehard fish-heads" -- had identified almost every specimen.

With 5,000 identifications in hand, the team was able to deliver their results to the government and return home on schedule. The National Museum of Natural History's blog ran a story on the team's novel use of social networking to crowdsource their data. Then the Smithsonian Institution's blog, *Smithsonian Science*, and *Smithsonian* magazine's blog did the same. Not long after that, employees at Facebook caught wind of the story and chose it as a "Facebook Story of the Week" on the company's page. In less than a few weeks, more than 9,000 people had "liked" the story, and more than 2,500 comments were registered.

"Bloom's elegant approach to solving this particular scientific and logistical problem is reflective of the ingenuity and inventiveness that one finds amongst UTSC researchers," says vice-principal of research at UTSC, Malcolm Campbell. "Combining his passion for research, with the preparedness and cutting-edge thinking that are part-and-parcel of his UTSC graduate degree, Bloom devised a particularly effective solution in a tight spot," says Campbell. "Bloom and his supervisor, assistant professor Nate Lovejoy, are superb examples of how the best minds are conducting the best research at UTSC."

The results of the biodiversity survey on the Cuyuni River were somewhat discouraging. Bloom says 5,000 fish is not many; he can remember similar trips on different Guyanese rivers where the team pulled in up to 20,000 specimens. "Species diversity and abundance were very low," he says. "We need to continue monitoring, but this isn't good news for the region."

But the team's use of Facebook to crowdsource accurate scientific data has had an unexpected consequence: it's led Bloom to change his mind about the value of online tools. "Social networking is so powerful, and scientists should be using it more to connect with the world-at-large," he says. "I can't take credit for the idea, though." Bloom's friend, an ichthyologist at Texas A&M named Nathan Lujan, has been using Facebook to identify fish for years. "And Nathan?" says Bloom. "Nathan is a real fish-head."

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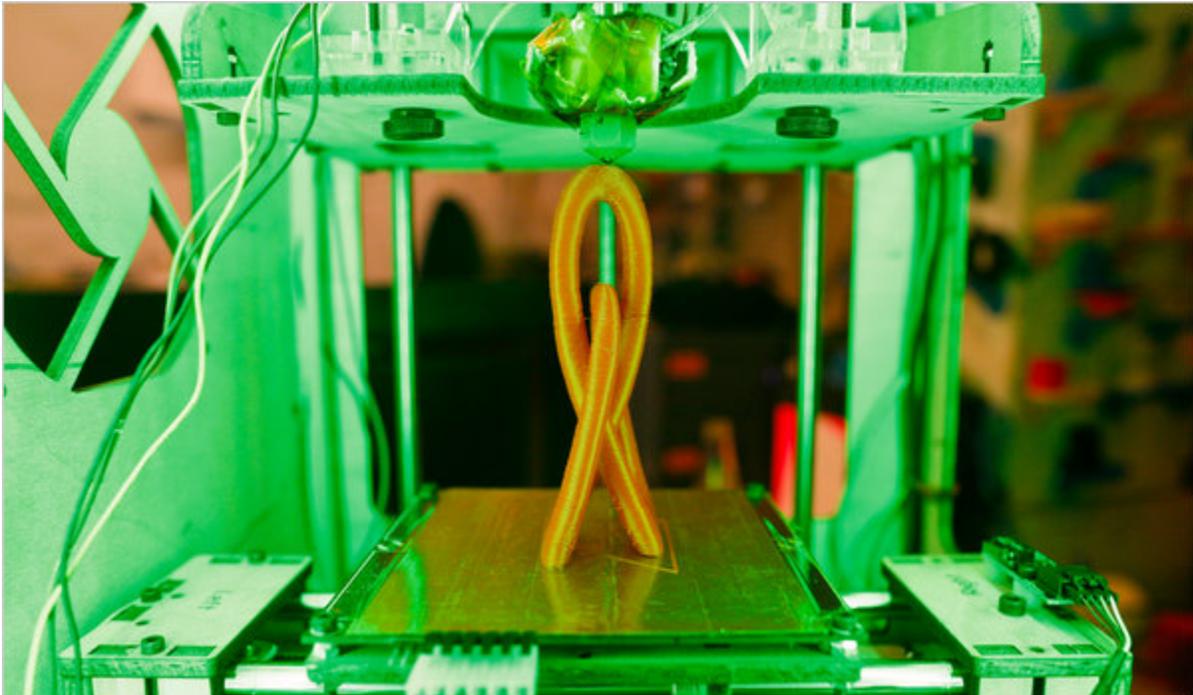
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### 3-D Art for All: Ready to Print

By **MELENA RYZIK**



Angel Franco/The New York Times

With some assembly and tinkering, the MakerBot makes three-dimensional objects from molten plastic from a computer design. The curious may try out the MakerBot on Saturday at 3rd Ward in Brooklyn

As it turns out, there really is a great future in plastics.

“There’s nothing like working with plastic!” Marius Watz announced to an appreciative crowd at the start of a talk in Brooklyn recently. Mr. Watz, a Norwegian-born artist, was describing his work with MakerBot, a new consumer-grade, desktop-size 3-D printer. With some assembly and do-it-yourself tinkering, the MakerBot makes, or “prints,” three-dimensional objects from molten plastic, creating a piggy bank, say, or a Darth Vader head from a computer design at the touch of a button.

“I’d heard about 3-D printing in the ’90s, but at that time it sounded like some sci-fi technology, like laser guns,” Mr. Watz said. “Basically, it sounded totally awesome.”

“Awesome” was sort of the buzzword at MakerBot’s inaugural open house, held at its warehouselike offices in Gowanus, Brooklyn, where Mr. Watz, its first artist in residence, showed off his sculptural forms (“We just started doing some blobby objects — vaguely disturbing but also awesome”) to a few dozen admirers and MakerBot owners, mostly guys in various stages of nerdy bliss. (“*Aaawwwwe-some.*”)

After a burst of invention by three friends, the company was formed two years ago — “built on caffeine,” said a founder, Bre Pettis — and has since expanded to 32 employees and thousands of MakerBot kits sold. Three-D printing has existed for years, but the machines were cumbersome and expensive, relegated to art and

engineering schools, often monopolized by specialists. The MakerBot, which tops out at about \$1,300, gives anybody with a computer and an idea the same creative horsepower, and artists are beginning to take notice.

On Saturday 3rd Ward, the Brooklyn arts and design collective, will host a Make-a-Thon, where those interested can play with the Bots and receive miniature 3-D busts of themselves printed by Kyle McDonald, MakerBot's current artist in residence and an expert in digital scanning.

"It's definitely baked into the DNA of MakerBot that this is a tool for creative people," said Mr. Pettis, 38, who worked as a middle school art teacher in Seattle before starting the company with Zach Hoeken Smith, 28, and Adam Mayer, 35, hardware and Web developers. (They met at a Brooklyn hacker space.) As part of their mission, MakerBot's founders also embrace sharing: users are encouraged to post their designs for the machine on a company blog, Thingiverse, where anyone can have access to them, to print or modify.

"We're obsessively open-source," said Mr. Pettis, who, like many people in the MakerBot universe, speaks with the zeal of the technologically converted. "In this age of the Internet, the sharers are the people who will come out ahead — the people who make progress and then share it so that other people can stand on their shoulders."

He knows his audience. John Abella, a MakerBot hobbyist from Huntington, N.Y., came to the open house with a bin full of objects for the show-and-tell.

"Almost all these things are things we got off Thingiverse," he said, clutching a brightly colored plastic doodad. "We have a rabbit that someone put a dragon head on."

Mr. Abella, 35, who works in network security, said the appeal of MakerBot was that "everybody sees it with their own slant."

"My wife's friends look at it, and they ask me for cookie cutters in shapes that don't exist," he continued. "At work people see it and say, 'Can that replace the missing part in the company Ping-Pong table?'" (Probably, though the MakerBot has its limits — it can print objects that are at most five inches on a side, at relatively low resolution.)

Another hobbyist, Ed Hebel, made a carrying case for a single cigarette. "I go out and I don't want to take a whole pack of cigarettes," Mr. Hebel, an engineer from upstate New York, said, demonstrating his little holder, which he invented for the show-and-tell. "This is called a Lucy. I thought of this like two days ago. I thought for like 20 minutes, and I thought of this. And an hour later, I printed it."

And shortly after that, it went up on Thingiverse, where, despite Mr. Hebel's disclaimer that smoking is bad, another user quickly suggested a modification.

As part of its open-source ethos, in its offices MakerBot has a "botfarm" — 18 machines capable of operating almost continuously — that it will give over to worthwhile projects. Michael Felix, a Brooklyn designer, used it to make the hinges for a giant geodesic dome he built for a music video shoot. Noting that nearly 4,500 MakerBots have been sold so far, Mr. Pettis said, "For artists, it's kind of like, imagine, you create something that's a 3-D model, there's 4,500 different locations in the world where it can seep out of the Internet into the real world and blow people's minds."

But the ease of replication does present some questions for art professionals.

“Art is not traditionally an open-source practice,” Mr. Watz, who is represented by the DAM gallery in Berlin, noted dryly at the open house. Nonetheless, he posted some of his technical specs on Thingiverse, explaining that he didn’t want to take advantage of the generous community spirit there without giving back.

And as a digitally oriented artist, Mr. Watz said, he had long questioned the art market’s economy of scarcity, even if he participated in it with limited-edition designs. For prospective buyers, he does offer to sign his MakerBot work, which brings up another question.

“What is the real value of my signature on the object?” he mused, adding: “When I’m trying to model with the MakerBot, I don’t consider that printed model the final product. It’s the process that is the significant part.”

Some Bot artists are just excited about the machine’s practical applications. David Bell and Joe Scarpulla have been laboring for years on a stop-motion animated film and photo series with an elaborate, labor-intensive miniature set. On a whim, Mr. Bell and Mr. Scarpulla bought a MakerBot — a “CupCake” model, which costs about \$700 — and found it to be a good fit as a custom manufacturer.

“Our first successful prop was a miniature toilet bowl,” Mr. Bell said. “We’re outfitting an entire apartment in 1/8 scale. So far we’ve done sinks and light sockets, a bathtub and pots and pans.” Including the painstaking design process and troubleshooting, using the Bot takes the same amount of time as hand carving, Mr. Scarpulla added, “but the results are definitely better.”

Now they are imagining other things they can use their machine for, on a much bigger scale. “It opens up a lot of opportunities,” Mr. Bell said.

That sentiment was echoed by Mr. Watz and Mr. McDonald and visible on a tour of MakerBot headquarters, known as the Botcave. In the front, by the whirring Botfarm, is a vending machine of Bot-extruded plastic bangles. Employees sit behind stacks of products with high-tech Seussian names, like Thingomatic Gen. 4 Subkit for Stepper Drivers V 3.3.

Little plastic doohickeys and thingamabobs cover many surfaces. (A new employee recalled being told to print out his own coat hook.) Mr. McDonald, 25, comes nearly every day to work on his MakerBot project, which turns the Kinect, an inexpensive 3-D scanner and Xbox accessory, into a miniature replicator. Though his previous work was theoretical — his background is in computer science and philosophy, which translated to an interest in “democratizing technology,” he said — playing with plastics and engaging with other Bot fiends has changed his focus.

“Now I think about physical things,” he said. “I spend a lot of time thinking, how can these systems be used in an interactive way? It’s basically my full-time job to inspire myself and others. It doesn’t pay very well, but I’m happy.”

[http://www.nytimes.com/2011/05/14/arts/design/makerbot-is-a-new-3-d-printer.html?\\_r=1&partner=rss&emc=rss](http://www.nytimes.com/2011/05/14/arts/design/makerbot-is-a-new-3-d-printer.html?_r=1&partner=rss&emc=rss)

## Gold Mania in the Yukon

By GARY WOLF



Finlay MacKay for The New York Times

Shawn Ryan outside Whitehorse, Yukon Territory.

**When I first** met Shawn Ryan and Cathy Wood, in 2005, they were living with their two young children in a small cabin outside Dawson City, at the northernmost end of the paved road system in Canada's Yukon Territory. It was a beautiful site in the summertime, with clear water lapping the banks of the Klondike River and the sky still bright at midnight. But the sun hit their roof for the last time each year in early December and didn't show up again for six weeks. Temperatures in the dead of winter could reach 50 below zero. Wood sometimes feared that their children would freeze. Back then Ryan and Wood already knew they had found gold, but they didn't have proof.

Recently, I went to see them again in their new home in Whitehorse, the territorial capital, and I sat with Ryan one night as he talked business over the phone. His right arm was stretched around the back of his head, holding his BlackBerry to his left ear. "Those guys were at 6 cents a share last year, now they are over a buck, and they got nothing," he said. "When you look at it, it's like a hundred claims." The shares Ryan was talking about belonged to a mineral-exploration company, one of his many competitors. The claims are mining claims, a government license to extract minerals from a 50-acre patch of wilderness. To Ryan, a hundred claims is pathetic. He and Wood own more than 35,000 claims. "We just passed Luxembourg, and over the summer we'll be the size of Samoa," he continued, describing just one of his projects. Credible estimates of the amount of gold still buried in his properties run to the billions of dollars.



Ryan is the king of a new Yukon gold rush, the biggest since the legendary Klondike stampede a century ago. Behind this stampede is the rising price of gold, and behind this price is fear. As the Federal Reserve keeps interest rates very low to stimulate the economy, gold bugs make nightmarish predictions that loose money and a huge federal deficit will crush the value of the dollar and bring ruinous inflation. Gold holds its value when national currencies collapse and is easily imported and universally traded. It feels like the perfect investment for the apocalypse. A few weeks ago, gold passed \$1,500 an ounce, an astonishing level. George Soros warned of a bubble back when gold was barely over \$1,000. Glenn Beck cried that the run was just beginning: just wait until the United States is bankrupt and the real trouble starts. Gold bulls talk of \$2,000 gold, \$5,000 gold, even \$10,000 gold. But 10 years ago, when Ryan made his first discoveries, nobody cared at all.

**Ryan has been** in the woods his whole life. At age 15, he was snaring foxes, martens and mink near Timmins, Ontario, where his father worked in a mine. Trapping in Canada is regulated through licenses called trap lines, and Ryan didn't have a trap line of his own, he just went where he pleased. This is called poaching, and eventually he was caught. Instead of turning him in, the trapper he was poaching from put him to work. Ryan would skin animals until midnight, then go to school without bathing. Looking back, he understands why he was socially isolated. In his 20s, Ryan came west to work a trap line of his own in the sparsely populated expanse of the Yukon, but his plan changed when he learned about mushrooms.

Twenty years ago there was a kind of gold rush in mushrooms that enticed itinerant pickers to make a long circuit through British Columbia, Alaska and the Yukon, collecting chanterelles, matsutakes and morels. The market was driven by demand in Paris and Tokyo, and brokers built a network of little buying stations wherever mushrooms were fruiting. It was cash on the ground, and the pickers taunted one another with stories of thousand-dollar days. Ryan eventually settled near Dawson, once the roaring center of the Klondike gold fields, now a community of about 2,000 people surrounded by wilderness and close to good morel-picking territory.

Ryan met Wood in 1992 at the height of the mushroom season. He was down in Whitehorse shopping for supplies when he noticed a young woman standing outdoors in spangled tights selling bundles of sage. Wood, who was from New Brunswick, had been working for a Toronto bank, but she didn't like it. After she quit, she took her savings and rode across the continent on a motorcycle. By the time she got to Whitehorse, her cash was gone. When Ryan walked up, she was reorganizing the last of the sage into smaller packets so she wouldn't run out of stock before something else turned up. He was a striking person, compact and strong, with hair braided nearly to his waist. And he had a good thing going: the banks of the White River should be thick with morels. Did she want to come pick with him?

From then on they were a team. The mushroom market was extremely volatile, and they were both hard workers who liked to take risks. The biggest challenge for a picker is finding something to pick; but the second biggest problem is transport. There may be carpets of morels fruiting in the bush, but after you pick them you have to walk out again, with 70 or 80 pounds of fragile fungus on your back, through swamps foggy with mosquitoes and hillsides piled with downed trees. Ryan was known as a high roller, because he would use the accumulated cash from his latest bonanza to make bold bets on the next one: organizing a system of backwoods mushroom drying and river conveyance, for instance, or recruiting a crew to cut a trail for all-terrain vehicles. One season, he and Wood picked morels worth tens of thousands of dollars, but ended the year broke after crashing a used helicopter they purchased with all of the money they made.

It is tough to be penniless in Dawson in the winter. Wood cleaned some houses and served as court bailiff when the judge came to town, but in February 1993, they were down to their last \$5. At the employment center, Wood saw a notice for a job removing the snow from the roof of Diamond Tooth Gerties, the local casino, which opened for a brief winter season coinciding with a dog-sled race. The job was usually taken on by a team of local residents for thousands of dollars. Wood bid 500. Townspeople came out to see how the low bidders were going to do it. She and Ryan cleared the edges of the roof with shovels, then Ryan climbed



to the top and jumped up and down like a monkey. Gravity did the rest. The expressions of surprise on the faces of the onlookers made Wood laugh. People in Dawson had to acknowledge that for people at the bottom of the status hierarchy — and there aren't many rungs beneath mushroom picker — they had some unmistakable gifts.

**How could they not** think about gold? Fortunes had been taken from the streams near Dawson City during the Klondike stampede. Little stretches of trickling water sometimes held millions of ounces of gold. What tormented the imagination was not just the breathtaking richness of the creeks but the decades of failure that followed. Generations of miners tried to find the mother lode, that hidden, hard-rock channel of mineral wealth whose eroding edges had supposedly poured its gold into the gravel. Nobody succeeded. In fact there is very little exposed rock around Dawson. A layer of dirt many feet thick is piled on top of the bedrock, and most of the ground is frozen all year long. After years of picking, Ryan knew the challenges of the terrain as well as anybody. This struck him as an advantage; it meant less competition.

To minimize their cash outlay, Wood and Ryan moved into an abandoned miner's shack. Their new home was made of tin, and it had neither running water nor electricity. Ryan spent winter nights by the wood stove reading old mining journals. In the summer, he gathered rocks and drove them down to Whitehorse to show to Mike Burke, a government geologist. Burke enjoyed it when prospectors came by. They would stand in the parking lot, scratch at the rocks with their knives, talk. Burke asked questions about what Ryan was seeing, drew him out and set him off again full of optimism and clues.

It was part of Burke's job to keep Ryan looking. To govern a land, population is required, and in the Yukon, in which nearly 200,000 square miles are occupied by 35,000 residents, persuading the citizens not to leave takes cash. The territorial budget is over a billion Canadian dollars, and among the line items is a program to support prospectors. Ryan would develop his ideas, and Wood would fill out grant-application forms longhand. When spring came they would have a little money to spend walking the bush, turning over rocks, collecting plastic bags full of dirt to sample the soil. The money quickly spread around town: on hardware, on fuel, on air transport. How much faith was there that the ideas contained in those prospecting grants were going to lead to a gold mine? Nobody even pretended to have much. Even the prospectors were skeptical. They could talk with conviction only about their own schemes. In regard to their rivals their realism was severe.

Burke helped Ryan get a better view of how the exploration industry worked on a global scale. A handful of companies — "majors" — run the active mines and control the worldwide market. Majors are listed on the big stock exchanges, and they have nondescript names: BHP Billiton, Vale, Barrick, Rio Tinto. Meanwhile, thousands of smaller exploration companies — "juniors" — raise funds and chase ideas. Juniors are essential to the majors because they do much of the initial work in the exploration industry: sampling the soil, digging trenches, publicizing promising geological results. Publicity is key, because juniors raise money by selling their shares on penny-stock markets, like the TSX Venture Exchange in Toronto. Every hopeful glimmer can cause shares to rise, and when shares are under \$1, a jump of a few pennies is a handsome return. Juniors are free to have aggressive names: Monster Mining, Bling Capital, Northern Tiger. They are striving to be noticed.

At the very bottom of this opaque and volatile market are mining claims like the ones Ryan was staking when he walked around the bush near Dawson, pounding wooden four-by-fours into the earth, sometimes attached to a steel rod if the ground was too hard penetrate. These stakes gave him an exclusive right to extract minerals. But if he didn't work on the claim, or pay an additional fee, his rights would expire over time. Typically, prospectors support themselves by optioning claims to juniors in exchange for yearly cash payments and thousands of shares of penny stock.

All through the 1990s, Wood and Ryan made more money picking mushrooms than optioning claims. They were still learning how to prospect, of course, but there was a bigger problem. People weren't interested in

gold. As long ago as 1924, the economist John Maynard Keynes called the gold standard “a barbarous relic,” and by the turn of the millennium central bankers everywhere agreed with him. Gold still had value as jewelry, of course, but as an investment it was purely for rubes. Stocks went up; gold went nowhere. In the Yukon, the aviation companies were struggling, and with few big mining companies around, the government geologists had time to work with small-timers. “It got down to the core people,” Burke recalls. “I have pictures of company presidents out there under a tarp, getting their hands dirty, just to keep their claims in good standing.”

To Ryan, the notion that gold wasn't worth looking for was absurd. The market might profess disinterest, but this was cash in the ground. His closest friend, Antoine Deschenes, a rail-thin, 6-foot-4 Quebécois, had an idea. “In the winter the Yukon runs clear,” he said.

The significance of his insight is hard to appreciate without a bit of background. The gold of the Klondike rush was placer gold, found at the bottom of creeks and streams. Deschenes imagined that some of this gold had, during tens of millions of years of erosion, traveled all the way down the Klondike into the Yukon River. At Dawson, the Yukon is opaque from mixing with the water of the silt-laden White River. But in the winter the White is frozen solid. Therefore, the Yukon runs clear, and a daring prospector could dive in and find the riches he sought just lying there, in plain sight.

Ryan knew that Deschenes's plan was madness. The Yukon is covered in winter by eight feet of ice, under which is another eight feet of slush. If the idea of placer gold in the Yukon had any merit, it could be investigated cautiously, through careful sampling of the gravel. But Deschenes had gold fever, a latter-day version of the disease afflicting the original Klondike stampedeers, many of whom ruined themselves, or perished, on their thoughtless dash north. We remember the fortunes taken from the Klondike at the turn of the century, but for most people, the journey to Dawson earned them nothing but suffering.

Deschenes would not listen to reason. He took scuba lessons, bought a tank, a wet suit and a cheap face mask from Canadian Tire. He chopped a hole in the ice with an ax and a chain saw, inserted a cable to the river bottom to keep him from drifting downstream, tied a rope to his waist and jumped in.

He came back empty-handed and asked Ryan to help. Ryan didn't want Deschenes out there on his own. On the other hand, standing on the frozen surface of the Yukon and holding a rope attached to your best friend implies a willingness to go in after him. Their daughter Cheyenne was 4 years old; their son Callum was just 2. As Wood and Ryan discussed Deschenes's dangerous obsession, she asked Ryan a hard question: if something terrible happened, could he live knowing that he had been standing up there holding the rope? On Feb. 22, 2001, when Deschenes went out for his third dive, Ryan was in the bush far away.

Later he heard that the rescue divers from the Royal Canadian Mounted Police actually caught a glimpse of Deschenes's body stuck in the slush. But they couldn't reach him on the first try and had to give up when the search became too perilous. The Yukon appears calm at the surface, but its flow is powerful, running more than 2,000 miles before emptying into the Bering Sea. Deschenes's body was never found.

By this time, Ryan and Wood no longer lived in their tin shack. Wood had had enough: all four of them sleeping in the same bed, only one table to sit at. A Dawson old-timer sold her two 20-by-24-foot cabins on credit, and one day he came by and helped her winch them together while Ryan was out in the woods. With the kids hanging around, banging hammers and pretending to help, Wood and some friends moved the possessions, and she scheduled a utility hook up. When Ryan came back, he was angry. Now they were on the grid. Now they would have bills. He threatened to quit prospecting. He promised to become a baker and get fat. “He was grumpy for a long time,” Wood says, “but that move was the key.” Ryan plugged a computer into one of the outlets, downloaded government maps and began exploring the territory the way real geologists did it: using data, from above.

A new aerial magnetic-resonance survey of the Yukon had just been released, which gave important clues about the composition of the rocks underground. Ryan, who is a fast learner, identified a promising spot about 30 miles from Dawson. He staked a few claims and told Wood he wanted to do a large soil-sampling project to see what they really had. After nine years of mushroom picking, their savings totaled 3,000 Canadian dollars. This was just about what the project would cost.

“Go ahead,” Wood said.

This made Ryan pause. His wife had always played the role of the reasonable partner, the anchor, the person holding the rope. But when he reflected on what they had done together — running mushrooms down the rivers in a boat, living in a shack, crashing a helicopter, all the way back to jumping up and down on the roof at Gerties — he started to wonder. “You realize I’m going to spend all the money we have, right now,” he said.

“Yes, I do.”

Holy crow, Ryan thought, maybe she’s no better than me.

**He called his claims** “the Lucky Joe.” With Burke’s help, Ryan optioned them to a junior mining company based in Vancouver, which turned around and offered them to Kennecott, owned by one of the biggest of the majors. The person Kennecott sent north to check out the claims struck everybody as unique. In a field in which the archetype is a large, taciturn white man, Ricardo Presnell was short, ebullient and black. He had a Ph.D. from the University of Utah, was the review editor of an important academic journal and had searched for minerals all over the world. A generous talker and an even more generous listener, he knew how to win the respect of prospectors. “Hardly taller than me, and looked up to by everybody,” Wood said.

Presnell and Ryan camped out together for weeks at a time while doing research on the Lucky Joe. Ryan was already using soil samples to give him clues about where to find gold, but Presnell introduced him to advanced mapping software and showed him how to tell his stories on a grand scale. The goal, after all, was not to pack a few hundred ounces of gold out of the bush in a satchel but to locate deposits big enough to support investment in a mine. That meant a billion-dollar deposit, minimum. The two of them talked endlessly about sampling methods, about “quality work,” about the Yukon’s unique geological history. A modern prospector is selling hope, backed up by some fancy colored maps. But it couldn’t be pure hocus-pocus. The game was one of statistical probabilities, backed by reliable data that geologists like Presnell could put a fair price on.

After Kennecott bought the Lucky Joe, Ryan grabbed his payout and spent it all chasing more gold. “Double-or-Nothing,” Burke called him. But Ryan was not just gambling. He was exploring systematically, doing thousands of soil samples a year. In the early 1900s, a government geologist reported a rumor of a high-grade specimen of gold-bearing quartz in hills near the White River. Something like this isn’t easily forgotten, but because nobody was able to find the rock again, the story was eventually relinquished as fantasy. Walking above the White, where his soil data looked good, Ryan caught sight of a low outcropping of quartz. Shortly after he got out of the bush, he called Burke, and they hiked back in together with a stick of dynamite. It was a clear fall day and 23 degrees. Fog had frozen on the branches, and the sound going through the woods was like breaking dishes. Ryan stuck the dynamite in a crack.

“That blowed up good,” Burke said.

Ryan took out his hand-lens and walked back through the snow.



“Mike, we got a hole in one,” Burke heard him say. In many deposits, even good ones, the gold is so crushed and intermixed with rock that it can’t be seen. Burke joined him at the rock face and took a look for himself. There, on the freshened face of the rock, were visible flecks of gold.

“Shawn, people have been looking for this for a hundred years,” he said.

In the two years following the discovery of gold on the White, Ryan and Wood sold a dozen options. The price of gold was rising steadily. Every few months there was a new high. In 2005, gold was more than \$400 an ounce. Within a year it would pass \$600. Now the juniors could raise more money. To supply them with claims, Ryan developed his own exploration technique. He knew the juniors had a rule of thumb: they wanted to see soil samples that contained gold at 50 parts per billion. This had always bothered him, because the standard was so arbitrary. What was important was not the soil, but the bedrock under the soil, and what ought to matter was not the absolute amount of gold in any particular sample, but the existence of an anomaly in relation to the background level. “It’s like Sasquatch tracks,” Ryan argued. Their mere existence should be interesting, even if the imprint is faint. Ryan’s proof was admirably simple: he just dug deeper. When soil samples taken at the conventional depth showed only a slight uptick, he enlarged the hole until he got numbers that looked good on a PowerPoint slide. This got the juniors interested.

Ryan and Wood were high rollers again. All day long young men in their employ came and went. They had 15 workers in the summer of 2005; some were line cutters, so called because they hacked their way through thickets and brambles; others were busy sampling the soil. Wood packed meals for them, chatted with them, collected the gossip. She didn’t allow shoes in the house, and because none of the workers wanted to unlace their boots, they jostled and piled up around the front door of the cabin, giving the impression of a looming masculine thundercloud hovering just outside the domestic perimeter. Then they would take off in a helicopter that came and went from the staging area near their front door. Ryan loved being airborne. He knew what it was like to crawl along the ground.

I stayed with the family for a week in June 2005 while reporting a story about the Yukon mushroom trade, about which they knew everything. But their minds were on gold. One night I listened to them argue. A few hours earlier they finalized an option deal on some new claims that gave them a chunk of shares worth 130,000 Canadian dollars. Their little galley kitchen was a mess. Wood’s desk was piled high with paperwork; Ryan’s was littered with GPS receivers, technical manuals and unopened brochures. They were doing well, at least temporarily, but their expenses were high because Ryan kept staking. He found it hard to evaluate where they stood. Sometimes he felt very rich. After all, he flew in a helicopter almost every single day. “I got accounts all over town,” he said. “I need a bag of chips, I just go to the store.”

“Maybe you don’t realize you have to pay these accounts,” Wood said.

“A mine solves all the problems,” Ryan answered.

Prospectors receive a royalty on the total amount of gold taken from a mine. But the path to a mine was hard to see from where they stood. They had optioned the White River gold claims to a Vancouver speculator named Donald Gee, who ran many small companies with prospects in gold, uranium and oil. If these companies had little to show in terms of actual discoveries, at least the stocks ran up and down with minimal legal friction; there were no spectacular ascents or lawsuit-provoking crashes. Gee put together a colorful group of investors, including an English polo fanatic and a fellow trader who previously had been sanctioned by regulators, and created a company called Madalena Ventures, through which he optioned Ryan’s claims. But over time his payments came more slowly and he seemed disengaged from the business of exploration.

Now Ryan was proposing to stop prospecting temporarily and send a crew to pick mushrooms instead. Morels were thick again along the banks of the White. He was so eager to apply himself to the old mushroom problems that Wood couldn’t bring herself to stand in his way. She enjoyed picking, too. Still, the things he

was saying about the profits they would earn from the mushrooms made no sense. The two of them fought like singers in an operetta, and at the start of every other sentence, Ryan placed his favorite exclamation, that antique northern “aye” that was his assertion of authority, his cry of negation, his tool of interruption, his warning.

“Cath, we just did the calculations.”

“We? Who’s we?”

“There’s no way we’re getting less than \$60,000.”

“That’s gross! You always take the gross figure!”

He searched around for his calculations but he couldn’t put his hands on them.

“Oh, they’ve disappeared,” Wood said. “They’re gone! You could be the municipal government of Dawson, the way you handle your accounts.”

He looked happy to be arguing with his wife.

“Aye, she’s asking me how many jugs of gas I’m going to use for the boat when I’m here trying to figure out how many thousands of dollars we’re going to make,” he said.

Things often got to this point.

“What is wrong with you?” Wood would ask him. “Did you not get enough puzzles to solve as a child?”

But here was the real problem: How was he to profit when the puzzle was solved? He had already found miraculous amounts of gold, but that didn’t mean he had won the game. Mushrooms and gold were strangely similar when it came to getting paid. A mushroom is the most perishable commodity, gold is the least, but the value of both is subject to uncertainty. The price you got for your mushrooms depended on the mood of the buyer under his tarp at the end of a dirt road and on the orders he got from his boss in Vancouver and on economic conditions in France. And as for gold; well, his claims so far had been good enough only for penny-stock operators like Donald Gee. Ryan was a hard man to depress, but that spring he had doubts. Were the gifts of nature real or were they speculators’ props? Wood knew his scheme to turn line cutters into mushroom pickers was economically unsound. Still, she understood the need it served. Ryan wanted to live like a frontier hero; drying thousands of pounds of morels and carrying them down to Dawson in his boat was a raw, old-fashioned triumph. But Wood had another thought. Maybe some of the key pieces to their puzzle weren’t in the Yukon at all.

**Prospectors.** They come into your office with the shiniest rock they can put their hands on and crow they’ve struck gold. Rob McLeod would laugh if it weren’t so sad. But when McLeod, who ran a junior in Vancouver called Full Metal Minerals, took a call from a woman in Dawson City who wanted to set up a meeting, he knew quickly she wasn’t true to type. Wood told him she had multiple claim blocks in the region, each with an extensive packet of geological data, and she wanted him to meet her husband. Every winter there is a giant mining convention in Toronto. There, in a quiet room away from the frenzied exhibit floor, the drunken parties and the aggressive lying, McLeod looked over the soil-sampling data from the White. The data was thorough and precise. It amazed him to see it just sitting there, as it had for a century: 5 miles by 2 miles of anomalous minerals, surrounded by creeks that had been full of placer gold. There was no way to be sure without further exploration, but McLeod wanted those claims.



“No,” Wood said when they spoke by phone. “I’m looking for a tighter shell.” For two years she had been training herself in the complexities of the junior market; buying and selling penny stocks, reading up on directors and executives; analyzing capital structures. Seeing beneath the surface of the exploration industry, with its deceptive brochures and corrupt stock analysts, became her job. She knew she didn’t want another partner like Donald Gee. Madalena Ventures had owned the right to all the gold on Ryan’s claims on the White, but Gee let it slip from his hands when he reorganized the company, let go of the claims and moved on. (Gee did not respond to questions.)

Wood told McLeod that she wanted to work with a new junior, one that hadn’t yet made any other investments and was therefore exclusively devoted to Ryan’s new discoveries. Did he know of anybody else who might be interested? He did: an Australian geologist named Adrian Fleming had just started Underworld Resources on the TSX Venture Exchange. McLeod was a director. Their plan was to pursue mineral exploration in New Zealand and Australia, but when Fleming saw the White, he changed his mind. Wood obtained a high price: in the first year of the deal, she took 500,000 shares of Underworld’s stock, a 4 percent royalty and 150,000 Canadian dollars as a cash advance. In 2008, they started to drill. At the first site they were disappointed. They moved the drill and tried again. The hollow steel tube, whose cutting edge was lined with diamond teeth, chewed through the earth. When it came up, the rocks in the tube were specked with gold. They drilled 21 holes that year and a hundred in 2009, trying to pin down exactly how big the strike was. Rumors of what was happening up north started to bounce around certain online bulletin boards, where penny-stock gamblers noticed that new companies were staking claims all around the Underworld discovery, hoping to capitalize on the excitement.

At Wood and Ryan’s cabin in Dawson, the roar of air transport was constant. Ryan was flying over a growing empire with confidence. Yet his latest assertion was so hard to believe that even Fleming, who had spent more than \$10 million proving the deposits on the White, found it hard to credit. Ryan told him there was more than one mother lode.

The holes Underworld was drilling on the White showed a thick, concentrated deposit: a million and a half ounces in one small zone. This was not a long quartz vein, as in the California gold fields, but a well-defined pocket, a bubble of gold. Had it been closer to a creek, it would have all washed down and left nothing behind. Ryan was building evidence of a second huge deposit on a ridge only 20 miles away, but when Fleming looked at the data, he waved it off.

On some level, Ryan understood why he had little credibility. “By any statistical measure, I’m not supposed to find even one,” he admitted. “So what are the chances I’m going to find two?” Ryan optioned the claims to a different junior, and when they started drilling, they struck gold, too. Ryan couldn’t help rubbing it in: “Aye, now they’re saying: ‘What do these guys have in common? Wait a second, maybe it’s *Shawn*.’”

Fleming came to realize that Ryan had something special. This was not about luck. If Ryan’s highly personal mix of craft, science and logistical expertise found two big deposits, there was no reason there couldn’t be more. Of course, a mining company whose stock is traded in the public markets can’t rely entirely on a prospector with only a high-school education to explain its exploration technique. Fleming wanted a scientist on the team, so that summer he called Ricardo Presnell back to the territory.

It was a happy reunion. Presnell’s goal was to be the chief geologist of a worldwide exploration company, and in late 2009, with gold at more than \$1,000 an ounce, it looked as if Underworld might turn out to be more than the typical mining junior. “You’re either creating a staking rush or chasing one,” Ryan said. With Presnell’s science, Wood’s realism, Fleming’s worldliness and Ryan’s methodological genius, not to mention a billion dollars of gold in the ground, perhaps they could build something strong enough to hold its shape in the swell of the market.



They didn't get the chance. In December, Fleming received a call from Kinross Gold — a Toronto-based major — informing him that Kinross intended to buy Underworld. Fleming managed to stall, but not for long. Underworld's stock had risen from 15 Canadian cents to 2 Canadian dollars a share on the TSX Venture Exchange. But it was still a minnow; Kinross was a \$10 billion corporation and could easily manage a takeover.

For a little while Fleming tried to keep their idea alive. We'll just do another company, he thought. The others were eager to discuss it. "See you in a week," Presnell said. Skiing a few days later in Big Cottonwood Canyon, near Salt Lake City, Presnell was making his classic big-stance telemark turns when a giant slab of snow broke loose and swept him into a grove of trees. He was dead when the rescuers found him.

**Gold is what** people turn to when the world looks as if it's falling apart. It is pitched as an indestructible physical asset, a form of currency invulnerable to destruction or government manipulation. But a moment's thought establishes the impracticality of physical gold as a store of personal wealth: even small pieces of it are too valuable for many purposes, it's vulnerable to theft and requires weighing to prove its value. Even at the height of its monetary use in the 19th century, gold was used mainly to secure the credit of governments and banks.

Most people who turn to gold don't store ingots in a vault, but trade stocks whose price is linked to gold: exchange-traded gold funds or the shares of mining companies. This makes them players in the market and vulnerable to mania.

With the well-publicized Kinross takeover of Underworld — worth nearly 140 million Canadian dollars, with Ryan and Wood taking about \$6 million for themselves — the great staking rush in the Yukon started in earnest. The slightest hint of a mineral anomaly within 300 miles of Ryan's discoveries on the White River was now exciting enough to float a junior. Ryan and Wood were still staking, chasing new ideas, and it was easy for Wood to unload options, but it took a lot of patience to work with some of the juniors who optioned them. Doing the next stage of exploration demanded expertise. Sometimes they didn't even have a geologist on the payroll and could barely handle what they had bought.

In late April of this year, Ryan and Wood combined all the Yukon claims that weren't under contract already, a total of more than 1,300 square miles, and put them into a new partnership that included Ned Goodman, a legendary investor in Toronto. In exchange they received more than 20 million Canadian dollars in cash and stock and as much exploration backing as they could handle. The new company is called Ryan Gold. Ryan wants access to as much money as possible this summer, because capital for gold prospecting will never again in his lifetime be so readily available and, besides, within a few years the territory will be crowded with claims. "It's a land-grab game now," he said, as we sat and talked in Mike Burke's living room in Whitehorse. Burke recently quit his government job. He now works for a junior called Golden Predator. He has joined the gold rush, too.

Ryan guesses that there will be more than 140 exploration companies coming north this summer, but he has the jump on them. He has been staking all winter, running elaborate logistical operations with a fixed-wing aircraft on skis, remote fuel depots and crews in winter camps for a week at a time. This is just a preview of what is coming when the weather improves. His goal is to complete 150,000 samples. That's a ton of earth every day in small paper bags. The limiting factor, as always, is air transport. "Here's how I'd like to do it," he says. "A blimp."

Eventually gold will crash again. In the back of his mind, Ryan is already thinking about other problems to solve. Mines can acidify the water around them; in one poorly managed mine in the Yukon, the cost of dealing with toxic contamination might prove greater than the value of all the minerals that ever came out of it. But there are places in Canada where acidic soils have healthy plants growing on them. This is due, Ryan

surmises, to the evolutionary adaptation of the fungus they live among. “You have to go and look for these mushrooms,” he says. “You have to go mushroom hunting!”

In the meantime, Wood wonders where their people are going to sleep. Waves of exploration workers are about to pour into town, and nobody is quite prepared for them. The rent on a dismal room in Dawson, with a bathroom down the hall, has already gone up to 600 Canadian dollars a month, and the season hasn’t started. Dawson was living largely off government handouts and a trickle of tourism left over from the celebration of the 100th anniversary of the Klondike stampede. Now even the remnant nonconformists who hung on during the lean years are making bank.

Wood often thinks back on that anniversary celebration, in 1998. There were so many residents in Dawson that there was a tent city by the river. The U.S. dollar was strong, making it easy for American tourists, and there were no passport checks at the border. She was pregnant with Callum, and at midnight on Canada Day she danced with friends in the shadow of the Dome, a little mountain against which Dawson rises. The mushroom scene was still booming. Then things changed. Terrorists attacked the World Trade Center, and as the borders got tighter and fuel prices rose, the mushroom-picking circuit collapsed. Late that winter, Ryan staked the Lucky Joe. His timing could not have been better. Gold is countercyclical to happiness. Outside the territory, fear was making a comeback, and the price had already started to rise.

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<http://www.nytimes.com/2011/05/15/magazine/mag-15Gold-t.html?ref=magazine>

### *The lessons of philanthropy*

Giving for results

**There is more to philanthropy—much more—than just giving money away**

May 12th 2011 |



WHETHER America's famed philanthropic tradition is all it is cracked up to be will become much clearer during the next few years. Superficially, that tradition has emerged from the global financial crisis in remarkably good shape. In the past year some 69 of America's billionaires and billionaire families have promised to give away at least half of their fortunes by signing the Giving Pledge championed by Bill Gates and Warren Buffett, two of the world's richest men. Among them is 27-year-old Mark Zuckerberg, a founder of Facebook, proof that America's giving gene has passed to the next generation.

The question is, will all that giving, by the billionaires and the thousands more Americans with far smaller amounts of money, actually do any good? There is rather a depressing history of well-intentioned donations often doing nothing to alleviate society's problems, and sometimes even making matters worse. As Mr Buffett has said many times, "making money is far easier than giving it away effectively." Moreover, the need to give effectively, to maximise the bang for every charitable buck, is about to become even greater, as many of the organisations that receive their funds from private philanthropy or the public sector begin to feel the effects of America's fiscal problems. Spending cuts will cause a crisis in the social sector that "will have an impact on almost every non-profit [organisation] in America, whether or not it receives government funds," writes Mario Morino, a veteran philanthropist, in "Leap of Reason", one of three new books that address the same thorny question of how to not merely give, but to give well.

As evinced by his subtitle, "Managing to Outcomes in an Era of Scarcity", Mr Morino focuses on delivering results, as do the other authors, with their emphasis on smart giving and changing the world. The books draw examples from the many years the authors have spent promoting better philanthropy, and are all worth reading. Only Mr Morino is actually in the process of giving away a fortune he earned for himself, which

makes him less prone to wrapping his iron fist in a velvet glove than the other authors, who are all professional philanthrocrats of different kinds. Joel Fleishman raised a fortune for Duke University and ran the American arm of the Atlantic Philanthropies; Thomas Tierney gave up his role as boss of Bain to found Bridgespan, a consulting firm for non-profits; the three authors of “Do More Than Give” work for FSG, another consultancy.

For Mr Buffett, the main reason why giving is harder to do than making money is that in business “you go after the low-hanging fruit”, whereas in philanthropy you are trying to tackle problems that are inherently difficult, such as how to educate demotivated urban kids or end rural poverty. But all three books make the case that the ineffectiveness of much philanthropy is actually the fault of the philanthropist. They applaud the motives for giving, but all make the point that people too often let their philanthropy be guided by their hearts alone. “Deciding what you will do to make change happen is a choice that requires both your head and your heart”, write Messrs Fleishman and Tierney in the best chapter in “Give Smart”, entitled “What Am I Accountable For?” The biggest problem for philanthropists, they argue, may be that “they are essentially accountable to no one but themselves.” To avoid being tempted into a self-deluded belief in their own success, philanthropists should create systems that force them to hear what may at times be unpleasant truths about the ineffectiveness of their work, and to be constantly challenged to improve.

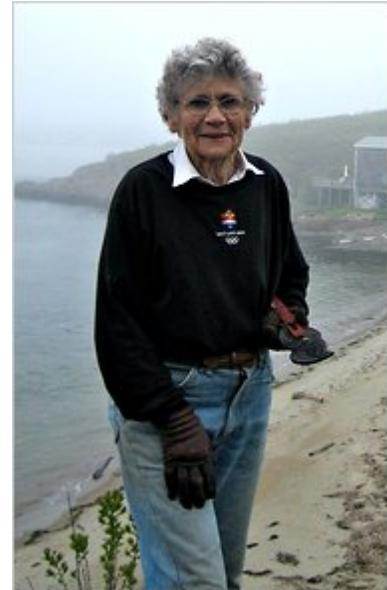
Of the six practices of effective philanthropists described in “Do More Than Give”, two stand out as being unusual. To achieve real change—what the authors, Leslie Crutchfield, John Kania and Mark Kramer, call “catalytic philanthropy”—the best course may be to engage in political advocacy to change government policy, they argue. The Bill & Melinda Gates Foundation is doing this a lot more than most, on issues ranging from education reform to international aid. But the advice also works at a local level, as the book illustrates through the story of how the Tow Foundation improved juvenile justice policy in Connecticut. Their second sound piece of advice is that philanthropists should work together more often. This seems obvious, but as the authors rightly ask, “Why don’t more foundations actively collaborate with their peers?”

For Mr Morino, a pioneer of “venture philanthropy”, in which the donor works closely to build up the non-profits he supports, one of the key lessons is for philanthropists and non-profits to be clear about the outcomes they are trying to achieve— and to measure properly the progress they are making towards those goals. He is the first to admit that measuring the right thing is not easy, and he has wasted money by measuring the wrong things. Yet far too many philanthropists and non-profits shy away from setting goals and measuring progress. As a result they condemn themselves to ineffectiveness. This must change if philanthropy and the non-profit sector it helps to fund is to achieve the “quantum leap” in effectiveness that he believes is an urgent priority. As he says, “the time to dramatically improve our collective impact is now, when we are needed most.”

<http://www.economist.com/node/18679019/print>

## Kate Swift, Writer Who Rooted Out Sexism in Language, Dies at 87

By WILLIAM GRIMES



**Betsy Huston**

Kate Swift

Kate Swift, a writer and editor who in two groundbreaking books — “Words and Women” and “The Handbook of Nonsexist Writing” — brought attention to the sexual discrimination embedded in ordinary English usage, died on Saturday in Middletown, Conn. She was 87.

The cause was stomach cancer, her grandniece Corin R. Swift said.

Ms. Swift turned her attention to the issue of sexist language when she and Casey Miller, her companion, formed a professional editing partnership in 1970 and were asked to copy-edit a sex education manual for junior high school students.

The stated goal of the manual was to encourage mutual respect and equality between boys and girls, but Ms. Swift and Ms. Miller, who died in 1997, concluded that the author’s intent was being undermined by the English language.

“We suddenly realized what was keeping his message — his good message — from getting across, and it hit us like a bombshell,” Ms. Swift said in a [1994 interview](#) for the National Council of Teachers of English. “It was the pronouns! They were overwhelmingly masculine gendered.”

The partners turned in a manuscript with suggestions that sex-identifying singular pronouns be made plural, or that pronouns be avoided altogether, and that word order be changed so girls preceded boys as often as the reverse.

“The publisher accepted some suggestions and not others, as always happens,” Ms. Swift said. “But we had been revolutionized.”

Now, they wrote in the preface to their first book, “Words and Women,” “everything we read, heard on the radio and television, or worked on professionally confirmed our new awareness that the way English is used to make the simplest points can either acknowledge women’s full humanity or relegate the female half of the species to secondary status.”

Ms. Swift and Ms. Miller went on to write two attention-getting essays on the subject in 1972: “Desexing the English Language,” which appeared in the inaugural issue of *Ms. magazine*, and “One Small Step for Genkind,” which was published in *The New York Times Magazine*. “Words and Women: New Language in New Times” followed in 1976. An updated version was published in 1991.

The book illustrated the implicit biases in spoken and written English, highlighting the time-honored phrases “all men are created equal” and “land where our fathers died,” the persistent identification of women by Miss and Mrs., and the journalistic habit of describing women as divorcées or blondes, who might be pert, dimpled or cute.

Some of the authors’ proposals gained traction. Many newspapers, textbooks and public speakers avoid “fireman” and “stewardess” nowadays. Other ideas fell by the wayside, notably “genkind” as a replacement for “mankind,” or “tey,” “ter” and “tem” as sex-neutral substitutes for “he/she,” “his/her” and “him/her.”

Barbara Peabody Swift, known as Kate, was born on Dec. 9, 1923, in Yonkers, to a journalistic family. Her paternal grandfather, J. Otis Swift, wrote a daily nature column, “News Outside the Door,” for *The New York World* and its successor, *The World-Telegram*, for 40 years. Her father and mother were both newspaper and magazine journalists.

She grew up in Hastings-on-Hudson, N.Y., and attended Connecticut College before earning a journalism degree from the University of North Carolina in 1944. After working as a copy runner in the NBC newsroom, she enlisted in the Women’s Army Corps as a writer and editor for the Army’s information and education department.

She was a writer for the Port of New Orleans, an editorial assistant at *Time* and a news writer for the public relations department of the Girl Scouts of America before becoming a science writer on the public-affairs staff of the Museum of Natural History in Manhattan in 1954, serving as the press liaison for the Hayden Planetarium. In 1965 she became the director of the news bureau of the school of medicine at Yale.

She lived in East Haddam, Conn., and Georgetown, Me. Her marriage ended in divorce. She is survived by a brother, John, of Georgetown, Me., and a half-sister, Marguerite Swift of Flagstaff, Ariz., and Georgetown.

Although Ms. Swift and Ms. Miller followed up their first book with a style guide, “*The Handbook of Nonsexist Writing*,” in 1980, Ms. Swift insisted that she had no interest in policing the language.

“We just wanted to give people the background, to make them aware of what was happening right underneath their noses,” she said of the handbook. “We didn’t want to tell people, Do This or Don’t Do That!”

<http://www.nytimes.com/2011/05/10/education/10swift.html>

## At 100, Still a Teacher, and Quite a Character

By **JOSEPH BERGER**



Chester Higgins Jr./The New York Times

Bel Kaufman, author of "Up the Down Staircase," the seminal book on the hardships and joys of teaching in New York City, celebrated her 100th birthday

When Bel Kaufman sits you down on her sofa and asks, "Are you comfortable?" the right answer, she reminds you, requires a Yiddish inflection, a shrug and the words, "I make a living."

At 100 years old, Ms. Kaufman is still shpritzing jokes, Jewish and otherwise, which is in her genes. Her grandfather was the great Yiddish storyteller Sholem Aleichem, a writer who was able to squeeze heartbreaking humor out of the most threadbare deprivation and wove the bittersweet Tevye stories that became the source for "Fiddler on the Roof."

This year, Ms. Kaufman did something more than tell jokes. She became one of the few adjunct professors in her age cohort and taught a course on Jewish humor at Hunter College, her alma mater. One of the jokes the class dissected:

"The Frenchman says: 'I'm tired and thirsty. I must have wine.' The German says: 'I'm tired and thirsty. I must have beer.' The Jew says: 'I'm tired and thirsty. I must have diabetes.'"

“We were not just telling jokes,” Ms. Kaufman said in her book-lined Park Avenue study, her eyes glinting mischievously. “We were investigating why so many comedians are Jewish and so many Jewish jokes are so self-accusing.”

“It goes back to immigration from the shtetl, from that poverty, and because the Jew was the object of so much opprobrium and hatred,” she said. “The jokes were a defense mechanism: ‘We’re going to talk about ourselves in a more damaging way than you could.’ ”

Her first triple-digit birthday party was Tuesday, and Ms. Kaufman was honored by Hunter, with a medley of playfully reconstructed songs from “Fiddler,” and other honors coming from the National Yiddish Theater-Folksbiene and the Dutch Treat Club.

Ms. Kaufman was 5 when her grandfather died, on May 13, 1916, and she believes she is the last person alive who remembers him and his impish humor.

“I remember his laugh; I remember his hand when we walked,” she said. “He used to say the tighter I hold on to his hand, the better he will write. He wrote me a letter which I treasure: ‘I’m writing you this letter to ask you to hurry and grow up and learn to write so you can write me a letter. In order to grow up, it is necessary to drink milk and eat soup and vegetables and fewer candies.’ ”

Ms. Kaufman graduated from Hunter in 1934, just 11 years after emigrating from the Soviet Union as a 12-year-old and being forced to start in first grade. Born in Berlin, she was raised in Odessa and Kiev, and the Russian Revolution was the background music of her childhood.

“Dead bodies were frozen in peculiar positions on the street,” she recalled. “People ate bread made of the shells of peas because there was no flour. But a child has no basis for comparison. Doesn’t every child step over dead bodies? I didn’t know any different.”

Ms. Kaufman’s hard work and the watchful eye of a demanding father led to a master’s degree in literature from Columbia and teaching jobs at a series of public high schools. Her 20-year odyssey became the springboard out of her grandfather’s shadow. In 1965, she published “Up the Down Staircase,” a novel about a new teacher very much like Ms. Kaufman who struggles to keep up her spirits in a school crowded with more than a few hopeful but ornery students and where memo-happy principals issue rules like not walking “up the down staircase.”

It spent 64 weeks on The New York Times’s best-seller list and led to Ms. Kaufman’s second career as a speaker.

Ms. Kaufman, who is recovering from a broken rib, refused to have her photograph taken until she changed into a more elegant turquoise blouse, scarf and earrings. But, “without vanity,” she described herself as having been a “wonderful teacher.”

Yet she recalled how difficult it was to get fully certified by a byzantine school bureaucracy. The examiners had her explain a sonnet by Edna St. Vincent Millay, and told her afterward she had given “a poor interpretation.” Having been blocked once before because of a trace of a greenhorn accent, she refused to be stopped a second time. So she did what any true aspirant would have done: she wrote a letter to Ms. Millay and had her evaluate her interpretation.

“You gave a much better explanation of it than I myself should have,” the poet wrote back, and the chastened examiners saved face by urging Ms. Kaufman to try for the license again.



She now meets former students who are grandparents. Indeed, she cannot believe that she has a son, Jonathan Goldstine, 69, who is a retired professor of computer science, and a daughter, Thea, a psychologist, who is 67. Ms. Kaufman lives with her second husband, Sidney J. Gluck, 94, who runs the Sholem Aleichem Memorial Foundation.

“He likes older women,” Ms. Kaufman said with a chuckle.

Now that her rib is healing, Ms. Kaufman intends to resume her hobby — dancing mambos and tangos at a local school. Her determination helps explain how she made it to 100, though she does not think it is such a big deal.

“It must have happened gradually, while I wasn’t looking,” she said. “I feel no different than I felt at 99, 98 or 97. Just because you live a long time, you get all this attention. Just because you survived? Of course, I survived a lot.”

<http://www.nytimes.com/2011/05/12/nyregion/bel-kaufman-at-100-still-a-teacher-and-a-jokester.html>

## Colin Pillinger: What Mars rocks can tell us

- 18:08 16 May 2011 by Colin Pillinger

Magazine issue 2813.



Meteorite fragments may have come from impact sites like this one at Meridiani Planum (Image: NASA)

When is there going to be another mission to look for life on Mars? It is a question I have been asked time and again since Christmas Day 2003, when my team lost contact with our Beagle 2 lander. It was due to call home at 0528 GMT that morning, after landing on the surface of Mars, but there was only silence.

Beagle 2 was carrying an instrument that I believe could have detected traces of living things on the Red Planet. None of the three landers that NASA has since successfully sent to Mars has had the ability to do anything similar. NASA initially agreed to work with the European Space Agency (ESA) on a mission to send two rovers to search for life, planned for 2018. But it announced this year that budget constraints would require a rethink that could mean major reductions in these vehicles' payload and capabilities. ESA itself initially promised there would be a follow-up mission to search for life as soon as 2007, but that date has slipped many times.

Fortunately, none of this means we have to give up on looking for evidence of life on Mars. We have a remarkable resource in the form of fragments of Martian rock blasted from the planet's surface by an asteroid impact, which have ended up landing on Earth many thousands of years later. We know of more than 90 examples of such Martian meteorites, although some come from the same object that disintegrated in the

atmosphere. Many of them have been recovered from the deserts of north Africa, including one called NWA 2975 – a piece of which [New Scientist](#) is offering as a prize.

We know these fragments come from Mars because all meteorites contain clues about their origins. Buried inside some are small pockets of glass formed during the asteroid impact, which can contain traces of gas. Measurements of the composition of this gas match the analysis of the Martian atmosphere by NASA's [Viking landers](#) in the 1970s – a discovery that provided the first confirmation that some meteorites found on Earth really do come from Mars.

Another indicator of a meteorite's origin is the relative abundance of three isotopes of oxygen – oxygen-16, oxygen-17 and oxygen-18 – in the molecules of silicate they contain. Because the relative abundance of these isotopes varies throughout the solar system, it is possible to establish whether a meteorite comes from the moon, the asteroid belt or Mars. At the [Open University](#), we pioneered a method in which we use a laser to melt the silicate minerals in the presence of chemicals that liberate oxygen, and then make very precise isotope measurements. Meteorites from Mars have a slight excess in the abundance of oxygen-17. This is how we authenticated the prize meteorite.

Martian meteorites can also tell us about the existence of water on Mars. That's because they contain minerals such as carbonates, which are likely to have been precipitated from water. Orbiting spacecraft have never managed to locate these minerals in copious quantities, though [NASA's Phoenix lander](#) did find various salts that might have originated in a similar way.

There is plenty of other evidence that water, the key ingredient needed by life, has been present on Mars for a long time. NASA's orbiters and [ESA's Mars Express](#) have found surface features that can only have been made by large quantities of water perhaps 3 billion years ago. This is consistent with the age of the carbonate deposits in Mars meteorites, which have been dated using radioisotopes to originating as early as 3.9 billion years ago.

### Vital signs

Studies of Martian meteorites have outpaced the findings made by NASA's rovers, too. In 1978, Robert Hutchison at the [Natural History Museum in London](#) found evidence in a Martian meteorite of minerals deposited by water – more than 25 years before similar evidence was uncovered by Steve Squyres and his team at NASA, thanks to the [Spirit and Opportunity rovers](#).

Meteorites have, of course, given rise to the most widely publicised suggestion that life may once have thrived on the Red Planet. The rock, known as [ALH 84001](#), came down in Allan Hills, Antarctica, around 13,000 years ago. In August 1996, US president Bill Clinton announced what he called "stupendous" news: Everett Gibson and his colleagues at NASA had discovered what appeared to be a nanometre-sized fossil within ALH 84001.

But this was not the first time a Martian meteorite had yielded evidence of life. In 1989, at the Open University, we made a remarkable discovery in another meteorite also from Antarctica, called EETA 79001. Within the carbonate present in the meteorite, we found a measurable proportion of organic material, typical of that left by the remains of living things on Earth. We stopped short of saying we had discovered life on Mars, preferring, like good scientists, to remain sceptical. In our paper, we merely said that if we are correct "the implications are obvious" ([Nature](#), vol 340, p 220). Later, in the furore surrounding ALH 84001, I found myself being described in the press as "the man who missed life on Mars".

After the fuss had died down, geologists and biologists began to question the validity of ALH 84001's supposed fossil and the organic material we had reported. Some preferred to believe that the fossil was an



artefact and that the organic material was contamination picked up after the meteorite landed in Antarctica. Nevertheless I was convinced our findings were real. It was this that provided the impetus for the Beagle 2 mission.

Since 1996 we have analysed several more carbonate deposits in EETA 79001. The organic materials are confined to one part of the rock, which would seem to exclude the possibility of contamination because there is no obvious way extraneous carbon could find its way into just one bit of the rock and not others. In any case, Antarctic melt water contains such small amounts of carbon that vast amounts of water would need to have percolated through the meteorite to accumulate the organics we found.

It is eight years since Beagle 2 didn't call home and it looks like being at least that long until another lander sends back any information about life on Mars. So we will just have to wait – unless, of course, some hitherto undiscovered secret is found hiding in another meteorite. Maybe there is one lurking in the piece of Mars that you could win.

*Colin Pillinger is a professor of planetary science at the Open University, Milton Keynes, UK. His autobiography, [My Life on Mars: The Beagle 2 diaries](#) is published by the British Interplanetary Society*

<http://www.newscientist.com/article/dn20475-colin-pillinger-what-mars-rocks-can-tell-us.html?full=true&print=true>

## Squid go into space – for the sake of humanity

- Updated 15:11 16 May 2011 by **Michael Marshall**



God speed, bobtail squid (Image: Dennis Kunkel Microscopy/Corbis)

**Update:** At 0856 Eastern Standard Time today, Endeavour successfully launched. Nine minutes later, it entered orbit around the Earth.

If the final launch of the space shuttle Endeavour goes ahead as planned next week, it will be carrying an unusual cargo: baby squid.

This is not because the astronauts want a change in their menu: the squid could help us understand how "good" bacteria behave in the microgravity of space. As Jamie Foster of the University of Florida in Gainesville, who is running the experiment, puts it: "Do good bacteria go bad?"

We already know that disease microbes grow faster and become more virulent if they are sent into space. In 2006 *Salmonella* bacteria were sent up on a space shuttle, and when they returned to Earth they were almost three times as likely to kill mice as normal (*Proceedings of the National Academy of Sciences*, DOI: [10.1073/pnas.0707155104](https://doi.org/10.1073/pnas.0707155104)). *Escherichia coli* also changes its behaviour.

These studies all focused on harmful bacteria. "This is the first to look at beneficial bacteria," Foster says.

### Orbital tentacles

Squid are cephalopods, a group of relatively intelligent animals that also includes octopuses and cuttlefish 🐙. Cephalopods have never been into space before – not in reality, at least.

Foster has arranged to send up the bobtail squid *Euprymna scolopes*, a Pacific species that carries a cargo of bacteria called *Vibrio fischeri* in its body. The microbes colonise young squid soon after the squid hatch and set up home in their light organs. The squid use the bacteria to generate light, which they shine downwards to ensure they don't cast a visible shadow.



This is a classic example of mutualism: the two species cooperate and each benefits. Humans have similar relationships with microbes, which help shape our immune and digestive systems, but thousands of species are involved with us rather than just one. "Humans are way too complex," Foster says.

Foster's experiment is simple. Newly hatched squid that have not yet encountered their bacterial partners will go up to orbit in tubes of seawater. 14 hours after launch, an astronaut will add the bacteria and give them 28 hours to colonise the squid. Then the squid will be killed and fixed solid, and brought back to Earth for examination.

Foster has some preliminary results from Earth-bound experiments that simulated microgravity and appeared to show problems with the uptake of bacteria by squid. If the shuttle study shows the same result, it would suggest that astronauts' relationships with their own microbes might also be affected in space. "We want to make sure the astronauts are healthy," she says.

Foster developed the experiment with Margaret McFall-Ngai of the University of Wisconsin-Madison, the Florida Space Grant Consortium and students from Milton Academy in Massachusetts and Merritt Island High School, Florida.

<http://www.newscientist.com/article/dn20474-squid-go-into-space--for-the-sake-of-humanity.html>

## Alien life may huddle under hydrogen blankets

- 12 May 2011 by **Ken Crowell**
- Magazine issue 2812.



Wrap up warm (Image: NASA)

OUR planet seems to be in just the right spot to sport a mild climate. Not too near the sun's heat, not too far from its warmth, in a narrow habitable zone in which water is liquid and life can thrive. But Earth could still support life even if it were as far from the sun as Saturn, claim two scientists in the US, as long as the air abounded with hydrogen. If they are right, then billions of life-bearing planets may exist much further from their host stars than astronomers had thought possible.

Earth owes much of its warmth to carbon dioxide and water vapour in its atmosphere trapping solar heat, but these greenhouse gases freeze at the low temperatures far from the sun. In contrast, hydrogen stays gaseous, and at high pressure it is also an effective greenhouse gas.

Raymond Pierrehumbert at the University of Chicago and Eric Gaidos at the University of Hawaii in Honolulu calculated the warming effect of a hydrogen blanket on Earth-sized planets, as well as on worlds a few times more massive than our own, known as super-Earths. They found that, swaddled in a hydrogen atmosphere a few dozen times thicker than our nitrogen-oxygen one, such a planet could keep warm at up to 15 times Earth's distance from the sun. And despite the thickness of this alien atmosphere, Pierrehumbert and Gaidos calculate that enough sunlight would reach the planet's surface to foster photosynthesis.

"It's a clever idea," says James Kasting of Pennsylvania State University in University Park, "but I'm sceptical as to whether you can form these planets." He doubts that an Earth-like planet or super-Earth would pull in so much hydrogen from the cloud of gas surrounding a young star.



Kasting adds that far-out planets will be fainter and harder to see than close-in planets, so finding these distant worlds will be more difficult, as will studying their atmospheres.

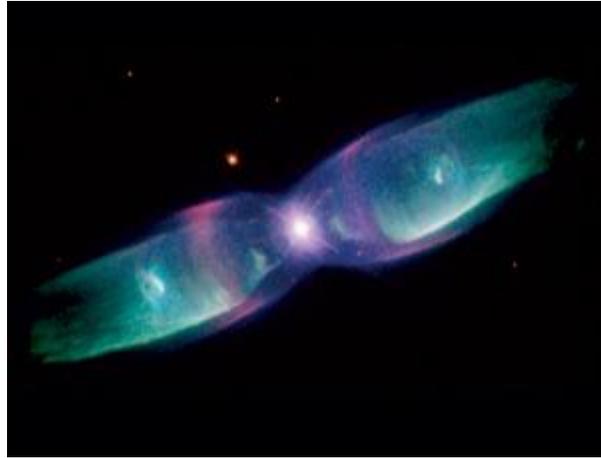
Nevertheless, Pierrehumbert and Gaidos point to one known planet that may fit the bill. Named OGLE-05-390Lb, it is about six times as massive as Earth. It orbits a red dwarf - a small, cool, faint star - at 2.6 times Earth's distance from the sun. A naked planet so far from such a dim star would be a frigid world. But with a thick hydrogen atmosphere it could potentially sustain liquid water at its surface, say the researchers in a study to appear in *The Astrophysical Journal Letters*.

Yet if a far-out planet did spawn life, that life could sign its own death warrant. Some types of microbe consume hydrogen and carbon dioxide. By depleting these greenhouse gases, the microbes might turn their warm world into a giant snowball, killing them all.

<http://www.newscientist.com/article/mg21028124.800-alien-life-may-huddle-under-hydrogen-blankets.html>

## Ghostly nebulae show mysterious alignment

- 17:33 11 May 2011 by **Stephen Battersby**



Elongated nebulae feel a strange alignment (Image: Bruce Balick, Vincent Icke, Garrelt Mellema and NASA/ESA)

File under "unexplained phenomena": elongated nebulae in the Milky Way's centre seem to lie parallel to the plane of the galactic disc, hinting at an underlying pattern.

Bryan Rees of the University of Manchester, UK, found the strange alignment after studying 44 such nebulae. His findings bolster observations made in 2008 by Walter Weidmann of Cordoba Observatory in Argentina and Ruben Diaz of the Gemini Observatory in Chile. Rees presented his results at the UK National Astronomy Meeting in Llandudno, UK, last month.

The structures are thought to result from the interaction between pairs of stars. As one ageing star breathes out its gases while whirling around a companion, it creates a planetary nebula that stretches out perpendicular to the plane of the stars' orbits. So the nebular alignment hints at an underlying alignment of stellar pairs.

Albert Zijlstra, Rees's adviser at Manchester, speculates that powerful magnetic fields might have once girded the galaxy's central stellar bulge and guided the tilt of star-forming gas clouds.

But Mike Edmunds of the University of Cardiff, UK, cautions that the apparent alignment might be due to an unknown observational bias that favours finding nebulae parallel to the galactic disc, rather than a real effect. "Spatial statistics is a minefield," he told *New Scientist*. He urges the team to recheck their analysis.

<http://www.newscientist.com/article/dn20467-ghostly-nebulae-show-mysterious-alignment.html>

### Talk with a dolphin via underwater translation machine

- 09 May 2011 by **MacGregor Campbell**
- Magazine issue 2811.



"So long, and thanks for all the fish" (Image: Flip Nicklin/Minden/FLPA)

A DIVER carrying a computer that tries to recognise dolphin sounds and generate responses in real time will soon attempt to communicate with wild dolphins off the coast of Florida. If the bid is successful, it will be a big step towards two-way communication between humans and dolphins.

Since the 1960s, captive dolphins have been communicating via pictures and sounds. In the 1990s, Louis Herman of the Kewalo Basin Marine Mammal Laboratory in Honolulu, Hawaii, found that bottlenose dolphins can keep track of over 100 different words. They can also respond appropriately to commands in which the same words appear in a different order, understanding the difference between "bring the surfboard to the man" and "bring the man to the surfboard", for example.

But communication in most of these early experiments was one-way, says Denise Herzing, founder of the Wild Dolphin Project in Jupiter, Florida. "They create a system and expect the dolphins to learn it, and they do, but the dolphins are not empowered to use the system to request things from the humans," she says.

Since 1998, Herzing and colleagues have been attempting two-way communication with dolphins, first using rudimentary artificial sounds, then by getting them to associate the sounds with four large icons on an underwater "keyboard".

By pointing their bodies at the different symbols, the dolphins could make requests - to play with a piece of seaweed or ride the bow wave of the divers' boat, for example. The system managed to get the dolphins' attention, Herzing says, but wasn't "dolphin-friendly" enough to be successful.

Herzing is now collaborating with Thad Starnier, an artificial intelligence researcher at the Georgia Institute of Technology in Atlanta, on a project named Cetacean Hearing and Telemetry (CHAT). They want to work with dolphins to "co-create" a language that uses features of sounds that wild dolphins communicate with naturally.

Knowing what to listen for is a huge challenge. Dolphins can produce sound at frequencies up to 200 kilohertz - around 10 times as high as the highest pitch we can hear - and can also shift a signal's pitch or stretch it out over a long period of time.

The animals can also project sound in different directions without turning their heads, making it difficult to use visual cues alone to identify which dolphin in a pod "said" what and to guess what a sound might mean.

To record, interpret and respond to dolphin sounds, Starnier and his students are building a prototype device featuring a smartphone-sized computer and two hydrophones capable of detecting the full range of dolphin sounds.

A diver will carry the computer in a waterproof case worn across the chest, and LEDs embedded around the diver's mask will light up to show where a sound picked up by the hydrophones originates from. The diver will also have a Twiddler - a handheld device that acts as a combination of mouse and keyboard - for selecting what kind of sound to make in response.

Herzing and Starnier will start testing the system on wild Atlantic spotted dolphins (*Stenella frontalis*) in the middle of this year. At first, divers will play back one of eight "words" coined by the team to mean "seaweed" or "bow wave ride", for example. The software will listen to see if the dolphins mimic them. Once the system can recognise these mimicked words, the idea is to use it to crack a much harder problem: listening to natural dolphin sounds and pulling out salient features that may be the "fundamental units" of dolphin communication.

The researchers don't know what these units might be. But the algorithms they are using are designed to sift through any unfamiliar data set and pick out interesting features (see "Pattern detector"). The software does this by assuming an average state for the data and labelling features that deviate from it. It then groups similar types of deviations - distinct sets of clicks or whistles, say - and continues to do so until it has extracted all potentially interesting patterns.

Once these units are identified, Herzing hopes to combine them to make dolphin-like signals that the animals find more interesting than human-coined "words". By associating behaviours and objects with these sounds, she may be the first to decode the rudiments of dolphins' natural language.

Justin Gregg of the Dolphin Communication Project, a non-profit organisation in Old Mystic, Connecticut, thinks that getting wild dolphins to adopt and use artificial "words" could work, but is sceptical that the team will find "fundamental units" of natural dolphin communication.

Even if they do, deciphering their meanings and using them in the correct context poses a daunting challenge. "Imagine if an alien species landed on Earth wearing elaborate spacesuits and walked through Manhattan speaking random lines from *The Godfather* to passers-by," he says.



"We don't even know if dolphins have words," Herzing admits. But she adds, "We could use their signals, if we knew them. We just don't."

### **Pattern detector**

The software that Thad Starner is using to make sense of dolphin sounds was originally designed by him and a former student, David Minnen, to "discover" interesting features in any data set. After analysing a sign-language video, the software labelled 23 of 40 signs used. It also identified when the person started and stopped signing, or scratched their head.

The software has also identified gym routines - dumb-bell curls, for example - by analysing readings from accelerometers worn by the person exercising, even though the software had not previously encountered such data. However, Starner cautions that if meaning must be ascribed to the patterns picked out by the software, then this will require human input.

<http://www.newscientist.com/article/mg21028115.400-talk-with-a-dolphin-via-underwater-translation-machine.html>

## 'Vertical street' collects rainwater

12:21 12 May 2011

Wendy Zukerman, *Asia-Pacific reporter*



(Image: CK Designworks)

The world's first "vertical street" will soon be built in Melbourne, Australia.

Every sixth floor of the 35-storey building will have gardens capable of growing trees up to 10 metres tall and the entire building will be boasting the very latest in green technology.

While roof gardens and landscaped balconies have been constructed in the past, project architect Robert Caulfield of CK Designworks, Melbourne, says this is the first time that five high-rise communal gardens have been attempted in the same building.

To achieve this feat, purpose-built planter boxes allowing tree roots to grow in the confined 120-square-metre gardens, and structural supports that hold the weight of the soil and trees will be used. Heat-reflective glass and solar-powered lighting will also be incorporated.

Since the site is a mere 360 square metres, the building's external walls - more than 8000 square metres - will be used to catch rainwater. "This is unusual," says Caulfield. Normally strong winds "just blow the rain off the building".



(Image: CK Designworks)

But, in this development, triangular balconies and a jagged façade are used to reduce the sideways movement of the wind, minimising the water escaping from the side. The catchment will feed into the building's water supply to be used for garden watering and toilet flushing.

The heating and cooling systems are also designed around the gardens. Conventional buildings either use individual air-conditioner systems, or long pipes that pump hot or cold water down the entire building. Both systems are inefficient, either wasting energy by heating one apartment at a time, or losing heat as water is moved great distances.

"We have a hybrid version," says Caulfield. A cooling system installed in each garden will pump water to only six floors, three above and three below. "The short pipe minimises heating or cooling loss," he says.

The building, which will house shops, offices and 154 apartments, will be completed by 2014.

And with horizontal space in demand worldwide, our vertical world is sure to expand. Caulfield's next project is building vertical factories in Nanjing, China.

<http://www.newscientist.com/blogs/onepercent/2011/05/vertical-street-uses-latest-in.html>

## Unsociable methane comes in from the cold

- 14:20 13 May 2011 by Cian O'Luanaigh

An abundant but stand-offish carbon-based molecule has been coaxed into playing nice. Chemists have devised a way to persuade methane to react with other molecules under gentle conditions, making it vastly more useful as a building block for synthesising more complex organic chemicals.

Methane molecules are composed of a single carbon atom connected to four hydrogens. This means methane is the simplest of all the hydrocarbons that contain only simple carbon-hydrogen (C-H) bonds.

To form a bond with another molecule or atom, at least one of these C-H bonds must break. But these bonds are stronger in methane than in any other similar molecule.

Methane is therefore rather reluctant to react – which is why vast pockets of pure methane or natural gas exist in the Earth, which are siphoned for use as fuel.

The downside of this lack of reactivity is that it makes methane an inconvenient raw material for the manufacture of drugs, plastics and innumerable other carbon-based compounds. There are ways to make methane react, but they require high temperatures and harsh, acidic conditions.

### Energy contest

Now Pedro Perez at the University of Huelva, Spain, and colleagues have managed to break one of methane's C-H bonds without acid, and at only 40 °C.

Perez's team had previously used metal-based catalysts to break C-H bonds in other similar hydrocarbons. "The main problem is running the reaction with methane," says Perez.

Because methane is a gas, it will only mix with other chemicals if it is in solution. The trouble is that most solvents that will dissolve methane have C-H bonds that require less energy to break than methane's – so the solvent reacts while methane remains unscathed.

### Beat the bonds

The challenge was to find a suitable solvent without a C-H bond. The team settled on supercritical carbon dioxide – which is neither gas nor liquid but shares features of both. This scCO<sub>2</sub> was sufficiently fluid-like that it mixed with the other reagents, and the reaction went ahead. For now, the team has used a silver-based catalyst to turn methane into an ester called ethyl propionate. Perez says a similar set-up could be used to turn methane into more versatile chemical building blocks, including methanol and ethanoic (acetic) acid. "Our system demonstrates it is possible to beat the bond dissociation energy of methane," he says.

"This really is a breakthrough," says chemist Ian Fairlamb of the University of York, UK. "Methane is cheap. There is plenty on Earth. But increasing methane in the atmosphere is a problem in global warming. Converting what is effectively a problem compound to something that's useful would be fantastic."

Journal reference: *Science*, DOI: 10.1126/science.1204131

<http://www.newscientist.com/article/dn20472-unsociable-methane-comes-in-from-the-cold.html>

### Know where the wind blows to boost power grid capacity

- 11 May 2011 by **David Hambling**
- Magazine issue [2811](#).



Cool the line to increase the load (Image: Chip Simons/Getty)

WIND farms need to connect to the grid, but existing power lines may not have spare capacity, and new lines can cost over £1 million per kilometre. Now a computer model is being developed to help engineers exploit the boost given to existing capacity by the wind itself.

Heat is a limiting factor for power lines; increasing the load makes them hotter and power lines have a maximum operating temperature of 80 °C. Above this the wires expand, causing them to sag. If they touch trees they can short circuit, causing a power outage - just like the US blackout in 2003 which left tens of millions of people without power.

At present, estimates of power line capacity are static and conservative. They also don't take into account the effect of weather conditions, such as wind. "Wind can have a big effect," says Kurt Myers at [Idaho National Laboratory \(INL\)](#), part of the team behind the model. "It can increase capacity by 100 or 200 per cent in certain conditions, and average improvements can be 30 per cent."

Working with the Idaho Power Company, the INL team collected data from 15 weather stations spread over 1500 square kilometres in the US. They then fed the data into existing weather simulation software, called WindSim, which calculates wind speed. From this they created a dynamic model that uses WindSim's results to estimate the wind's cooling effect on each section of power line. It also takes the wind's direction into account, as wind at right angles is far more effective at cooling lines than when it is blowing parallel to the line.

"Utilities have been trying to create dynamic models for years," says INL engineer Jake Gentle. "The problem is the granularity: getting a small enough scale and enough accuracy."

The model highlights areas where there is unused capacity, and locates bottlenecks where there is little cooling and where line upgrades would be needed if more power was to be added to the load.



Regulatory changes will be needed before the model estimates can be used for planning, but the team say they can already give extra confidence during emergency situations.

Later this year the team will validate their model's results by checking the actual wind speed around the power lines.

"The system is only as good as its weakest link," warns Philip Taylor, professor of renewable energy at Durham University in the UK, who is also looking at the effects of wind cooling on power lines. "The important thing is to identify thermal bottlenecks."

<http://www.newscientist.com/article/mg21028115.600-know-where-the-wind-blows-to-boost-power-grid-capacity.html>

## Vitamins May One Day Hitch a Protected Ride on Corn Starch

ScienceDaily (May 15, 2011) — Vitamins and medications may one day take rides on starch compounds creating stable vitamin-enriched ingredients and cheaper controlled-release drugs, according to Penn State food scientists.

The technique may offer drug and food companies a less expensive, more environmentally friendly alternative in creating, among other products, medications and food supplements.

In a series of experiments, researchers formed pockets with corn starch and a fatty acid ester to carry oil soluble vitamins, such as vitamin A and vitamin C, into the body, according to Gregory Ziegler, professor, food sciences.

Heat and acids can harm or destroy vitamins. The starch molecule forms a protective pocket around the vitamins as they travel through the highly acidic stomach and into the small intestines, where they can be absorbed into the blood stream.

To form the pocket, the researchers, who released their findings in a recent issue of *Carbohydrate Polymers*, used a type of corn starch called high amylose maize starch. When amylose comes into contact with fatty acids esters of vitamin A, for example, it creates a coil with an internal wall that repels water -- hydrophobic - - and an exterior wall that attracts water -- hydrophilic. The oil-soluble molecules automatically move into the coil that encapsulates the medication or vitamin.

"There's an ideal size and the real work is to get the right balance of the hydrophilic and hydrophobic properties," said Ziegler, who worked with Ursula V. Lay Ma, graduate student, and John D. Floros, professor, food sciences.

According to Ziegler, there are several benefits for using starches as hosts for delivering drugs and vitamins. Because starches are common, biodegradable and easily absorbed by the body, using corn starch could be inexpensive and better for the environment.

The pharmaceutical industry uses other ingredients and techniques to create inclusion complexes, said Ziegler. For example, cyclodextrin complexes -- donuts of sugar molecules -- form in a similar way to deliver controlled-release substances, such as Ibuprofen. Ziegler said that because the cavity in starch is a different size than that of cyclodextrin, it can increase the size range of molecules that can be encapsulated.

Corn starch could be used in a variety of other applications, including those outside the pharmaceutical and food industries, such as in make-up, containers and even optical and electronic devices, according to Ziegler. "We have more work and research to do," Ziegler said. "The trick is how can we set this up so we can do it simply."

The Pennsylvania Agricultural Experiment Station supported the research.

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### Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Penn State**.

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**Journal Reference:**

1. Ursula V. Lay Ma, John D. Floros, Gregory R. Ziegler. **Effect of starch fractions on spherulite formation and microstructure.** *Carbohydrate Polymers*, 2011; 83 (4): 1757 DOI: [10.1016/j.carbpol.2010.10.041](https://doi.org/10.1016/j.carbpol.2010.10.041)

<http://www.sciencedaily.com/releases/2011/05/110511114205.htm>

## Read It and Weep, Crybabies

### *Tears of Men and Women Are Different; Why It Can Be Hard to Avoid Choking Up*

By **KATHERINE ROSMAN**



WSJ's Katherine Rosman has the story of scientists learning more about how and why humans cry. Specifically, why men and women cry differently.

You first feel your bottom lip tremble as your work is critiqued in a meeting. Or maybe it's a clenching of your jaw. Or perhaps there is no warning at all. One moment you're composed and the next ... waterworks.

We can alter the shapes of our bodies, slow the signs of aging and learn to control our heart rates. Yet we're often powerless when it comes to crying.

<p><b>WOMEN</b></p> <ul style="list-style-type: none"> <li>■ Shed the most tears.</li> <li>■ When crying at work, 58% cite work reasons.</li> <li>■ 43% consider people who cry at work 'unstable.'</li> <li>■ Pick up subtle signs of sadness in a male face 90% of the time.</li> <li>■ In developed countries, cry more than women in societies where there is less gender equality.</li> </ul>			<p><b>MEN</b></p> <ul style="list-style-type: none"> <li>■ Have larger tear ducts.</li> <li>■ Are believed to cry more as they age.</li> <li>■ Shed tears 27% of the time when they get misty eyed.</li> <li>■ 47% consider people who cry at work 'unprofessional.'</li> <li>■ Pick up subtle signs of sadness in a female face 40% of the time.</li> </ul>
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Sylke Freeke, left, and Ludovic Coutaud, students at the New York Film Academy.

Source: Louann Brizendine, William H. Frey II, Anne Kreamer and WSJ reporting

Some new research efforts are helping to piece together the biological and cultural forces behind crying, showing that there are different types of tears as well as differences in the way men and women cry.

Women are biologically wired to shed tears more than men. Under a microscope, cells of female tear glands look different than men's. Also, the male tear duct is larger than the female's, so if a man and a woman both tear up, the woman's tears will spill onto her cheeks quicker. "For men and their ducts, it'd be like having a big fat pipe to drain in a rainstorm," says Louann Brizendine, a neuropsychiatrist at the University of California, San Francisco.

Social conditioning comes into play in restraining the impulse to cry, Dr. Brizendine says. When we experience physical pain or emotional sadness or frustration, the brain's amygdala, which is part of the limbic system or "emotional brain," fires up signals. If the stimulus is great enough, the energy can travel from the emotional area into the frontal motor strip. That's when breathing can devolve into sobbing.

Boys often come up with mechanisms to calm themselves before they cross the precipice from tearing up to weeping. "Boys are taught over and over again not to cry: to scrunch their faces, to think about the Gettysburg address, to distract themselves," says Dr. Brizendine, the author of the best-selling book, "The Female Brain."

Research indicates that testosterone helps raise the threshold between emotional stimulus and the shedding of tears. "It helps put the brakes on," she says.

To teach acting students to cry at the New York Film Academy, Glenn Kalison reminds them to consider that since they were babies, they have been building barriers to prevent themselves from crying. The trick is to imagine a character's pain and sadness, and then to connect with the barriers that character would have built, he explains. The realistic way to portray crying isn't to let tears flow, but to show the struggle not to cry.

"It's the attempt at suppressing the crying that is the familiar sensation," says Mr. Kalison, chairman of the academy's acting for film department. "Only actors want to cry."

Sylke Freeke brings herself to tears - whereas many people work to suppress them.

Studying tears and the process of crying is complex. There are two types of tears. Irritant tears help wash eyes of dust, dirt and impurities. Emotional tears are created and released in response to emotional stimulus and physical pain. All tears contain proteins, salt and hormones, among other substances, but emotional tears have higher levels of protein, says William H. Frey II, a neuroscientist and biochemist at Regions Hospital in St. Paul, Minn., who conducted research into the composition of tears.

One hormone in tears is prolactin, a lactation catalyst. Just as it helps to produce milk, prolactin also aids in tear production. By the time women reach 18, they have 50% to 60% higher levels of prolactin in their bloodstream than men do. "We believe this is one of the reasons that women cry more easily," Dr. Frey says.

Much remains unknown. Human beings are the only species that cries emotional tears, making it difficult to study the internal mechanics of tear glands. It is also not that easy to stimulate crying in a controlled research environment. Ad Vingerhoets, a professor of clinical psychology who focuses on stress and emotion at Tilburg University in the Netherlands, says that to elicit tears, he shows research participants photographs of people in various states of crisis to try to elicit tears of empathy. He also shows tear jerkers, like the 1979 movie "The Champ."

"We do not poke people in the eye," Dr. Vingerhoets says. "We use onions." Test tubes and vials are held to people's cheeks to collect the tears.

Researchers have a hard time getting accurate data because if people feel ashamed of crying, it can affect what they tell researchers. In recent studies conducted by Dr. Vingerhoets in conjunction with researchers at the University of South Florida, participants recorded in their diaries at the moment they cried that the episode didn't make them feel better. Yet when asked to reflect on the crying episodes later, other subjects said in retrospect that they felt better afterward. The researchers wonder if there is an initial sense of shame that comes with crying.

"We also think men are underreporting their crying," says Lauren Bylsma, a doctoral candidate who worked on the project.

The emotional benefits are hard to study too. "Science is hard when dealing with emotion," says Dr. Frey. "It is difficult to define feelings or emotion or to measure their intensity in a way that everyone agrees with."

Some scientists wonder if crying even delivers emotional relief or if tears happen to come at the same time that our bodies have processed emotional strain. They signal that we're starting to feel better but don't necessarily hasten the process.

All sorts of cultural influences determine who cries and the frequency. For her new book, "It's Always Personal," Anne Kreamer teamed with ad agency J. Walter Thompson to survey 1,200 working Americans. She found that age and gender play a role in frequency in crying: Women under 45 are 10 times as likely to cry at work as men 45 and older.

Dr. Vingerhoets conducted a project in 37 countries to compare the different rates of crying among men and women. Women in developed Western economies cry much more than men, and much more than women in societies where women have fewer rights, he says. As men age, they cry more—often provoked by altruism, camaraderie and issues of morality, Dr. Vingerhoets hypothesizes.

"When males get older," he says, "their testosterone levels decrease."

The male reluctance to shed tears is relatively new, says Tom Lutz, a University of California, Riverside professor. He traces this to the late 19th century, when factory workers—mostly men—were discouraged from indulging in emotion lest it interfere with their productivity.

Iconic historical and cultural depictions of men crying—in the Bible, Jesus wept at the death of Lazarus, for instance—have been overcome by more recent dictates discouraging men from crying. Biologically, and in the context of centuries and millennia, "male tears are the norm and males not crying is recent historical aberration," he says.

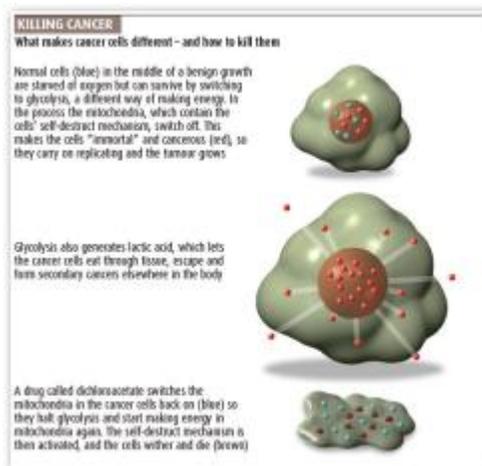
Last month, at a launch party for his newest project, the Los Angeles Review of Books, Mr. Lutz toasted the staff and felt himself getting emotional. Years ago, his father taught him to squeeze the tear ducts at the corners of his eyes with his thumb and forefinger. But the method failed. "I got weepy," Mr. Lutz says. "I couldn't stop it."

**Write to** Katherine Rosman at [katherine.rosman@wsj.com](mailto:katherine.rosman@wsj.com)

<http://online.wsj.com/article/SB10001424052748703922804576300903183512350.html>

## Cheap, 'safe' drug kills most cancers

- Updated 18:32 16 May 2011 by [Andy Coghlan](#)



What makes cancer cells different - and how to kill them

*New Scientist* has received an unprecedented amount of interest in this story from readers. If you would like up-to-date information on any plans for clinical trials of DCA in patients with cancer, or would like to donate towards a fund for such trials, please visit the [site set up by the University of Alberta and the Alberta Cancer Board](#). We will also follow events closely and will report any progress as it happens.

**Update, 16 May 2011:** If you've just heard about this story, [please read this recent update too](#).

It sounds almost too good to be true: a cheap and simple drug that kills almost all cancers by switching off their "immortality". The drug, dichloroacetate (DCA), has already been used for years to treat rare metabolic disorders and so is known to be relatively safe.

It also has no patent, meaning it could be manufactured for a fraction of the cost of newly developed drugs.

Evangelos Michelakis of the University of Alberta in Edmonton, Canada, and his colleagues tested DCA on human cells cultured outside the body and found that it killed lung, breast and brain cancer cells, but not healthy cells. Tumours in rats deliberately infected with human cancer also shrank drastically when they were fed DCA-laced water for several weeks.

DCA attacks a unique feature of cancer cells: the fact that they make their energy throughout the main body of the cell, rather than in distinct organelles called mitochondria. This process, called glycolysis, is inefficient and uses up vast amounts of sugar.

Until now it had been assumed that cancer cells used glycolysis because their mitochondria were irreparably damaged. However, Michelakis's experiments prove this is not the case, because DCA reawakened the mitochondria in cancer cells. The cells then withered and died (*Cancer Cell*, DOI: [10.1016/j.ccr.2006.10.020](#)).

Michelakis suggests that the switch to glycolysis as an energy source occurs when cells in the middle of an abnormal but benign lump don't get enough oxygen for their mitochondria to work properly (see diagram). In order to survive, they switch off their mitochondria and start producing energy through glycolysis.

Crucially, though, mitochondria do another job in cells: they activate apoptosis, the process by which abnormal cells self-destruct. When cells switch mitochondria off, they become "immortal", outliving other cells in the tumour and so becoming dominant. Once reawakened by DCA, mitochondria reactivate apoptosis and order the abnormal cells to die.

"The results are intriguing because they point to a critical role that mitochondria play:

they impart a unique trait to cancer cells that can be exploited for cancer therapy," says Dario Altieri, director of the University of Massachusetts Cancer Center in Worcester.

The phenomenon might also explain how secondary cancers form. Glycolysis generates lactic acid, which can break down the collagen matrix holding cells together. This means abnormal cells can be released and float to other parts of the body, where they seed new tumours.

DCA can cause pain, numbness and gait disturbances in some patients, but this may be a price worth paying if it turns out to be effective against all cancers. The next step is to run clinical trials of DCA in people with cancer. These may have to be funded by charities, universities and governments: pharmaceutical companies are unlikely to pay because they can't make money on unpatented medicines. The pay-off is that if DCA does work, it will be easy to manufacture and dirt cheap.

Paul Clarke, a cancer cell biologist at the University of Dundee in the UK, says the findings challenge the current assumption that mutations, not metabolism, spark off cancers. "The question is: which comes first?" he says.

**Cancer** - *Learn more about one of the world's biggest killers in our comprehensive [special report](#).*

## Stem cell setback as mice reject own tissue

- 18:00 13 May 2011 by [Andy Coghlan](#)
- For similar stories, visit the [Stem Cells](#) Topic Guide

Hopes that people might one day be given transplants made from their own cells have been dashed by experiments trying out the same procedure in mice.

The mice rejected transplants of stem cells even though they had been generated from skin cells genetically identical to their own.

The surprise finding casts doubt on claims that so-called [induced pluripotent stem cells](#) generated from a person's own tissue will ever be medically useful.

Ever since [Shinya Yamanaka](#) at Kyoto University in Japan made iPS cells by [reprogramming skin cells](#) in 2006, scientists have hoped that the technique could be used to generate transplantable tissue from an individual's own cells .

However, the new experiments show that mice recognise many of the reprogrammed cells as foreign and reject them.

"In the context of human therapy, we can't assume that these iPS cells will be immuno-tolerated," says [Yang Xu](#) at the University of California in San Diego, head of the team.

Xu and his colleagues made the iPS cells from skin cells of genetically identical mice by two methods. The first involved using a virus to ferry four reprogramming genes into each skin cell. These turned the cells into iPS cells, which were then transplanted back into genetically identical mice.

In the second, milder method, Xu's team introduced the reprogramming factors that the four genes code for without using a virus. They did this by immersing the cells in a solution containing the factors, which entered the cell through a process called electroporation – the use of an electric current to open up channels in the cell membrane .

The transplants produced with a virus were rejected faster and more vigorously than those produced with the milder method. "Damage to the transplanted tissues was much more limited, with only a small number of cells rejected, whereas with the viral method, the damage was extensive," says Xu.

The reason for rejection turned out to be proteins produced by the iPS cells. One especially strong trigger for rejection was Oct4, one of the reprogramming factors used to turn skin cells into iPS cells. The researchers found that it is subsequently produced by many of the reprogrammed iPS cells .

Xu says that humans and mice are naturally programmed to reject cells that produce Oct4, because the protein is normally only produced fleetingly during embryonic development and could be dangerous if produced in adult organisms. The reason rejection of the virally produced iPS cells was stronger was because as the gene coding for Oct4 remained switched on long after the reprogramming had finished.

Xu says that a possible solution for the milder method is to screen cells before they are transplanted to check whether they are producing the factors that cause rejection. A better solution would be to fine-tune the process to eliminate these unwanted effects.



"It's important to continue pursuing treatments based on human embryonic stem cells as these have so far proved to be the most reliable and versatile for regenerating new cells and tissue," says Xu.

Some people who oppose research on human embryonic stem cells (hESCs) claim that research on them should be halted because iPS cells are just as versatile but can be obtained without destroying embryos. The new research shows that iPS cells might not be the answer after all.

"Xu's findings throw another obstacle in the way of iPS cell development," says Robert Lanza, chief scientist at Advanced Cell Technology of Worcester, Massachusetts, which has won approval to test cell treatments derived from hESCs against two forms of blindness.

Journal reference: *Nature*, DOI: 10.1038/nature10135

<http://www.newscientist.com/article/dn20476-stem-cell-setback-as-mice-reject-own-tissue.html>

### New doubts over shaken-baby evidence

- 12 May 2011 by **Andy Coghlan**
- Magazine issue 2812.



"Proof" of abuse in doubt (Image: Nancy Honey/Getty)

WATER-FILLED cysts in the brain of a dead baby should not be taken as proof that the infant has been shaken to death. New findings show that cysts are also found in babies known to have died of innocent causes.

If the brain is starved of oxygen - because of a breathing problem or a blood clot caused by trauma, for example - it will swell up. A study of swollen brains in 20 babies who died aged 5 months or less showed that the longer they had survived before dying, the more likely they were to develop water-filled cysts between the cerebral cortex and the inner regions of the brain.

"While these cysts may be seen as a consequence of trauma, they do not appear to be due to mechanical tissue disruption, and may occur after brain swelling from any cause," says Waney Squier at the John Radcliffe Hospital in Oxford, UK (*Early Human Development*, DOI: [10.1016/j.earlhumdev.2011.03.003](https://doi.org/10.1016/j.earlhumdev.2011.03.003)). Squier's team suggests that the cysts arise because the brains of young babies have yet to fully develop the plumbing needed to drain excess fluid.



The paper is the latest to cast doubt on post-mortem evidence that has till now been taken to show that abuse has taken place. Last year, evidence emerged to challenge the use of the "triad" - the combination of brain swelling, and bleeding on the surface of the brain and at the back of the eyes - as evidence in such cases.

In January the Crown Prosecution Service in England and Wales issued new guidelines stating that the triad would no longer be sufficient to show that a dead infant had suffered "shaken baby syndrome". As well as requiring additional evidence of possible abuse before a prosecution is started, the guidelines also rename "shaken baby syndrome" as "non-accidental head injury".

"Squier has shown that sub-cortical fluid collections are not [always] the result of primary trauma to the cortex," says Julie Mack, a pathologist studying infant brain injury at Pennsylvania State Hershey Medical Center.

One prominent radiologist in the UK who preferred not to be named says he agrees that the cysts can have innocent causes. But he questions the validity of the new study, adding that he seldom sees evidence of cysts in MRI scans of living infants with swollen brains.

<http://www.newscientist.com/article/mg21028124.900-new-doubts-over-shakenbaby-evidence.html>

## Vaccine protects against monkey version of HIV

- 18:19 11 May 2011 by [Andy Coghlan](#)

For the first time, a vaccine has completely protected monkeys against infection with SIV, a virus related to HIV that infects the animals.

Out of 24 immunised rhesus macaques, 12 had long-term protection, with no signs of SIV a year after they were deliberately infected with the virus.

"In half the monkeys, we saw a dramatic effect on control of the virus," says [Wayne Koff](#), the scientific director at the International AIDS Vaccine Initiative, which collaborated in the trial. "We see it as a significant advance."

What made this vaccine different was the use of a live but relatively harmless virus as a host. To make it, [Louis Picker](#) at Oregon Health & Science University in Beaverton and colleagues packaged SIV genes into a live virus called a rhesus cytomegalovirus (RhCMV) vector, then injected it under the skin of the monkeys.

They compared its effectiveness with that of conventional vaccines, which deliver SIV genes in harmless adenovirus vectors, similar to those that cause colds.

### Lifetime guarantee

The main difference between the two types of vaccination is that RhCMV carries on replicating and producing SIV antigens throughout the monkey's life. By contrast, the adenoviral vaccine replicates once then vanishes.

The result, Koff explains, is that RhCMV keeps the body's immune system on constant alert for SIV, so that when an infection happens, it is instantly able to stub it out.

Monkeys injected with the RhCMV vaccine made a specific subset of white blood cells primed to destroy SIV. Called effector memory T-cells, these are ready and waiting for SIV throughout the body.

The result was that SIV was completely undetectable in 12 of the 24 monkeys. All monkeys receiving the conventional adenovirus vaccine gradually succumbed to the virus despite initially producing antibodies against it.

### Humans next?

"It puts back on the agenda the possibility that HIV can be controlled by the human immune system," says Robin Shattock at Imperial College London. However, the researchers also need to explain why the response was "all or nothing", with half the monkeys responding brilliantly and the others apparently not responding at all, says Shattock. None of the three vaccines tested in humans so far has shown any sign of matching the RhCMV vaccine's ability to control SIV. Only one of the three, the RV 144 vaccine tested in Thailand in 2009, has shown any ability to prevent infection, reducing it by about a third.

Journal reference: *Nature*, DOI: 10.1038/nature10003

<http://www.newscientist.com/article/dn20468-vaccine-protects-against-monkey-version-of-hiv.html>

### The grand delusion: What you see is not what you get

- 16 May 2011 by **Graham Lawton**
- Magazine issue 2812.



Only a tiny fraction of your visual field is captured in colour (Image: Suren Manvelyan/Rex Features)

Your senses are your windows on the world, and you probably think they do a fair job at capturing an accurate depiction of reality. Don't kid yourself. Sensory perception - especially vision - is a figment of your imagination. "What you're experiencing is largely the product of what's inside your head," says psychologist Ron Rensink at the University of British Columbia in Vancouver, Canada. "It's informed by what comes in through your eyes, but it's not directly reflecting it."

Given the basic features of your visual system, it couldn't be any other way. For example, every 5 seconds or so, you blink. Yet unless you're thinking about it, as you probably are right now, you don't notice the blackouts because your brain edits them out.

Blinking is just the tip of the iceberg. Even when your eyes are open they're only taking in a fraction of the visual information that is available.

In the centre of your retina is a dense patch of photoreceptor cells about 1 millimetre across. This is the fovea, the visual system's sweet spot where perception of detail and colour is at its best. "When you move away from the fovea, visual acuity falls away really quickly, and colour vision disappears," says Rensink. About 10 degrees to the side of the fovea, visual acuity is only about 20 per cent of the maximum.

What that means is you can only capture a tiny percentage of the visual field in full colour and detail at any one time. Hold your hand at arm's length and look at your thumbnail. That is roughly the area covered by the fovea. Most of the rest is captured in fuzzy monochrome.

And yet vision doesn't actually feel like this: it feels like a movie. That, in part, is because your eyes are constantly flitting over the visual scene, fixing on one spot for a fraction of a second then moving on. These jerky eye movements are called saccades and they happen about 3 times a second and last up to 200 milliseconds. With each fixation your visual system grabs a bite of high-resolution detail which it somehow weaves together to create an illusion of completeness.

That's remarkable given that during saccades themselves, you are effectively blind. Your eyes don't stop transmitting information as they lurch from one fixation to the next, but for about 100 milliseconds your brain is not processing it.

Look in the mirror and deliberately flick your eyes from left to right and back again. You won't see your eyes move - not because the movement is too fast (other people's saccades are visible), but because your brain isn't processing the information.

Given that you perform approximately 150,000 saccades every day, that means your visual system is "offline" for a total of about 4 hours during each waking day even without blinking (*Trends in Cognitive Sciences*, vol 12, p 466). Yet you don't notice anything amiss.

Exactly how your brain weaves such fragmentary information into the smooth technicolour movie that we experience as reality remains a mystery. One leading idea is that it makes a prediction and then uses the foveal "spotlight" to verify it. "We create something internally and then we check, check, check," says Rensink. "Essentially we experience the brain's best guess about what is happening now."

In conjuring up this "now", the visual system has to do something even more remarkable: predict the future. Information striking the fovea cannot be relayed instantaneously to conscious perception: first it has to travel down the optic nerve and be processed by the brain. This takes several hundred milliseconds, by which time the world has moved on. And so the brain makes a prediction about what the world will look like about 200 milliseconds into the future, and that is what you see. Without this future projection you would be unable to catch a ball, dodge moving objects or walk around without crashing into things.

There's another huge hole in the visual system that can render you oblivious to things that should be unmissable. The jerky movements that shift your fovea around the visual scene don't happen at random - they are directed by your brain's attentional system. Sometimes you consciously decide what to attend to, such as when you read. At other times your attention is grabbed by a movement in your peripheral vision or an unexpected noise.

The problem with attention is that it is a limited resource. For reasons that remain unknown, most people are unable to keep track of more than four or five moving objects at once. That can lead your visual system to be oblivious to things that are staring you in the face.

The most famous demonstration of this "inattention blindness" is the invisible gorilla, a video-based experiment created by Daniel Simons and Christopher Chabris at the University of Illinois at Urbana-Champaign. Viewers are asked to pay close attention to a specific aspect of a basketball game, and around half completely fail to see a person in a gorilla suit walk slowly across the screen, beat their chest and walk off again.

<http://www.newscientist.com/article/mg21028122.100-the-grand-delusion-what-you-see-is-not-what-you-get.html?full=true&print=true>

## Oxygen oases saved first animals from asphyxiation

- 18:00 15 May 2011 by **Michael Marshall**



Back in the burrow, quick (Image: Justin Lewis/The Image Bank/Getty)

Oxygen-rich microbial mats may have triggered the evolution of animals that could move.

The oldest known animal burrows are in 600-million-year-old rocks from the Ediacaran period. Their discovery surprised geologists, because oxygen levels in the oceans at the time were around one-tenth of today's levels – too low to support energetic activity.

To work out how the animals avoided suffocation, Murray Gingras of the University of Alberta in Edmonton, Canada, explored modern-day, low-oxygen lagoons in the Los Roques archipelago, Venezuela. He found that microbial mats on the lagoon floors contained four times as much oxygen as the virtually lifeless water above – enough to support a community of worms and insect larvae.

Gingras says the burrows these animals leave are similar to those found in the 600-million-year-old rocks. Because the rocks also contain fossil microbial mats, that suggests the mats produced enough oxygen to allow animals to become mobile for the first time, despite the generally low oxygen conditions that existed in the Ediacaran.

"This is a really neat solution to an old problem," says Ediacaran researcher Jim Gehling of the South Australian Museum in Adelaide. But he points out that animals in the Ediacaran might have struggled to survive at night, when the microbes stopped photosynthesising and oxygen levels fell.

Journal reference: *Nature Geoscience*, DOI: 10.1038/ngeo1142

<http://www.newscientist.com/article/dn20477-oxygen-oases-saved-first-animals-from-asphyxiation.html>

## Dusting for Fingerprints -- It Ain't CSI



*New research reveals that the human factor in the process of identifying fingerprints could lead to errors and false convictions of innocent people. (Credit: © James Steidl / Fotolia)*

ScienceDaily (May 15, 2011) — Fingerprints: dozens of crime dramas revolve around them. The investigators find the victim, dust for fingerprints, run them through a computer program and *voilà* -- the guilty party is quickly identified and sent to prison.

If only it were that easy. The reality is that this common but crucial part of an investigation is done by humans, not by computers. An upcoming study in *Psychological Science*, a journal of the Association for Psychological Science, reveals that the human factor in the process could lead to errors and false convictions of innocent people.

"We knew from other psychological research that the all-too-human foibles of distraction, rushes to judgment, biases and expectations can't be avoided even by the most diligent professionals, so we were understandably concerned about the potential for error," said lead author Jason Tangen of The University of Queensland.

"But despite its 100 year history, there have been few peer-reviewed studies directly examining the extent to which experts can correctly match fingerprints to one another."

Tangen, along with the other authors, set out to determine the likelihood of human error when dealing with fingerprints. They gave 37 qualified fingerprint experts and 37 novices pairs of fingerprints to examine and decide whether a simulated crime scene matched a potential suspect or not. Some of the print pairs belonged to the "criminal" while others were highly similar but actually belonged to an "innocent" person.

The experts correctly matched just over 92 percent of the prints to the criminal. But, they mistakenly matched 0.68 percent of the prints to the innocent person.

"Expertise with fingerprints provides a real benefit," said Tangen. "But experts -- like doctors and pilots -- make mistakes that can put lives and livelihoods at risk." he added.



Tangen said that experts tended to err on the side of caution by making errors that would free the guilty rather than convict the innocent. Even so, they made the kind of error that may lead to false convictions.

"The issue is no longer whether fingerprint examiners make errors, but rather how to acknowledge them."

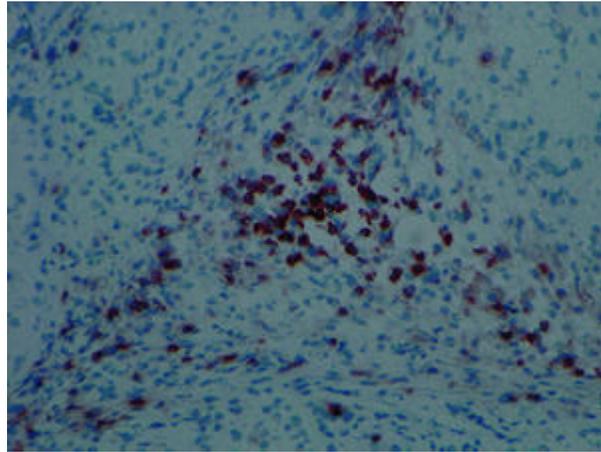
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**Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Association for Psychological Science**.

<http://www.sciencedaily.com/releases/2011/05/110511162536.htm>

## Therapies Using Induced Pluripotent Stem Cells Could Encounter Immune Rejection Problems



An infiltration of T cells, shown by dark brown color, can be seen in the tissues formed by iPSCs. (Credit: Yang Xu, UC San Diego)

ScienceDaily (May 15, 2011) — Biologists at UC San Diego have discovered that an important class of stem cells known as "induced pluripotent stem cells," or iPSCs, derived from an individual's own cells, could face immune rejection problems if they are used in future stem cell therapies.

In the journal *Nature*, the researchers report the first clear evidence of immune system rejection of cells derived from autologous iPSCs that can be differentiated into a wide variety of cell types.

Because iPSCs are not derived from embryonic tissue and are not subject to the federal restrictions that limit the use of embryonic stem cells, researchers regard them as a promising means to develop stem cell therapies. And because iPSCs are derived from an individual's own cells, many scientists had assumed that these stem cells would not be recognized by the immune system. As a consequence, the immune system would not try to mount an attack to purge them from the body.

In fact, scientists regarded iPSCs as particularly attractive candidates for clinical use because cells derived from embryonic stem cells will induce immune system rejection that requires physicians to administer immune suppressant medications that can compromise a person's overall health.

But the UCSD biologists, funded by NIH and an early translational grant from the California Institute for Regenerative Medicine, the state's stem-cell funding agency, found that iPSCs are subject to some of the same problems of immune system rejection as embryonic stem cells.

"The assumption that cells derived from iPSCs are totally immune tolerant has to be reevaluated before considering human trials," says Yang Xu, a professor of biology at UCSD who headed the team that published the study.

His team of biologists -- which included postdoctoral researchers Tongbiao Zhao, Zhen-Ning Zhang and Zhili Rong -- reached that conclusion after testing the immune response of an inbred strain of mice to embryonic stem cells and several types of iPSCs derived from the same strain of inbred mice.

The scientists found, not surprisingly, that the immune system of one mouse could not recognize the cells derived from embryonic stem cells of the same strain of mice. But the experiments also showed that the immune system rejected cells derived from iPSCs reprogrammed from fibroblasts of the same strain of mice,

mimicking the situation whereby a patient would be treated with cells derived from iPSCs reprogrammed from the patient's own cells. The scientists also found that the abnormal gene expression during the differentiation of iPSCs causes the immune responses.

"This result doesn't suggest that iPSCs cannot be used clinically," says Xu. "It is important now to look at exactly what types of cells derived from iPSCs -- and there probably are not that many based on our findings - are likely to generate immune system rejection."

"Our immune response assay is a robust method for checking the immune tolerance, and therefore, the safety of iPSC that may be developed," he added.

With grants from the California Institute for Regenerative Medicine, Xu's team is also developing strategies to minimize the formation of tumors that result from the use of human embryonic stem cells and to increase the immune tolerance of human embryonic stem cells.

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#### Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of California - San Diego**. The original article was written by Kim McDonald and Chris Palmer.

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#### Journal Reference:

1. Tongbiao Zhao, Zhen-Ning Zhang, Zhili Rong, Yang Xu. **Immunogenicity of induced pluripotent stem cells**. *Nature*, 2011; DOI: [10.1038/nature10135](https://doi.org/10.1038/nature10135)

<http://www.sciencedaily.com/releases/2011/05/110513132523.htm>

## Inaccurate IQs could be a matter of life and death

- 17:26 12 May 2011 by **Jessica Griggs**

Some people in the US may have been wrongly executed because of inaccuracies in the IQ tests used to assess them. But the inaccuracies may also have seen some escape execution if they scored lower on the tests than their real IQ.

Simon Whitaker, a psychologist at the University of Huddersfield, UK, searched the literature to identify sources of error in two of the most commonly used IQ tests: the third edition of the Wechsler Adult Intelligence Scale (WAIS-III), which can be used on people aged between 16 and 93, and the fourth edition of the Wechsler Intelligence Scale for Children (WISC-IV), suitable for children aged between 6 and 16.

In both cases, the test manuals state that you can be 95 per cent confident that a person's true IQ lies within 4 points of their test score.

However, Whitaker found that for people with extremely poor WAIS-III scores, their actual IQ could be up to 16 points higher or 26 points lower than the score achieved. In the WISC-IV test, actual IQ may be up to 25 points higher or 16 points lower than the score achieved.

In 2002, the US Supreme Court ruled that the execution of any mentally retarded person violates the Eighth Amendment's prohibition against "cruel and unusual punishments". An IQ of 70 is generally considered the threshold – making Teresa Lewis (IQ 72), who was executed in September last year, a borderline case.

### Too simplistic

Whitaker says that setting a cut-off point at 70 is too simplistic, given that his results suggest IQ tests may provide inaccurate results at this end of the IQ scale. He suggests looking at how an individual is functioning in the real world – "whether they are failing at everyday tasks that require intellectual ability" – to establish whether or not they are mentally retarded.

He offers a simple explanation for the wide error margins in IQ readings at the low end of the scale. The statistics used to arrive at the 95 per cent confidence level for the tests are based on the IQs of a representative sample of the population. "But by definition, most people in the population have average IQs," says Whitaker. "This causes problems when statistics based on the performance of people with average IQs are assumed to apply to people with low IQs."

What's more, the manuals usually take into account only one type of possible error – how well the items in the test measure the psychological factor that they are supposed to assess. In performing his calculation, Whitaker considered other sources of error such as the differences that may arise between scores an individual achieves if they take the IQ test several times.

James Ellis of the University of New Mexico, Albuquerque, who represented a convicted murderer in the case that resulted in the Supreme Court's ruling in 2002, says: "Courts are becoming more sophisticated in dealing with the details of individual evaluations, particularly in states with a substantial number of death penalty cases."

He points out that last month the Tennessee Supreme Court ruled that in cases where a defendant's IQ test score was slightly above 70, the lower courts should nonetheless not reject mental retardation as a defence.



## High stakes

Tomas Chamarro-Premuzic, a psychologist at Goldsmiths, University of London, says Whitaker's research makes an important point. "Anxiety, low confidence or even overconfidence can distort a person's IQ test score," he says.

Sitting a test to determine whether you are sentenced to death would be classed as a "high-stakes setting" by psychologists. "Under pressure like that, most people would not do their best," he says, and their score would underestimate their true IQ – again suggesting problems with using IQ alone to decide whether or not a convicted person should be spared the death penalty.

Whitaker reported his findings at the British Psychological Society conference in Glasgow, UK, last week.

<http://www.newscientist.com/article/dn20470-inaccurate-iqs-could-be-a-matter-of-life-and-death.html>

## Chimps hunt monkey prey close to local extinction

- 11:57 12 May 2011 by **Michael Marshall**



Can't get enough of those yummy colobus (Tim Laman/National Geographic/Getty)

Humans have a bad reputation for overhunting some animals, but a new study suggests we're not the only ones. Chimpanzees in Uganda have overhunted red colobus monkeys, causing their local population to fall to one-tenth of what it was just 33 years ago, a new study has found. This is the first time a non-human primate has been shown to overhunt another, leading to a population decline.

The chimps in question live in the forests of Ngogo, in Uganda's Kibale National Park. Like the chimps in Tanzania and Ivory Coast, they are skilled hunters and work together to catch their monkey prey – typically the red colobus (*Procolobus rufomitratu tephrosceles*).

Thomas Struhsaker of Duke University in Durham, North Carolina, and colleagues have been regularly surveying the chimp and red colobus populations in Kibale, along with the populations of another six monkey species. They have now compiled all their census data between 1975 and 2007 to see how the different species have fared

### Ups and downs

All the populations changed significantly, with some growing and others shrinking. The biggest change was seen in the red colobus population, which decreased by about 89 per cent. A previous study suggested a similar decline, but did not test its statistical significance.

Estimating changes in chimpanzee populations is more difficult due to the tendency of chimps to spend time on their own, says Struhsaker, but his team noticed that the number of chimps they have sighted over the years has risen by 53 per cent, which he says suggests that they were prospering at the increasing expense of their prey.

The number of red colobus killed by the chimpanzees in Kibale National Park had increased from an estimated 167 per year in the late 1990s to 322 in 2002. During that time, the chimpanzees killed between 15 and 53 per cent of the red colobus population each year, taking a particularly heavy toll on young animals that had not yet reproduced.

**Bounce back**

Struhsaker examined other factors that might have caused the red colobus to decline, such as disease, competition with other monkey species, changes to their habitat, and predation by crowned eagles. All had a much smaller effect than predation by chimpanzees, suggesting the chimps were mostly to blame.

David Watts of Yale University in New Haven, Connecticut, says the findings are in line with his own observations of the Ngogo monkeys. "The rate at which I encounter red colobus has gone way down," he says.

Watts says the chimps are now hunting less than they did, so young males are not getting as many opportunities to acquire the skill. That means the red colobus may not face as great a threat from them in the near future, and so could yet bounce back.

Journal reference: *American Journal of Primatology*, DOI: 10.1002/ajp.20965

<http://www.newscientist.com/article/dn20469-chimps-hunt-monkey-prey-close-to-local-extinction.html>

### Super-accurate clocks emerge from 'heat haze'

- 18:59 13 May 2011 by **Stephen Battersby**
- Magazine issue 2813.

Clocks that gain or lose no more than a fraction of a second over the lifetime of the universe could be on the way, thanks to a technique for cutting through the "heat haze" that compromises the accuracy of today's instruments.

The most accurate atomic clock we have now is regulated by the electrons of a single aluminium ion as they move between two different orbits with sharply defined energy levels. When an electron goes from the higher energy level to the lower it emits radiation of a precise frequency. That frequency is used to mark out time to an accuracy of better than 1 part in  $10^{17}$ , or 1 second in 3 billion years.

That's pretty good, but it could be better. Infrared photons emanating from the background cause the two energy levels to shift by slightly different amounts, says Marianna Safronova at the University of Delaware. That affects the frequency of the emitted radiation to an unknown extent, adding a small uncertainty to the clock's tick.

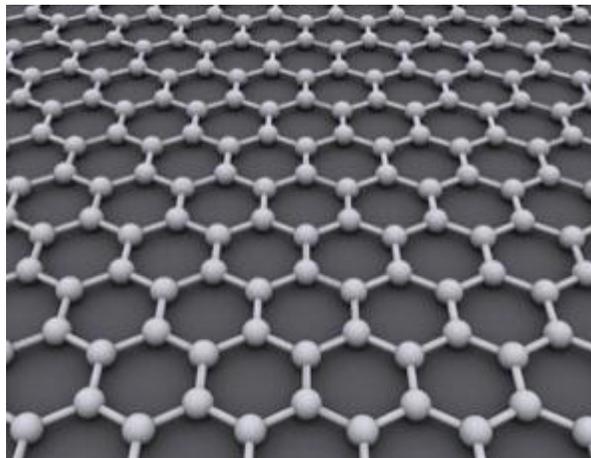
Safronova reported this month at a conference in Baltimore, Maryland, that by combining two different mathematical approaches, she and her colleagues have now managed to calculate how much the energy gap between the two levels changes.

Using this information to correct an atomic clock could in principle increase its precision to around 4 parts in  $10^{19}$ , or about 1 second per 80 billion years. Such a clock could test whether the fundamental constants of nature are changing, Safronova suggests.

<http://www.newscientist.com/article/dn20479-superaccurate-clocks-emerge-from-heat-haze.html>

## Graphene may reveal the grain of space-time

- 13 May 2011 by **Kate McAlpine**
- Magazine issue 2812.



Call that a spin? (Image: AlexanderAIUS/GNU Free Documentation License, Version 1.2 or any later)

COULD the structure of space and time be sketched out inside a cousin of plain old pencil lead? The atomic grid of graphene may mimic a lattice underlying reality, two physicists have claimed, an idea that could explain the curious spin of the electron.

Graphene is an atom-thick layer of carbon in a hexagonal formation. Depending on its position in this grid, an electron can adopt either of two quantum states - a property called pseudospin which is mathematically akin to the intrinsic spin of an electron.

Most physicists do not think it is true spin, but Chris Regan at the University of California, Los Angeles, disagrees. He cites work with carbon nanotubes (rolled up sheets of graphene) in the late 1990s, in which electrons were found to be reluctant to bounce back off these obstacles. Regan and his colleague Matthew Mecklenburg say this can be explained if a tricky change in spin is required to reverse direction. Their quantum model of graphene backs that up. The spin arises from the way electrons hop between atoms in graphene's lattice, says Regan.

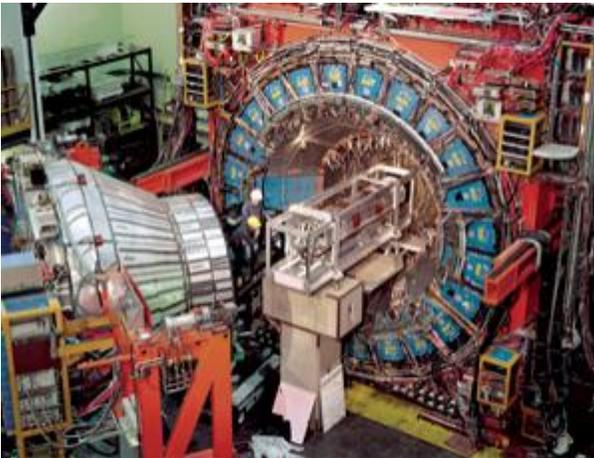
So how about the electron's intrinsic spin? It cannot be a rotation in the ordinary sense, as electrons are point particles with no radius and no innards. Instead, like pseudospin, it might come from a lattice pattern in space-time itself, says Regan. This echoes some attempts to unify quantum mechanics with gravity in which space-time is built out of tiny pieces or fundamental networks (*Physical Review Letters*, vol 106, p 116803).

Sergei Sharapov of the National Academy of Sciences of Ukraine in Kiev says that the work provides an interesting angle on how electrons and other particles acquire spin, but he is doubtful how far the analogy can be pushed. Regan admits that moving from the flatland world of graphene to higher-dimensional space is tricky. "It will be interesting to see if there are other lattices that give emergent spin," he says.

<http://www.newscientist.com/article/mg21028125.400-graphene-may-reveal-the-grain-of-spacetime.html?full=true&print=true>

## Out with a bang: The Tevatron's deathbed revelation

- 11 May 2011 by **Matthew Chalmers**
- Magazine issue 2811.



The Tevatron's CDF detector was upgraded in 2001 (Image: Fermilab)

*With just months before the iconic particle accelerator is dismantled, physicists are racing to confirm a tantalising glimpse of unexpected new particles*

TOM SCHWARZ describes his observations as a Lothario might describe his lovers. "They kind of come and go," he says. Such insouciance is a necessary part of being a particle physicist: Schwarz's workhorse, the Tevatron collider at Fermilab in Batavia, Illinois, delivers information about millions of particle collisions every second. This deluge of data can often take on intriguing and seductive forms, only to be revealed as plain and uninteresting when more numbers have been crunched or the scrutiny is intensified.

Recently, though, Schwarz has been smitten with a result he first spotted as a PhD student in 2006. "It is the longest relationship I have ever had with a measurement," he says. At first glance it seems a mundane affair. He and colleagues at the Tevatron's CDF and DZero experiments have found that the heaviest of the basic building blocks of matter, the top quark, does not emerge evenly in all directions from particle collisions. It shows a distinct preference for one direction over another.

To particle physicists, such an asymmetry is a teasing display. If it doesn't stop soon, it could well put their long-term relationship with their beloved "standard model" under strain, pointing the way to some deeper, more meaningful insight into the workings of nature. Experience says such flings usually don't last - but this one is proving hard to end.

In its illustrious 25-year history, the Tevatron has deepened our understanding of nature's fundamental particles and forces. Its high-water mark came in 1995, when both CDF and DZero spotted the top quark in the ejecta of head-on collisions between protons and antiprotons. This much more massive cousin of up and down quarks, which make up the protons and neutrons in the atomic nucleus, was the sixth and final quark to be discovered. Confirmation of its existence helped seal the deal on the standard model, our most successful theory of the world at its smallest. Of the particles predicted by the standard model, today only the Higgs boson remains at large.



Later this year, though, the Tevatron is due to be closed down and the contents of its 6.3-kilometre ring dismantled. Under such circumstances, it is not unusual for tantalising signs of new particles or effects to appear. Researchers know their kit inside out, and there is an understandable rush to squeeze every last morsel from the data and vie for the discovery that will cement an experiment's legacy. It happened in late 2000 at the CERN laboratory near Geneva, Switzerland, when the Large Electron-Positron Collider was due to make way for the Large Hadron Collider (LHC). And just last month, CDF itself published details of another anomalous effect - a bump that suggests the existence of a new particle not predicted by the standard model (*New Scientist*, 16 April, p 8).

Sober judgement and a healthy scepticism are required, then, to separate what is real from what is wishful thinking. But there is good reason to believe that the asymmetry effect that has captivated Schwarz and others is genuine. For a start, there's the fact that both CDF and DZero, two independent experiments that sit on opposite sides of the collider ring, have seen it. There's also the fact that the effect was first spotted well before the smasher's final collision date was known - and with more data, it is just getting stronger.

When protons and antiprotons collide at the scorching energies produced by the Tevatron, they are split open to expose their quark innards. These quarks can interact to produce other particles, including top quarks and their antiquark partners. The results from the Tevatron show that when such a pair is created, the top quark is between two and three times as likely to be emitted "forwards" - continuing in the same direction as the incoming proton - as "backwards", in the opposite direction along the trajectory of the antiproton. Similarly, the top antiquark prefers the direction of the antiproton.

In 2008, CDF reported this effect with a statistical significance approaching 2 sigma, representing a roughly 1 in 20 chance that the apparently meaningful pattern could have arisen through a random fluctuation. DZero also saw the same effect, albeit with a slightly lower significance. Effects of this size come and go all the time in particle physics. At the end of last year, however, having worked through more data, CDF saw a result with a significance of 3.4 sigma for a select bunch of the most energetic top quark-antitop quark pairs - corresponding to odds of about 1 in 1500 that such a pattern could have emerged by chance alone ([arxiv.org/1101.0034](http://arxiv.org/1101.0034)). Meanwhile, last year DZero saw an effect with a significance approaching 2 sigma in a larger data sample.

All this is highly problematic for the standard model. Quarks interact via the strong nuclear force, and the part of the standard model describing this force, a theory called quantum chromodynamics (QCD), embodies fundamental symmetries that mean quarks and antiquarks are treated equally. According to the simplest QCD calculation of how top quarks are produced, then, no forward-backward asymmetry should arise at all.

In reality, the picture is more complex. When quarks and antiquarks interact through the strong force, they exchange particles known as gluons. Gluons can interact with themselves, or produce other quarks which can themselves beget more gluons, and so on. This leaves anyone using QCD to calculate the outcome of Tevatron collisions with a huge series of interfering quark and gluon configurations to tot up.

The best attempts to do so show that a forward-backward asymmetry is to be expected. A gluon radiated by an incoming quark, for instance, can interfere with a gluon radiated by an outgoing top quark, altering the outgoing top-antitop pair's travel plans. Such activity means that between about 10 and 20 per cent more top quarks will be emitted forwards than backwards. But that is nowhere near enough to explain the measured asymmetry.

### Compelling stuff

"For better or for worse, this effect is different to many others," says Amnon Harel of the University of Rochester, New York, who works on the DZero experiment. Matt Strassler, a theorist at Rutgers University in

Piscataway, New Jersey, agrees. "It's not obvious where there could be a big mistake," he says. "As far as discrepancies from the standard model go, this is the most compelling that I have seen in many years."

So assuming the result is not a cruel taunt of nature, one that will eventually up sticks and disappear, what is going on? The theorists have certainly been busy: since details of the asymmetry were first made public, some 25 papers have appeared road-testing explanations for the effect. Contenders range from particles straddling extra dimensions ([arxiv.org/abs/1008.0742](http://arxiv.org/abs/1008.0742)) to invisible and weird "unparticles" ([arxiv.org/abs/1009.4165](http://arxiv.org/abs/1009.4165)), to the first indications of a 45-dimensional "grand unified theory" ([arxiv.org/abs/0912.0972](http://arxiv.org/abs/0912.0972)).

A more conservative take is that the QCD calculations of the asymmetry have not yet been fully tamed. An unfortunate cocktail of incomplete calculations, statistical fluctuations of the data and some other experimental subtlety could just about conspire to explain the observed discrepancy, says Strassler.

That is the kind of caution advocated by Frank Wilczek of the Massachusetts Institute of Technology, who co-invented QCD in the early 1970s and shared a Nobel prize for his efforts. "I expect, and hope, that there is a mundane explanation for the effect" - if indeed there is an effect, he says. Given the detailed and precise tests that QCD has already passed, Wilczek thinks it unlikely that the theory of the strong force needs major rewriting.

Others, though, say it might be too late for such minimalist explanations. To theorist JoAnne Hewett of Stanford University in California, the fact that the effect crops up specifically with the top quark - the heaviest known elementary particle - and especially at high energies, is suggestive. "It is exactly what you would expect to see if a new heavy particle that decays into top quarks were lurking just beyond the Tevatron's reach," she says.

If there is, it's something unexpected. The vaunted Higgs boson is not thought to produce such an effect, and nor is any of the particles predicted by simple versions of supersymmetry, the theory hotly tipped to tie up some of the loose ends left by the standard model.

Paul Frampton, a theorist at the University of North Carolina in Chapel Hill, thinks he knows what this mystery particle might be. When he heard the news from the Tevatron, he says, he started jumping up and down. By way of explanation, he points to the licence plate of his car, which reads, simply, "AXIGLUON".

"It's one of my long-shot dreams of winning a Nobel prize," he says. He thinks the signal seen by CDF and DZero has all the hallmarks of an exotic particle whose existence he predicted in 1987 together with Sheldon Glashow of Boston University in Massachusetts. Whereas the familiar strong force carried by gluons is symmetric with respect to left and right (a so-called parity symmetry), axigluons would carry a skewed variant of the strong force capable of generating the asymmetry observed at the Tevatron - even without fancy calculations.

If this picture is correct, it would rock the symmetries underpinning the standard model. The strong force would be exposed as just one facet of a primordial superforce that split into two as the universe cooled and became less energetic - just as today's weak nuclear and electromagnetic forces, we now know, were once combined in one "electroweak" force (see diagram).

## Eyes on the LHC

Not everyone is as keen on the idea as Frampton. Glashow, who shared the 1979 Nobel prize in physics for his work on the theory of the electroweak force, is not convinced that the axigluon can explain the Tevatron discrepancy, or even that the discrepancy is real. And Elizabeth Simmons of Michigan State University in East Lansing has concluded that the simplest axigluon models, such as Frampton's, have already been ruled

out. That is because axigluons should increase the rate at which particles made of a bottom quark, the top's slightly lighter sister, and a down antiquark oscillate into their antimatter counterparts - yet no such effect has been observed ([arxiv.org/abs/1007.0260](http://arxiv.org/abs/1007.0260)).

But Frampton reckons it is more credible to dig out a 20-year-old paper than to cook up a model with a new particle that has been customised to fit the data. That said, his original model predicted an asymmetry of the wrong sign, with more tops going backwards than forwards. He has fixed that, but only by postulating the existence of an unseen "fourth generation" of quarks even more massive than the top and bottom ([arxiv.org/abs/0911.2955](http://arxiv.org/abs/0911.2955)).

All this leaves things a little in limbo. "We're currently really living this to-and-fro of theory and experiment," says Strassler. With just months left to run, the Tevatron seems unlikely to settle the issue conclusively, and all eyes are now on the LHC to do the job. After a year of running at reduced performance, the LHC is now flexing its muscles and has already produced thousands of top quarks, the first to be made outside of Illinois.

There is just one problem in measuring a forward-backward asymmetry at the LHC: it does not have a "forwards" or "backwards". It does not smash antiprotons into protons, but protons into protons in a totally symmetric way that leaves no chance of reproducing the Tevatron effect. But the machine has so much juice that it should be able to produce the particles relevant to the anomaly directly. First indications are not good for proponents of the axigluon theory. In March, the LHC's ATLAS experiment ruled out the existence of axigluons with a mass between 0.6 and 2.1 teraelectronvolts, right where Frampton's putative particle should be ([arxiv.org/abs/1103.3864](http://arxiv.org/abs/1103.3864)).

There are other ways to coax out an asymmetry - up and down quarks could turn directly into top quarks, for example, by exchanging a new particle. One candidate, snappily labelled the W' (spoken "W prime"), is an exotic variant of the W bosons that carry the weak nuclear force ([arxiv.org/abs/1104.0083](http://arxiv.org/abs/1104.0083)). Another claims to explain not only the top asymmetry but also CDF's "mass bump", announced last month ([arxiv.org/abs/1104.2030v1](http://arxiv.org/abs/1104.2030v1)).

For Hewett, everything is still to play for. "No matter what piece of physics explains the top quark asymmetry, it has got to show up in this year's LHC run," she says. Working out what model any new particle belongs to, though, could take longer.

At the Tevatron, there are no signs anyone is tiring of the chase. In March, CDF reported [a 2.6-sigma forward-backward asymmetry](#) in an independent set of top-quark data, and DZero is finalising its latest analysis. As the Tevatron tunnel is emptied this autumn, the two experiments will join forces to see how high a significance they can squeeze from their results.

Will this be a dalliance that they will come to regret? [Giovanni Punzi](#) of the National Institute of Nuclear Physics in Pisa, Italy, doesn't think so. One of the leaders of the CDF experiment, he is bullish about the prospect of using the full Tevatron dataset to establish an asymmetry with 5-sigma significance - the 1-in-a-million gold standard for announcing a discovery. Then it really will be love. "I don't think we will go backward," says Punzi. "The question is, how far we will go forward?"

*Matthew Chalmers is a freelance writer based in Bristol, UK*

<http://www.newscientist.com/article/mg21028111.300-out-with-a-bang-the-tevatrons-deathbed-revelation.html>

## Splitting Water for Renewable Energy Simpler Than First Thought?



*Researchers aim to create a cheap, efficient way to split water, powered by sunlight, which would open up production of hydrogen as a clean fuel. (Credit: © Filipebvarela / Fotolia)*

ScienceDaily (May 15, 2011) — An international team, of scientists, led by a team at Monash University has found the key to the hydrogen economy could come from a very simple mineral, commonly seen as a black stain on rocks.

Their findings, developed with the assistance of researchers at UC Davis in the USA and using the facilities at the Australian Synchrotron, was published in the journal *Nature Chemistry* on May 15, 2011.

Professor Leone Spiccia from the School of Chemistry at Monash University said the ultimate goal of researchers in this area is to create a cheap, efficient way to split water, powered by sunlight, which would open up production of hydrogen as a clean fuel, and leading to long-term solutions for our renewable energy crisis.

To achieve this, they have been studying complex catalysts designed to mimic the catalysts plants use to split water with sunlight. But the new study shows that there might be much simpler alternatives to hand.

"The hardest part about turning water into fuel is splitting water into hydrogen and oxygen, but the team at Monash seems to have uncovered the process, developing a water-splitting cell based on a manganese-based catalyst," Professor Spiccia said.

"Birnessite, it turns out, is what does the work. Like other elements in the middle of the Periodic Table, manganese can exist in a number of what chemists call oxidation states. These correspond to the number of oxygen atoms with which a metal atom could be combined," Professor Spiccia said.

"When an electrical voltage is applied to the cell, it splits water into hydrogen and oxygen and when the researchers carefully examined the catalyst as it was working, using advanced spectroscopic methods they found that it had decomposed into a much simpler material called birnessite, well-known to geologists as a black stain on many rocks."

The manganese in the catalyst cycles between two oxidation states. First, the voltage is applied to oxidize from the manganese-II state to manganese-IV state in birnessite. Then in sunlight, birnessite goes back to the manganese-II State.

This cycling process is responsible for the oxidation of water to produce oxygen gas, protons and electrons.

Co-author on the research paper was Dr Rosalie Hocking, Research Fellow in the Australian Centre for Electromaterials Science who explained that what was interesting was the operation of the catalyst, which follows closely nature's biogeochemical cycling of manganese in the oceans.

"This may provide important insights into the evolution of Nature's water splitting catalyst found in all plants which uses manganese centres," Dr Hocking said.

"Scientists have put huge efforts into making very complicated manganese molecules to copy plants, but it turns out that they convert to a very common material found in the Earth, a material sufficiently robust to survive tough use."

The reaction has two steps. First, two molecules of water are oxidized to form one molecule of oxygen gas (O<sub>2</sub>), four positively-charged hydrogen nuclei (protons) and four electrons. Second, the protons and electrons combine to form two molecules of hydrogen gas (H<sub>2</sub>).

The experimental work was conducted using state-of-the art equipment at three major facilities including the Australian Synchrotron, the Australian National Beam-line Facility in Japan and the Monash Centre for Electron Microscopy, and involved collaboration with Professor Bill Casey, a geochemist at UC Davis.

"The research highlights the insight obtainable from the synchrotron based spectroscopic techniques -- without them the important discovery linking common earth materials to water oxidation catalysts would not have been made," Dr Hocking said.

It is hoped the research will ultimately lead to the development of cheaper devices, which produce hydrogen.

The work was primarily funded by the U.S. National Science Foundation and the U.S. Department of Energy Monash University, the Australian Research Council through the Australian Centre of Excellence for Electromaterials Science, and the Australian Synchrotron.

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The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Monash University**.

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#### Journal Reference:

1. Rosalie K. Hocking, Robin Brimblecombe, Lan-Yun Chang, Archana Singh, Mun Hon Cheah, Chris Glover, William H. Casey, Leone Spiccia. **Water-oxidation catalysis by manganese in a geochemical-like cycle**. *Nature Chemistry*, 2011; DOI: [10.1038/nchem.1049](https://doi.org/10.1038/nchem.1049)

<http://www.sciencedaily.com/releases/2011/05/110516102331.htm>

## New Evidence Shows Mobile Animals Could Have Evolved Much Earlier Than Previously Thought



*Microbial mat. Researchers have discovered that billions of years before life evolved in the oceans, thin layers of microbial matter in shallow water produced enough oxygen to support tiny, mobile life forms. (Credit: Courtesy of Murray Gingras)*

ScienceDaily (May 15, 2011) — A University of Alberta-led research team has discovered that billions of years before life evolved in the oceans, thin layers of microbial matter in shallow water produced enough oxygen to support tiny, mobile life forms.

The researchers say worm-like creatures could have lived on the oxygen produced by photosynthetic microbial material, even though oxygen concentrations in the surrounding water were not high enough to support life. The research was conducted in shallow lagoons in Venezuela where the high salt content is comparable to oceans older than 500 million years.

The link between biomats and animals is demonstrated by the trace-fossil record, which are tracks left behind by the movements of the worm-like creatures. The trace-fossil records for these animals date to at least 555 million years ago.

These findings suggest that the appearance of animals was not dependent on an oxygenated ocean. Rather, the earliest animals could have live within photosynthetic biomats and derived life-sustaining oxygen from that source.

The most widely accepted date for the start of life on Earth is 700 to 600 million years ago when oxygen was produced in deep ocean water.



The researchers say their work opens the door to the search for life in early periods of Earth's history when it was believed there was absolutely no oxygen and no chance of finding life.

The research was led by U of A geologist Murray Gingras and geomicrobiologist Kurt Konhauser. The research was published May 15 online in *Nature Geoscience*.

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**Story Source:**

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

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**Journal Reference:**

1. Murray Gingras, James W. Hagadorn, Adolf Seilacher, Stefan V. Lalonde, Ernesto Pecoits, Daniel Petrash, Kurt O. Konhauser. **Possible evolution of mobile animals in association with microbial mats.** *Nature Geoscience*, 2011; DOI: [10.1038/ngeo1142](https://doi.org/10.1038/ngeo1142)

<http://www.sciencedaily.com/releases/2011/05/110516102255.htm>

## Autonomous Robots Made to Explore and Map Buildings



*Henrik Christensen, a professor in Georgia Tech College of Computing and director of the Robotics and Intelligent Machines Center, is part of a team of researchers developing new mapping and exploration capabilities for robots. (Credit: Georgia Tech Photo: Gary Meek)*

ScienceDaily (May 15, 2011) — There isn't a radio-control handset in sight as several small robots roll briskly up the hallways of an office building. Working by themselves and communicating only with one another, the vehicles divide up a variety of exploration tasks -- and within minutes have transmitted a detailed floor map to humans nearby.

This isn't a future-tech scenario. This advanced autonomous capability has been developed by a team from the Georgia Institute of Technology, the University of Pennsylvania and the California Institute of Technology/Jet Propulsion Laboratory (JPL). A paper describing this capability and its present level of performance was presented in April at the SPIE Defense, Security and Sensing Conference in Orlando, Fla.

"When first responders -- whether it's a firefighter in downtown Atlanta or a soldier overseas -- confront an unfamiliar structure, it's very stressful and potentially dangerous because they have limited knowledge of what they're dealing with," said Henrik Christensen, a team member who is a professor in the Georgia Tech College of Computing and director of the Robotics and Intelligent Machines Center there. "If those first responders could send in robots that would quickly search the structure and send back a map, they'd have a much better sense of what to expect and they'd feel more confident."

The ability to map and explore simultaneously represents a milestone in the Micro Autonomous Systems and Technology (MAST) Collaborative Technology Alliance Program, a major research initiative sponsored by the U.S. Army Research Laboratory. The five-year program is led by BAE Systems and includes numerous principal and general members comprised largely of universities.

MAST's ultimate objective is to develop technologies that will enable palm-sized autonomous robots to help humans deal with civilian and military challenges in confined spaces. The program vision is for collaborative teams of tiny devices that could roll, hop, crawl or fly just about anywhere, carrying sensors that detect and send back information critical to human operators.

The wheeled platforms used in this experiment measure about one foot square. But MAST researchers are working toward platforms small enough to be held in the palm of one hand. Fully autonomous and collaborative, these tiny robots could swarm by the scores into hazardous situations.

The MAST program involves four principal research teams: integration, microelectronics, microsystems mechanics, and processing for autonomous operation. Georgia Tech researchers are participating in every area except microelectronics. In addition to the College of Computing, researchers from the Georgia Tech Research Institute (GTRI), the School of Aerospace Engineering and the School of Physics are involved in MAST work.

The experiment -- developed by the Georgia Tech MAST processing team -- combines navigation technology developed by Georgia Tech with vision-based techniques from JPL and network technology from the University of Pennsylvania.

In addition to Christensen, members of the Georgia Tech processing team involved in the demonstration include Professor Frank Dellaert of the College of Computing and graduate students Alex Cunningham, Manohar Paluri and John G. Rogers III. Regents professor Ronald C. Arkin of the College of Computing and Tom Collins of GTRI are also members of the Georgia Tech processing team.

In the experiment, the robots perform their mapping work using two types of sensors -- a video camera and a laser scanner. Supported by onboard computing capability, the camera locates doorways and windows, while the scanner measures walls. In addition, an inertial measurement unit helps stabilize the robot and provides information about its movement.

Data from the sensors are integrated into a local area map that is developed by each robot using a graph-based technique called simultaneous localization and mapping (SLAM). The SLAM approach allows an autonomous vehicle to develop a map of either known or unknown environments, while also monitoring and reporting on its own current location.

SLAM's flexibility is especially valuable in areas where global positioning system (GPS) service is blocked, such as inside buildings and in some combat zones, Christensen said. When GPS is active, human handlers can use it to see where their robots are. But in the absence of global location information, SLAM enables the robots to keep track of their own locations as they move.

"There is no lead robot, yet each unit is capable of recruiting other units to make sure the entire area is explored," Christensen explained. "When the first robot comes to an intersection, it says to a second robot, 'I'm going to go to the left if you go to the right.' "

Christensen expects the robots' abilities to expand beyond mapping soon. One capability under development by a MAST team involves tiny radar units that could see through walls and detect objects -- or humans -- behind them. Infrared sensors could also support the search mission by locating anything giving off heat. In



addition, a MAST team is developing a highly flexible "whisker" to sense the proximity of walls, even in the dark.

The processing team is designing a more complex experiment for the coming year to include small autonomous aerial platforms for locating a particular building, finding likely entry points and then calling in robotic mapping teams. Demonstrating such a capability next year would culminate progress in small-scale autonomy during MAST's first five years, Christensen said.

In addition to the three universities, other MAST team participants are North Carolina A&T State University, the University of California Berkeley, the University of Maryland, the University of Michigan, the University of New Mexico, Harvard University, the Massachusetts Institute of Technology, and two companies: BAE Systems and Daedalus Flight Systems.

Research was sponsored by the Army Research Laboratory under Cooperative Agreement Number W911NF-08-2-0004.

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#### **Story Source:**

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<http://www.sciencedaily.com/releases/2011/05/110516102327.htm>

## Massive Tornado Onslaught Raises Questions About Building Practices, Code Enforcement



*The roof blew off this house during the massive April, 2011, tornadoes in the South -- due in part, researchers say, to inadequate connections between the roof trusses and the sidewalls. (Credit: Photo courtesy of Oregon State University)*

ScienceDaily (May 14, 2011) — There is no practical, economic way to build structures that could stand up to the savagery of EF5 tornadoes like those that ripped through the South in late April, experts say, but damage from lesser storms could be reduced by better building practices and better enforcement of existing codes.

Researchers with a rapid assessment team supported by the National Science Foundation say that much of the damage could be linked to inadequate connections between building members, especially trusses, roof rafters and walls. And even though modern codes are generally adequate, they said, such codes are not always followed or enforced.

The result last month, one day of which has been called the fifth deadliest day of tornadoes in the nation's history, was 305 tornadoes, three of which were the maximum "EF5" category, that killed at least 326 people and may have caused more than \$5 billion in damage.

"We often found inadequate or no connections at critical locations in structures, such as attaching the trusses or rafters to the supporting walls, or sill plate to the foundation," said Rakesh Gupta. He is a professor of wood science and engineering in the College of Forestry at Oregon State University, an expert in wind loading and structural resistance, and was a member of the NSF research team.

"Time and again we've seen that such connections are often inadequate under extreme loading conditions," Gupta said. "For instance, trusses that were just toe-nailed to the walls often failed in the high winds, the roof blew off and that allowed the rest of the building to collapse. And in some cases there were no anchor bolts between the bottom plate and foundation, allowing the whole building to shift off the foundation."

The final report from the assessment team is not yet complete, but early observations pointed not just to building codes, but enforcement of those codes, Gupta said.

"In one town in Alabama, I was told there is no inspection of homes by the city building inspector," he said. "Property taxes are very low, inspection is often inadequate, and sometimes that can result in inadequate construction quality and enforcement."

In many cases with the largest tornadoes, the researchers concluded, no existing codes or even quality construction practices made a difference.

"In an EF5 tornado, we observed that even new buildings built with the latest codes were totally destroyed," Gupta said. "One complex had used hurricane clips on trusses, the code-required nailing of roof and wall sheathing, and anchor bolts every four feet. It was destroyed right down to the concrete slab."

Gupta said that it would be possible to build structures that might resist an EF5 tornado, but not economically feasible.

"We could design a wood-frame house which would resist such forces, but who will pay for it?" he said.

Another part of the issue, researchers said, is that the more routine steps which can be taken to prevent greater storm damage are often easy and fairly inexpensive when a structure is being built, but comparatively expensive and difficult to do in retrofitting existing structures.

"When homes are under construction, the reality is that people are more interested in what they are spending on deluxe kitchen countertops and hardwood floors than some foundation bolt they never see," Gupta said. "The things it takes to improve structures and make them more safe are usually hidden behind the walls."

The team also observed that "safe rooms" designed with special construction features to provide refuge during severe storms may only work if a structure is of adequate size. On small houses or other buildings, the entire structure may be blown away and there is no safe place.

The research team will later compile its findings in a full report. Team members were from OSU, the University of Florida, University of Alabama, South Dakota State University, and some private industry agencies.

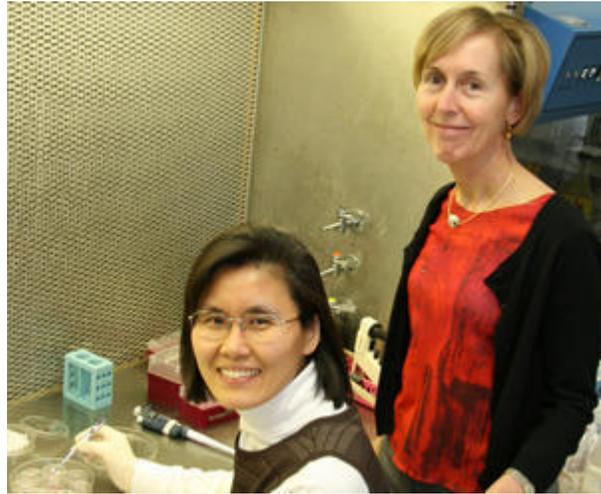
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#### Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Oregon State University**.

<http://www.sciencedaily.com/releases/2011/05/110513091636.htm>

## Disruption of Nerve Cell Supply Chain May Contribute to Parkinson's



Neurobiology researchers Jeong Sook Kim-Han and Karen O'Malley, PhD, found evidence of a specific vulnerability in nerve cells affected by Parkinson's disease. (Credit: Michael C. Purdy)

ScienceDaily (May 13, 2011) — New data offer hints to why Parkinson's disease so selectively harms brain cells that produce the chemical dopamine, say researchers at Washington University School of Medicine in St. Louis.

Dopamine is involved in brain cell communications including the signals that control movement. As Parkinson's kills the dopamine-producing cells, patients begin to develop tremors, problems moving and other symptoms.

The new research shows that a drug known to damage dopamine-producing nerve cells and mimic Parkinson's disease does so by rapidly damaging cellular energy generators called mitochondria. This damage impairs the ability of mitochondria to circulate around the cell as they normally would. As a result, axons, the extended arms nerve cells use to send messages, wither; a few days later, the body or main portion of the cell also dies.

"Much of the research into Parkinson's disease treatments is focused on saving the bodies of these cells, but our results suggest that keeping axons healthy also is essential," says Karen O'Malley, PhD, of Washington University School of Medicine in St. Louis. "When axons die back, dopamine is no longer delivered to the neurons that need it. The cell body also has fewer connections to other cells, and it needs those connections to survive."

The results were published May 11 in *The Journal of Neuroscience*.

Many processes and facilities for cellular maintenance are in the body of the nerve cell, and their products sometimes have to travel a significant distance to reach the axon's end.

"If you think, for example, about one of your peripheral nerves, the cell body is located in the spinal column, but some of the axons extend as far as your big toe," says O'Malley, professor of neurobiology. "That's like the cell body sits in an office in St. Louis and the end of the axon is in Chicago."

O'Malley compares the axon's system for transporting supplies to a railroad. Mitochondria are part of the railroad's cargo. They supply the energy that allows the axon to do its work.

For the study, O'Malley gave cultured mouse nerve cells a toxin called MPP+ that causes Parkinson's-like symptoms.

"MPP+ is a derivative of a synthetic form of heroin developed in California in the early 1980s," O'Malley says. "It came to scientists' attention when teenage abusers of the drug went to the hospital with Parkinson's disease symptoms."

O'Malley found that the toxin stopped the movement of mitochondria in the axon in 30 minutes. The railroad still functioned, shipping other cargo to the end of the axon. But most mitochondria either stopped moving or were headed for the cell body instead of the axon.

O'Malley suspected that this meant the mitochondria were damaged by the changes caused by the toxin and being shipped back to the cell body for repair. Additional tests supported this theory, showing that the mitochondria had lost their ability to maintain their membrane potential, a measure of mitochondrial fitness.

The specificity of this toxin for dopamine-producing cells is reinforced by the finding that other types of nerve cells did not have problems transporting mitochondria after toxin exposure. In a comparison between different nerve cell types, O'Malley found mitochondria in dopamine-producing nerve cells are smaller in size and travel three times slower. But she can't yet definitively say that these distinctions play a role in the problems caused by the toxin.

Scientists screened several compounds to see if they could block the toxin's effects. Only two antioxidants worked, glutathione and N-acetyl cysteine. The latter compound has already been shown to be effective in animal models of Parkinson's disease and is used as a treatment for other disorders in patients.

O'Malley is currently studying whether two genes linked to Parkinson's disease affect mitochondria damaged by the toxin.

"We're going to continue to look for specific differences in these cells that might help scientists develop better treatments," O'Malley says.

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#### Story Source:

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

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## How Do Honeybees Control Their Flight Speed to Avoid Obstacles?



*A honeybee adapting its speed to a complex environment. (Credit: Copyright DGA/F.Vrignaud)*

ScienceDaily (May 13, 2011) — Unlike humans, bees have a dorsal visual field that enables them to avoid obstacles above their heads. Until now, it was not known whether this helped them to control their flight speed. Recent research by biorobotics specialists at the Institut des sciences du mouvement (CNRS / Université de la Méditerranée) confirms that it does. Bees have been shown to adjust their speed according to obstacle proximity, whether such obstacles are in the horizontal or vertical plane. They achieve this through perceived optic flow, especially from overhead.

These findings were recently demonstrated experimentally using previously modeled honeybee flight navigation in three dimensions. They were published on 12 May, 2011 in the journal *PLoS One*.

How can a creature as tiny as a bee, whose brain is proportionally smaller than that of a bird, manage to control its flight and avoid obstacles both in flight and on the ground? We now know that bee sensory-motor performance depends on a nervous system consisting of a hundred thousand to a million neurons. As the insect flies, an image of its environment moves from the front to the back of its visual field, creating an optic flow, which is defined as the angular speed of environmental contrasts passing through its visual field. By definition, these optic flows depend on the relationship between speed and distance from the nearest surfaces.

The researchers already developed a honeybee flight simulation model, called ALIS, last year. ALIS can reproduce insect trajectories primarily using computer-processed visual data (the objects that are present and their movements). These biorobotics specialists then built a flight chamber, with a complex geometric shape, that foraging bees slowly learned to cross to reach a reward of sugar water. This flight chamber had several constrictions where the floor and ceiling, or the side walls, converged. The researchers observed that a bee's speed decreased in proportion to the narrowest point of passage in the flight chamber, whether the constriction was horizontal or vertical. In other words, a bee slows its flight speed as an obstacle gets closer. Its speed

depends on the size of the visual field and, therefore, on the closeness of the obstacle. This behaviour was well predicted by the ALIS model simulation: the trajectories of bees flying in the flight chamber corresponded perfectly to the trajectories predicted by virtual insect modeling.

The scientists point to the existence of controllers that maintain the optical flows, i.e., visually-perceived speed/distance, at constant values. Thus, if the insect is flying in an environment that is becoming increasingly crowded, this "cruise control" forces it to reduce its speed in order to maintain constant speed/distance. An "optic flow regulator" model makes it possible to understand how a bee is able to fly without ever needing to measure its speed or its position from the walls and how it can do without traditional aerospace sensors, like Doppler radars, that give speed in relation to the ground. These ultra-precise sensors have the disadvantage of being bulky, expensive and power consuming. The present research illustrates the dual challenge of biorobotics, both in fundamental and applied research. These findings could have aerospace applications, such as during the crucial phases when aircraft fly in confined environments.

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**Story Source:**

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **CNRS (Délégation Paris Michel-Ange)**.

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**Journal Reference:**

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<http://www.sciencedaily.com/releases/2011/05/110513112525.htm>

## Gut Bacteria Linked to Behavior: That Anxiety May Be in Your Gut, Not in Your Head



*Rendering of bacteria. For the first time, researchers at McMaster University have conclusive evidence that bacteria residing in the gut influence brain chemistry and behavior. (Credit: © Irochka / Fotolia)*

ScienceDaily (May 17, 2011) — For the first time, researchers at McMaster University have conclusive evidence that bacteria residing in the gut influence brain chemistry and behaviour.

The findings are important because several common types of gastrointestinal disease, including irritable bowel syndrome, are frequently associated with anxiety or depression. In addition there has been speculation that some psychiatric disorders, such as late onset autism, may be associated with an abnormal bacterial content in the gut.

"The exciting results provide stimulus for further investigating a microbial component to the causation of behavioural illnesses," said Stephen Collins, professor of medicine and associate dean research, Michael G. DeGroote School of Medicine. Collins and Premysl Bercik, assistant professor of medicine, undertook the research in the Farncombe Family Digestive Health Research Institute.

The research appears in the online edition of the journal *Gastroenterology*.

For each person, the gut is home to about 1,000 trillion bacteria with which we live in harmony. These bacteria perform a number of functions vital to health: They harvest energy from the diet, protect against infections and provide nutrition to cells in the gut. Any disruption can result in life-threatening conditions, such as antibiotic-induced colitis from infection with the "superbug" *Clostridium difficile*.

Working with healthy adult mice, the researchers showed that disrupting the normal bacterial content of the gut with antibiotics produced changes in behaviour; the mice became less cautious or anxious. This change was accompanied by an increase in brain derived neurotrophic factor (BDNF), which has been linked, to depression and anxiety.

When oral antibiotics were discontinued, bacteria in the gut returned to normal. "This was accompanied by restoration of normal behaviour and brain chemistry," Collins said.

To confirm that bacteria can influence behaviour, the researchers colonized germ-free mice with bacteria taken from mice with a different behavioural pattern. They found that when germ-free mice with a genetic background associated with passive behaviour were colonized with bacteria from mice with higher exploratory behaviour, they became more active and daring. Similarly, normally active mice became more passive after receiving bacteria from mice whose genetic background is associated with passive behaviour. While previous research has focused on the role bacteria play in brain development early in life, Collins said this latest research indicates that while many factors determine behaviour, the nature and stability of bacteria in the gut appear to influence behaviour and any disruption, from antibiotics or infection, might produce changes in behaviour. Bercik said that these results lay the foundation for investigating the therapeutic potential of probiotic bacteria and their products in the treatment of behavioural disorders, particularly those associated with gastrointestinal conditions such as irritable bowel syndrome.

The research was funded by grants from the Canadian Institutes of Health Research (CIHR) and the Crohn's and Colitis Foundation of Canada (CCFC).



**story Source:**

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

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<http://www.sciencedaily.com/releases/2011/05/110517110315.htm>

## Deprivation and Neglect Found to Age Children's Chromosomes



*New research finds that the length of time spent in conditions of social deprivation and neglect correlates with lower IQ and behavioral problems. (Credit: iStockphoto/Shawn Lowe)*

ScienceDaily (May 17, 2011) — Studies in institutionalized Romanian children have found that the length of time spent in conditions of social deprivation and neglect correlates with lower IQ and behavioral problems. A new study, led by researchers at Children's Hospital Boston and Tulane University, shows that early adversity even affects children's chromosomes -- prematurely shortening the chromosome tips, known as telomeres, and hastening how quickly their cells "age."

The study, published online this week in *Molecular Psychiatry*, is the first to find an association between adversity and telomere length in children. It is part of the Bucharest Early Intervention Project (BEIP), which is conducting a long-term clinical trial tracking two groups of institutionalized children: those who remained in the institution and those who were removed to high-quality foster care at varying ages.

Laboratory studies, conducted by Stacy Drury and colleagues at Tulane University, examined DNA samples collected from mouth swabs of the Romanian children (62 boys and 47 girls). The studies found that children exposed longer to institutional care before age 5 had significantly shorter relative telomere length (compared to that expected for their age) when they reached age 6-10.

"The telomere is designed to protect the chromosome, so accelerating how early in life telomeres lose length correlates with shortened life span," says Charles Nelson, PhD, director of the Laboratories of Cognitive Neuroscience at Children's and principal investigator of BEIP. "Children institutionalized early in life have shortened telomeres, which may lead to health consequences downstream, including premature aging." The actual biological significance of these findings is unknown, but the researchers note that studies in adults have associated shorter telomere length with cognitive defects and with increased rates of cardiovascular disease and cancer.

The BEIP study contributes to a growing body of research linking early adversity with early shortening of telomeres. In 2004, Elizabeth Blackburn (who received a Nobel prize in 2009 for co-discovering telomeres) and Elisa Epel, both at the University of California at San Francisco, reported that women who took care of children with chronic illnesses had shorter telomeres -- the equivalent of having lost 9 to 17 years of life. Other studies have found shorter telomere length in adults who experienced adversity, abuse or serious illness in childhood.

The BEIP study also found a gender difference. In girls, the amount of time spent in the institution before the baseline assessment (done at an average of 22 months of age) was the strongest predictor of telomere shortening during middle childhood; in boys, the cumulative amount of institutional care at the 54-month assessment was the stronger predictor.

"One question we are currently studying is whether telomere length can recover as a child spends more time in foster care, or whether the shortening we observed reflects a permanent change," says Nelson.

The Romanian orphanages, which mostly house children who were abandoned, not orphaned, are infamous for severe child neglect. They are a legacy of the 1960s, when Romania's Communist dictator Nicolae Ceausescu taxed all families that had fewer than five children. When families began having children they could not afford, Ceausescu built child placement centers. By 1989, when Ceausescu's government fell, more than 170,000 Romanian children were living in state-run institutions.

By the time BEIP was begun in 2000, the Romanian government had begun reuniting children with their birth families, cutting Romania's institutionalized population in half. Spurred by BEIP findings, the government has banned institutionalization for children younger than 2, unless they are profoundly handicapped; they have also started a network of foster care families.

The study was supported by the Center for the Developing Child at Harvard University, the John D. and Catherine T. MacArthur Foundation, the Binder Family Foundation, Tulane University School of Medicine and The Brain and Behavior Research Foundation (formerly NARSAD).

#### Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Children's Hospital Boston**, via EurekAlert!, a service of AAAS.

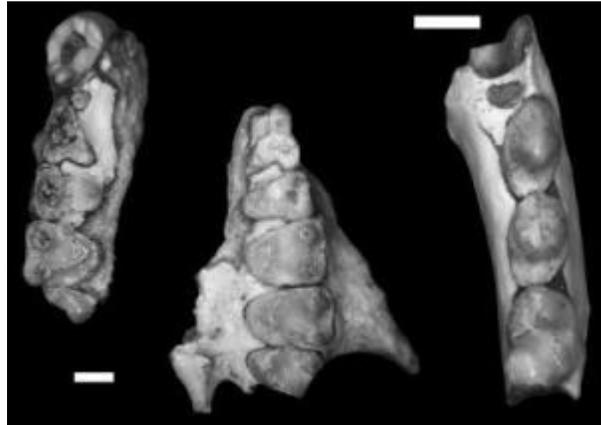
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## Anthropologist Discovers New Fossil Primate Species in West Texas



This is *Mescalerolemur horneri*'s partial upper jaw (in two pieces, at left) and partial lower jaw (at right) (scales = 2 mm). (Credit: University of Texas at Austin)

ScienceDaily (May 17, 2011) — Physical anthropologist Chris Kirk has announced the discovery of a previously unknown species of fossil primate, *Mescalerolemur horneri*, in the Devil's Graveyard badlands of West Texas.

*Mescalerolemur* lived during the Eocene Epoch about 43 million years ago, and would have most closely resembled a small present-day lemur. *Mescalerolemur* is a member of an extinct primate group -- the adapiforms -- that were found throughout the Northern Hemisphere in the Eocene. However, just like *Mahgarita stevensi*, a younger fossil primate found in the same area in 1973, *Mescalerolemur* is more closely related to Eurasian and African adapiforms than those from North America.

"These Texas primates are unlike any other Eocene primate community that has ever been found in terms of the species that are represented," says Kirk, associate professor in the Department of Anthropology at The University of Texas at Austin. "The presence of both *Mescalerolemur* and *Mahgarita*, which are only found in the Big Bend region of Texas, comes after the more common adapiforms from the Eocene of North America had already become extinct. This is significant because it provides further evidence of faunal interchange between North America and East Asia during the Middle Eocene."

By the end of the Eocene, primates and other tropically adapted species had all but disappeared from North America due to climatic cooling, so Kirk is sampling the last burst of diversity in North American primates. With its lower latitudes and more equable climate, West Texas offered warm-adapted species a greater chance of survival after the cooling began.

Kirk says Marie Butcher, a then undergraduate who graduated with degrees in anthropology and biology from The University of Texas at Austin, found the first isolated tooth of *Mescalerolemur* in 2005. Since that time, many more primate fossils have been recovered by Kirk and more than 20 student volunteers at a locality called "Purple Bench." This fossil locality is three to four million years older than the Devil's Graveyard sediments that had previously produced *Mahgarita stevensi*.

"I initially thought that we had found a new, smaller species of *Mahgarita*," Kirk says.

However, as more specimens were prepared at the Texas Memorial Museum's Vertebrate Paleontology Lab, Kirk realized he had discovered not just a new species, but a new genus that was previously unknown to science.

Fossils of *Mescalerolemur* reveal it was a small primate, weighing only about 370 grams. This body weight is similar to that of the living greater dwarf lemur. *Mescalerolemur*'s dental anatomy reveals a close evolutionary relationship with adapiform primates from Eurasia and Africa, including *Darwinius masillae*, a German fossil primate previously claimed to be a human ancestor. However, the discovery of *Mescalerolemur* provides further evidence that adapiform primates like *Darwinius* are more closely related to living lemurs and bush babies than they are to humans.

For example, the right and left halves of *Mescalerolemur*'s lower jaws were two separate bones with a joint along the midline, a common trait for lemurs and bush babies. *Mahgarita stevensi*, the closest fossil relative of *Mescalerolemur*, had a completely fused jaw joint like that of humans.

"Because *Mescalerolemur* and *Mahgarita* are close relatives, fusion of the lower jaws in *Mahgarita* must have occurred independently from that observed in humans and their relatives, the monkeys and apes" Kirk says.

The new genus is named *Mescalerolemur* after the Mescalero Apache, who inhabited the Big Bend region of Texas from about 1700-1880. The species name, *horneri*, honors Norman Horner, an entomologist and professor emeritus at Midwestern State University (MSU) in Wichita Falls, Texas. Horner helped to establish MSU's Dalquest Desert Research Site, where the new primate fossils were found.

#### Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **University of Texas at Austin**, via [EurekAlert!](#), a service of AAAS.

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## Smoke-Related Chemical Discovered in the Atmosphere Could Have Health Implications



*Smoke from the Fourmile Canyon wildfire west of Boulder, Colo. in fall 2010 flows toward the city to the right of the image. A new NOAA study found isocyanic acid in the smoke from that fire -- and in urban Los Angeles air, in cigarette smoke, and in laboratory-simulated wildfires. That acid has been linked with health effects from cataracts to cardiovascular disease. (Credit: Photograph courtesy of Daniel Lack, NOAA/CIRES)*

ScienceDaily (May 17, 2011) — Cigarette smoking, forest fires and woodburning can release a chemical that may be at least partly responsible for human health problems related to smoke exposure, according to a new study by NOAA researchers and their colleagues.

Using a custom mass spectrometer designed by the researchers, the NOAA-led team was able get the first look at levels of the chemical, isocyanic acid, in the atmosphere. Isocyanic acid has been difficult to detect with conventional measurement techniques.

"We found isocyanic acid in a number of places, from air in downtown Los Angeles and air downwind of a Colorado wildfire, to cigarette smoke," said Jim Roberts, lead author of the new paper and a chemist with NOAA's Earth System Research Laboratory in Boulder, Colo. "We also demonstrated that it dissolves readily in water, which means that humans can be exposed directly if it gets into eyes or lungs."

The health effects of such exposure are not fully known. In the body isocyanic acid, described by the chemical formula HNCO, is part of a biochemical pathway linked with cataracts and inflammation that can trigger cardiovascular disease and rheumatoid arthritis. Until now, the acid had not been measured in air outdoors or in tobacco smoke.

The research team made four separate measurements of HNCO: in the air in urban Los Angeles; in the air in Boulder downwind of the fall 2010 Fourmile Canyon wildfire; in laboratory burning experiments at high concentrations; and in cigarette smoke. The team also made the first measurements of the acid's ability to dissolve in water, which determines the chemical's tendency to dissolve into moist tissues in the body.

"There are literally billions of people in the world who burn biomass for cooking and heating," Roberts said. "If these indoor fires release similar levels of isocyanic acid as the fires we studied in the laboratory, families could be exposed to high levels of the chemical."

Roberts and colleagues from NOAA and University of Colorado at Boulder's Cooperative Institute for Research in Environmental Sciences, the North Carolina Agricultural and Technical State University and the University of Montana published their paper in the May 17 edition of the *Proceedings of the National Academy of Sciences*.

The research project started in the Missoula Fire Sciences Laboratory, where scientists burned brush, tree branches and other vegetation, to better understand the air quality effects of wildfires. They used a new, specialized instrument -- a mass spectrometer built by Roberts and several colleagues -- to measure the amounts of a suite of organic acids, which are emitted by burning vegetation. Such acids are involved in chemistry that can degrade air quality.

During simulated wildfires in the Montana laboratory, levels of HNCO approached 600 parts per billion volume (ppbv). The HNCO was a few thousand times less concentrated in both the air in Los Angeles during a time without recent fires, and in the air in Boulder when the Fourmile Canyon fire was burning upwind. At about 1 ppbv, the research team calculated that enough HNCO would dissolve into exposed tissues -- lungs and eyes -- that those tissues could be vulnerable to "carbamylation," part of the chemical process triggering inflammation and cataract development. People could experience higher exposure to HNCO near wildfires or in indoor environments where coal, wood or other biomass is burned for heating or cooking. The health effects of chronic exposure to lower-level amounts isocyanic acid, such as those found in the California and Colorado air are not known.

The extreme sensitivity of the new instrument to low concentrations of HNCO made it impossible to quantify the very high levels of isocyanic acid in cigarette smoke.

"We conclude that tobacco-derived HNCO needs to be measured more extensively and potential exposure to it quantified," the scientists wrote, adding that the acid is not currently listed as a "harmful" or "potentially harmful" constituent in tobacco products or smoke.

In their paper, researchers noted other sources of atmospheric HNCO, including pollution-control equipment that is being introduced in California and Europe to reduce emissions by diesel trucks. The systems are designed to reduce nitrogen oxides, which contribute to air quality problems, but they emit HNCO as a by-product. This new source could increase human exposure to the chemical in urban areas.

Moreover, climate change is expected to bring hotter temperatures and drier conditions to some regions of the world, with accompanying increases in biomass burning, including wildfire. "We may be facing a future of higher amounts of HNCO in the atmosphere," said Roberts. "It is fortunate that now we can measure it."

#### **Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **National Oceanic and Atmospheric Administration**.

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## Striking Ecological Impact on Canada's Arctic Coastline Linked to Global Climate Change



*Dead vegetation killed by the 1999 storm surge is in stark contrast to the vegetation along the edges of waterways that receive regular freshwater (and thus survived the damage). (Credit: Trevor Lantz, University of Victoria)*

ScienceDaily (May 16, 2011) — Scientists from Queen's and Carleton universities head a national multidisciplinary research team that has uncovered startling new evidence of the destructive impact of global climate change on North America's largest Arctic delta.

"One of the most ominous threats of global warming today is from rising sea levels, which can cause marine waters to inundate the land," says the team's co-leader, Queen's graduate student Joshua Thienpont. "The threat is especially acute in polar regions, where shrinking sea ice increases the risk of storm surges."

By studying growth rings from coastal shrubs and lake sediments in the Mackenzie Delta region of the Northwest Territories -- the scene of a widespread and ecologically destructive storm surge in 1999 -- the researchers have discovered that the impact of these salt-water surges is unprecedented in the 1,000-year history of the lake.

"This had been predicted by all the models and now we have empirical evidence," says team co-leader Michael Pisaric, a geography professor at Carleton. The Inuvialuit, who live in the northwest Arctic, identified that a major surge had occurred in 1999, and assisted with field work.

The researchers studied the impact of salt water flooding on alder bushes along the coastline. More than half of the shrubs sampled were dead within a year of the 1999 surge, while an additional 37 per cent died within five years. A decade after the flood, the soils still contained high concentrations of salt. In addition, sediment core profiles from inland lakes revealed dramatic changes in the aquatic life -- with a striking shift from fresh to salt-water species following the storm surge.

"Our findings show this is ecologically unprecedented over the last millennium," says Queen's biology professor and team member John Smol, Canada Research Chair in Environmental Change and winner of the 2004 NSERC Herzberg Gold Medal as Canada's top scientist. "The Arctic is on the front line of climate change. It's a bellwether of things to come: what affects the Arctic eventually will affect us all."

Since nearly all Arctic indigenous communities are coastal, the damage from future surges could also have significant social impacts. The team predicts that sea ice cover, sea levels and the frequency and intensity of storms and marine storm surges will become more variable in the 21st century.

Other members of the team include Trevor Lantz from the University of Victoria, Steven Kokelj from Indian and Northern Affairs Canada, Steven Solomon from the Geological Survey of Canada and Queen's undergraduate student Holly Nesbitt. Their findings are published in the *Proceedings of the National Academy of Sciences*.

Research funding comes from the Natural Sciences and Engineering Research Council of Canada (NSERC), the Polar Continental Shelf Program, the Cumulative Impact Monitoring Program, and Indian and Northern Affairs Canada.

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**Story Source:**



The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Queen's University**.

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## Biophysics of Snakebites: How Do Venomous Snakes Inject Venom Into Victim's Wound?



*Like a drop on a wine glass, a snake venom "tear" runs down the groove of the fang. The surface tension acting on the venom is the dominant physical force underlying envenomation. And venom is a non-Newtonian fluid. It sticks when necessary while waiting for prey, whereas any break in the prey's skin acts as a venom attractant and soaks the venom into the deeper tissues. (Credit: Bruce A. Young, University of Massachusetts, Lowell)*

ScienceDaily (May 16, 2011) — Most snakes do not inject venom into their victims bodies using hollow fangs, contrary to common misconceptions. The fact is that most snakes and many other venomous reptiles have no hollow fangs. Physicists have now uncovered the tricks these animals use to force their venom under the skin of their victims.

For years Professor Leo von Hemmen, a biophysicist at the TU Muenchen, and Professor Bruce Young, a biologist at the University of Massachusetts Lowell, have been researching the sense of hearing in snakes. While discussing the toxicity of their snakes, it dawned on them that only few snakes inject their venom into their victims' bodies using hollow fangs. Yet, even though the vast majority of venomous reptiles lack hollow fangs, they are effective predators.

Only around one seventh of all venomous snakes, like the rattlesnake, rely on the trick with the hollow fang. The vast majority has developed another system. A typical representative of this class is the mangrove pit viper, *Boiga dendrophila*. Using its twin fangs, it punches holes into the skin of its victims. The venom flows into the wound between the teeth and the tissue. But there is an even easier way: many fangs simply have a groove the venom flows along to enter the wound.

The researchers asked themselves how this simple method could be so successful from an evolutionary perspective, considering that bird feathers, for example, should be able to easily brush away any venom flowing along an open groove. To get to the bottom of this mystery, they investigated the surface tension and viscosity of various snake venoms. The measurements showed that snake venom is amazingly viscous. The surface tension is high, about the same as that of water. As a result, the surface energy pulls the drops into the fang grooves, where they then spread out. In the course of evolution, snakes have adapted to their respective preferred prey using a combination of optimal fang groove geometry and venom viscosity. Snakes that prey on birds developed deeper grooves to keep the viscous venom from being brushed away by bird feathers.



The researchers also found an answer to the question of how snakes manage to ferry the venom well under the skin of their prey. After all, only there can it unfold its deadly effect. Here too, snakes developed a trick in the course of evolution: When a snake attacks, the fang grooves and the surrounding tissue form a canal. Just like blotting paper, the tissue sucks the venom through this canal. And snake venom has a very special property to facilitate this effect: Just like ketchup, which becomes significantly more fluid upon shaking, the sheer forces that arise from the suction cause the venom to become less viscous, allowing it to flow through the canal quickly as a result of the surface tension.

Scientists refer to substances with these characteristics as non-Newtonian fluids. These have a very practical consequence for snakes: As long as there is no prey in sight, the venom in the groove remains viscous and sticky. When the snake strikes, the venomous "tears" flow along the groove -- just like wine along a glass -- and into the wound, where the venom takes its lethal effect.

The German Federal Ministry for Education and Research funded portions of this work via the Bernstein Center for Computational Neuroscience Munich. Professor van Hemmen is a member of the Excellence Cluster Cognition for Technical Systems (CoTeSys).

**Story Source:**

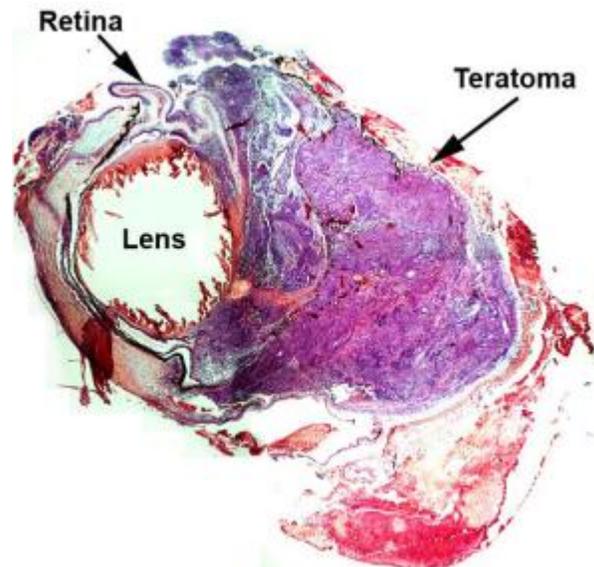
The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Technische Universitaet Muenchen**, via EurekAlert!, a service of AAAS.

**Journal Reference:**

1. Bruce Young, Florian Herzog, Paul Friedel, Sebastian Rammensee, Andreas Bausch, J. van Hemmen. **Tears of Venom: Hydrodynamics of Reptilian Envenomation**. *Physical Review Letters*, 2011; 106 (19) DOI: [10.1103/PhysRevLett.106.198103](https://doi.org/10.1103/PhysRevLett.106.198103)

<http://www.sciencedaily.com/releases/2011/05/110516121728.htm>

## Sections of Retinas Regenerated and Visual Function Increased With Stem Cells from Skin



*Histological staining of a teratoma containing Rho<sup>-/-</sup> eye at 21 days post-injection of a heterogeneous population of SSEA1-containing D33 differentiated cells. (Credit: Tucker et al., DOI: 10.1371/journal.pone.0018992)*

ScienceDaily (May 16, 2011) — Scientists from Schepens Eye Research Institute are the first to regenerate large areas of damaged retinas and improve visual function using IPS cells (induced pluripotent stem cells) derived from skin. The results of their study, which is published in *PLoS ONE* this month, hold great promise for future treatments and cures for diseases such as age-related macular degeneration, retinitis pigmentosa, diabetic retinopathy and other retinal diseases that affect millions worldwide.

"We are very excited about these results," says Dr. Budd A. Tucker, the study's first author. "While other researchers have been successful in converting skin cells into induced pluripotent stem cells (iPSCs) and subsequently into retinal neurons, we believe that this is the first time that this degree of retinal reconstruction and restoration of visual function has been detected," he adds. Tucker, who is currently an Assistant Professor of Ophthalmology at the University of Iowa, Carver College of Medicine, completed the study at Schepens Eye Research Institute in collaboration with Dr. Michael J. Young, the principle investigator of the study, who heads the Institute's regenerative medicine center.

Today, diseases such as retinitis pigmentosa (RP) and age-related macular degeneration (AMD) are the leading causes of incurable blindness in the western world. In these diseases, retinal cells, also known as photoreceptors, begin to die and with them the eye's ability to capture light and transmit this information to the brain. Once destroyed, retinal cells, like other cells of the central nervous system have limited capacity for endogenous regeneration.

"Stem cell regeneration of this precious tissue is our best hope for treating and someday curing these disorders," says Young, who has been at the forefront of vision stem cell research for more than a decade. While Tucker, Young and other scientists were beginning to tap the potential of embryonic and adult stem cells early in the decade, the discovery that skin cells could be transformed into "pluripotent" cells, nearly identical to embryonic cells, stirred excitement in the vision research community. Since 2006 when researchers in Japan first used a set of four "transcription factors" to signal skin cells to become iPSCs, vision scientists have been exploring ways to use this new technology. Like embryonic stem cells, iPSCs have the ability to become any other cell in the body, but are not fraught with the ethical, emotional and political issues associated with the use of tissue from human embryos.

Tucker and Young harvested skin cells from the tails of red fluorescent mice. They used red mice, because the red tissue would be easy to track when transplanted in the eyes of non-fluorescent diseased mice.

By forcing these cells to express the four Yamanaka transcription factors (named for their discoverer) the group generated red fluorescent iPSCs, and, with additional chemical coaxing, precursors of retinal cells. Precursor cells are immature photoreceptors that only mature in their natural habitat -- the eye. Within 33 days the cells were ready to be transplanted and were introduced into the eyes of a mouse model of retina degenerative disease. Due to a genetic mutation, the retinas of these recipient mice quickly degenerate, the photoreceptor cells die and at the time of transplant electrical activity, as detected by ERG (electroretinography), is absent. Within four to six weeks, the researchers observed that the transplanted "red" cells had taken up residence in the appropriate retinal area (photoreceptor layer) of the eye and had begun to integrate and assemble into healthily looking retinal tissue. The team then retested the mice with ERG and found a significant increase in electrical activity in the newly reconstructed retinal tissue. In fact, the amount of electrical activity was approximately half of what would be expected in a normal retina. They also conducted a dark adaption test to see if connections were being made between the new photoreceptor cells and the rest of the retina. In brief, the group found that by stimulating the newly integrated photoreceptor cells with light they could detect a signal in the downstream neurons, which was absent in the other untreated eye. Based on the results of their study, Tucker and Young believe that harvesting skin cells for use in retinal regeneration is and will continue to be a promising resource for the future. The two scientists say their next step will be to take this technology into large animal models of retinal degenerative disease and eventually toward human clinical trials. Other scientists involved in the *PLoS ONE* study include In-Hyun Park, Sara D. Qi, Henry J. Klassen, Caihui Jiang, Jing Yao, Stephen Redenti, and George Q. Daley.

**Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Schepens Eye Research Institute**.

**Journal Reference:**

1. Budd A. Tucker, In-Hyun Park, Sara D. Qi, Henry J. Klassen, Caihui Jiang, Jing Yao, Stephen Redenti, George Q. Daley, Michael J. Young. **Transplantation of Adult Mouse iPS Cell-Derived Photoreceptor Precursors Restores Retinal Structure and Function in Degenerative Mice.** *PLoS ONE*, 2011; 6 (4): e18992 DOI: [10.1371/journal.pone.0018992](https://doi.org/10.1371/journal.pone.0018992)

<http://www.sciencedaily.com/releases/2011/05/110516131536.htm>

## Stem Cell Study Could Pave the Way to Treatment for Age-Related Muscle Wasting

ScienceDaily (May 17, 2011) — A team led by developmental biologist Professor Christophe Marcelle has nailed the mechanism that causes stem cells in the embryo to differentiate into specialized cells that form the skeletal muscles of animals' bodies. The scientists published their results in the British journal *Nature* on May 16.

Scientists world wide are racing to pin down the complex molecular processes that cause stem cells in the early embryo to differentiate into specialist cells such as muscle or nerve cells. The field has the potential to revolutionize medicine by delivering therapies to regenerate tissue damaged by disease or injury.

Differentiation happens soon after fertilization, when embryonic cells are dividing rapidly and migrating as the animal's body takes shape.

Professor Marcelle's team analyzed the differentiation of muscle stem cells in chicken embryos. The mechanisms in birds are identical to those in mammals, so the chick is a good model species for understanding the mechanisms in humans, says team member and the paper's lead author, Anne Rios.

The scientists investigated the effect of a known signaling pathway called NOTCH on muscle differentiation. They found that differentiation of stem cells to muscle was initiated when NOTCH signaling proteins touched some of the cells. These proteins were carried by passing cells migrating from a different tissue—the neural crest—the progenitor tissue of sensory nerve cells. Muscle formation in the target stem cells occurred only when the NOTCH pathway was triggered briefly by the migrating neural crest cells.

"This kiss-and-run activation of a pathway is a completely novel mechanism of stem cell specification which explains why only some stem cells adopt a muscle cell fate," Ms Rios said.

Professor Marcelle said that more than 2 per cent of the population was affected by muscle dysfunction.

"Muscle frailty in aging and disease imposes a huge economic burden, so it is critical to explore novel avenues of research that could lead to new treatments," he said.

He said the team would now focus on unraveling the mechanisms of embryonic muscle cell differentiation at the molecular level as a necessary step to regulating regeneration of the muscles in human patients.

### story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by [Monash University](#).

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### Journal Reference:

1. Anne C. Rios, Olivier Serralbo, David Salgado, Christophe Marcelle. **Neural crest regulates myogenesis through the transient activation of NOTCH.** *Nature*, 2011; DOI: [10.1038/nature09970](https://doi.org/10.1038/nature09970)

<http://www.sciencedaily.com/releases/2011/05/110517105806.htm>

## Vaccine Protects from Deadly Hendra Virus



*CSIRO's high bio-containment facility at the Australian Animal Health Laboratory was necessary to safely assess the vaccine's effectiveness. (Credit: CSIRO)*

ScienceDaily (May 16, 2011) — CSIRO scientists have shown that a new experimental vaccine helps to protect horses against the deadly Hendra virus.

Dr Deborah Middleton from CSIRO's Australian Animal Health Laboratory (AAHL) announced the successful progress to develop the vaccine at the Australian Veterinary Association conference in Adelaide on May 17, 2011.

"Our trials so far have shown that the vaccine prevents the infection of horses with Hendra virus," Dr Middleton said.

Stopping the disease in horses could also help protect people from the disease.

"A horse vaccine is crucial to breaking the cycle of Hendra virus transmission from flying foxes to horses and then to people, as it prevents both the horse developing the disease and passing it on," Dr Middleton said.

Hendra virus first appeared in 1994 and five of the 14 known outbreaks have spread to people. The virus has killed four of the seven people infected.

Depending on further development, field trials and registration the vaccine may be available as early as 2012.

Dr Barry Smyth, President of the Australian Veterinary Association, said that the news on the vaccine will be welcomed by both vets and horse owners.

"It's important that veterinarians and horse owners continue with precautions that reduce the risk of spreading the virus and that they report suspected cases immediately," Dr Smyth said.

Recent work on evaluating the vaccine was jointly funded by the CSIRO, the Australian Government Department of Agriculture, Fisheries and Forestry and the Queensland Government Department of Employment, Economic Development and Innovation.

The development of the vaccine goes back more than ten years to shortly after CSIRO scientists first isolated the virus following the first outbreak of the disease in Hendra, Queensland.

Development and source of the vaccine is the result of a close collaboration with Dr Christopher Broder of the Uniformed Services University of the Health Sciences (the US federal health sciences university) supported by the US National Institutes of Health, but the high bio-containment facility at AAHL was essential for evaluating its beneficial effects.

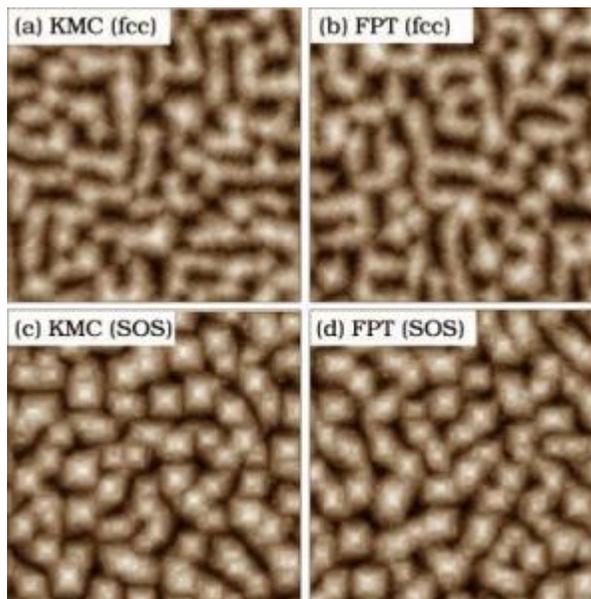
"Our bio-security facility at AAHL is the only laboratory in the world where this work could have been done. It has been slow, painstaking and high-risk work and the credit is due to many people who've worked on this since 1994," Dr Middleton said.

### Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **CSIRO Australia**.

<http://www.sciencedaily.com/releases/2011/05/110517091939.htm>

## Physicist Accelerates Simulations of Thin Film Growth



*The University of Toledo's Jacques Amar, Ph.D., leveraged Ohio Supercomputer Center systems to test an accelerated approach to simulating thin film growth. Using two different models (fcc and SOS), Amar compared the regular Kinetic Monte Carlo method (figures A and C) with a first-passage-time approach coupled with the KMC method (figures B and D). (Credit: Amar/University of Toledo)*

ScienceDaily (May 17, 2011) — A Toledo, Ohio, physicist has implemented a new mathematical approach that accelerates some complex computer calculations used to simulate the formation of micro-thin materials. Jacques Amar, Ph.D., professor of physics at the University of Toledo (UT), studies the modeling and growth of materials at the atomic level. He uses Ohio Supercomputer Center (OSC) resources and Kinetic Monte Carlo (KMC) methods to simulate the molecular beam epitaxy (MBE) process, where metals are heated until they transition into a gaseous state and then reform as thin films by condensing on a wafer in single-crystal thick layers.

"One of the main advantages of MBE is the ability to control the deposition of thin films and atomic structures on the atomic scale in order to create nanostructures," explained Amar.

Thin films are used in industry to create a variety of products, such as semiconductors, optical coatings, pharmaceuticals and solar cells.

"Ohio's status as a worldwide manufacturing leader has led OSC to focus on the field of advanced materials as one of our areas of primary support," noted Ashok Krishnamurthy, co-interim co-executive director of the center. "As a result, numerous respected physicists, chemists and engineers, such as Dr. Amar, have accessed OSC computation and storage resources to advance their vital materials science research."

Recently, Amar leveraged the center's powerful supercomputers to implement a "first-passage time approach" to speed up KMC simulations of the creation of materials just a few atoms thick.

"The KMC method has been successfully used to carry out simulations of a wide variety of dynamical processes over experimentally relevant time and length scales," Amar noted. "However, in some cases, much of the simulation time can be 'wasted' on rapid, repetitive, low-barrier events."

While a variety of approaches to dealing with the inefficiencies have been suggested, Amar settled on using a first-passage-time (FPT) approach to improve KMC processing speeds. FPT, sometimes also called first-hitting-time, is a statistical model that sets a certain threshold for a process and then estimates certain factors, such as the probability that the process reaches that threshold within a certain amount time or the mean time until which the threshold is reached.

"In this approach, one avoids simulating the numerous diffusive hops of atoms, and instead replaces them with the first-passage time to make a transition from one location to another," Amar said.

In particular, Amar and colleagues from the UT department of Physics and Astronomy targeted two atomic-level events for testing the FPT approach: edge-diffusion and corner rounding. Edge-diffusion involves the "hopping" movement of surface atoms -- called adatoms -- along the edges of islands, which are formed as the material is growing. Corner rounding involves the hopping of adatoms around island corners, leading to smoother islands.

Amar compared the KMC-FPT and regular KMC simulation approaches using several different models of thin film growth: Cu/Cu(100), fcc(100) and solid-on-solid (SOS). Additionally, he employed two different methods for calculating the FPT for these events: the mean FPT (MFPT), as well as the full FPT distribution. "Both methods provided "very good agreement" between the FPT-KMC approach and regular KMC simulations," Amar concluded. "In addition, we find that our FPT approach can lead to a significant speed-up, compared to regular KMC simulations."

Amar's FPT-KMC approach accelerated simulations by a factor of approximately 63 to 100 times faster than the corresponding KMC simulations for the fcc(100) model. The SOS model was improved by a factor of 36 to 76 times faster. For the Cu/Cu(100) tests, speed-up factors of 31 to 42 and 22 to 28 times faster were achieved, respectively, for simulations using the full FPT distribution and MFPT calculations.

Amar's research was supported through multiple grants from the National Science Foundation, as well as by a grant of computer time from OSC.

**Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Ohio Supercomputer Center**.

**Journal Reference:**

1. Giridhar Nandipati, Yunsic Shim, Jacques G. Amar. **First-passage time approach to kinetic Monte Carlo simulations of metal (100) growth.** *Physical Review B*, 2010; 81 (23) DOI: [10.1103/PhysRevB.81.235415](https://doi.org/10.1103/PhysRevB.81.235415)

<http://www.sciencedaily.com/releases/2011/05/110517141451.htm>

## There's No Magic Number for Saving Endangered Species



*The mountain gorilla numbers substantially less than 5,000 individuals. (Credit: Stephen G. Willis (Durham University))*

ScienceDaily (May 16, 2011) — A new study offers hope for species such as the Siberian Tiger that might be considered 'too rare to save', so long as conservation efforts can target key threats.

The findings have important implications for conserving some of the world's most charismatic endangered species, which often exist in populations far smaller than the many thousands of individuals that earlier studies had argued were necessary for viability.

Charismatic examples include the mountain gorilla, which likely now number 1,000 or less, the approximately 450 remaining Amur or Siberian tigers, the 180-500 remaining mature Philippine eagles, and the 70 wild Puerto Rican parrots.

The findings of a UK-US research team, the largest critical review of the use of minimum viable population (MVP)<sup>(\*)</sup> numbers in conservation, dispute the use of a universal MVP as a yardstick for conservation policies. According to the researchers there is no single population size that can be used as a catch-all guideline to save endangered species.

Co-author of the report, Dr. Philip Stephens, School of Biological and Biomedical Sciences, Durham University, said: "Populations usually show rapid declines as a result of human activities such as hunting and habitat conversion. The results of the study are encouraging and show that if we can remove the negative effects of human activities, even relatively small populations could be viable in the long term."

Dr. Greg Hayward, the U.S. Forest Service's (USFS) regional ecologist for Alaska said: "This is good news for biologists working to save species like the tiger. There's a lot of work to do to arrest the effects of poaching, prey loss and habitat destruction. However, if that work is successful, the tiger might yet be able to recover, despite the relatively small size of most tiger populations."

The study, published in the journal, *Trends in Ecology and Evolution*, shows that population sizes required for long-term viability vary, both within and among species, and depend on the specific circumstances in which the population is found. Estimates of viable population sizes were typically reduced to hundreds rather than thousands of individuals for populations that were relatively stable.

Previous studies have suggested that the allocation of conservation effort should be related to the number of individuals in threatened populations. For species which would require intense effort to raise numbers to 5,000 individuals, it might be too late to act and better to concentrate limited conservation resources elsewhere, the previous studies have suggested.

Researchers on the US-UK team argue that conservationists should not give up on saving an endangered species if its population is below an MVP figure, and they advise policy-makers to be cautious about setting guidelines for 'safe' population sizes.

The researchers also warn against potential complacency and stress the need to look in detail at the specific threats that a species faces. They argue that no population size is likely to be safe from extinction when conservation activities fail to reduce the impact of the factors causing the population to decline.

Dr. Curt Flather, a research ecologist with the USFS Rocky Mountain Research Station in Colorado said: "The enormous variability in estimates shows that many populations also need to be highly abundant to be

viable. The extinction of the passenger pigeon, which numbered 3 to 5 billion individuals in North America during the 1800s, is a reminder that population size alone is no guarantee against extinction."

Steve Beissinger, a Professor at the University of California, Berkeley, emphasized the need to go beyond established guidelines in determining whether a species is endangered. "Viability depends on the idiosyncrasies of the factors causing a species to decline, and there is no single population size that guarantees safety for all species. There's more that matters than just size."

(\*1) MVP refers to the size of a population that is thought to have a specified probability of persistence for a given period, for example, a population size that has a 99 per cent probability of avoiding extinction for the next forty generations.

#### Story Source:

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

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#### Journal Reference:

1. Curtis H. Flather, Gregory D. Hayward, Steven R. Beissinger, Philip A. Stephens. **Minimum viable populations: is there a 'magic number' for conservation practitioners?** *Trends in Ecology & Evolution*, 2011; DOI: [10.1016/j.tree.2011.03.001](https://doi.org/10.1016/j.tree.2011.03.001)

<http://www.sciencedaily.com/releases/2011/05/110516201101.htm>

## Hormone Improves Long-Term Recovery from Stroke, Study Suggests

ScienceDaily (May 17, 2011) — Scientists at the Sahlgrenska Academy have discovered an explanation of how stroke patients can achieve better recovery. A hormone that is associated with the growth hormone system has proved to benefit recovery during the later phases of rehabilitation after a stroke.

Insulin-like growth factor I, IGF-I, is a hormone that is found in the blood and contributes to, among other things, growth and bone mass. The levels of this hormone are higher in people who exercise regularly and those with good health. Scientists at the Sahlgrenska Academy have shown for the first time that high levels of this hormone are associated with better long-term recovery after a stroke. The study has been presented in an article in the *Journal of Clinical Endocrinology and Metabolism*.

"This study is interesting for two reasons. The first is that we show that a hormone is associated with improved long-term recovery, and thus there is still the prospect of improvement -- even after three months after the stroke. The second is that levels of this hormone are known to be elevated in those who exercise often," says Associate Professor David Åberg at the Sahlgrenska Academy, who has led the study in collaboration with Professor Jørgen Isgaard.

"It is, however, important to add that the levels of IGF-I are controlled also by other factors such as other growth hormones, heredity and nutrition," emphasises David Åberg.

The study is based on 407 patients who are participating in the SAHLISIS study at the Sahlgrenska Academy, in which people aged 18-70 years who are affected by stroke are followed up for two years after the event. SAHLISIS is an acronym for "The Sahlgrenska Academy Study on Ischemic Stroke."

Scientists have measured the levels of IGF-I in these 407 patients and seen that increased levels are associated with better recovery, when the degree of recovery is determined between 3 and 24 months after the stroke. Previous research (Bondanelli et al) has also shown a positive effect of high IGF-I levels in the early phase after a stroke, while the scientists at the Sahlgrenska Academy have now demonstrated that the positive effects on recovery remain long after the stroke event.

"Our results may explain why patients who exercise more actively, with physiotherapy and physical exercise, demonstrate better recovery after a stroke. Unfortunately, we do not know how much our patients exercised after the stroke. This means that we need to carry out further studies in which we measure both the amount of physical activity and the levels of IGF-I, in order to understand the exact relationships better," David Åberg points out.

These results pave the way for further studies on whether drug treatments that raise IGF-I levels can improve long-term recovery after stroke. David Åberg believes that two avenues are open: either to treat with IGF-I, or to treat with the better known growth hormone (GH). This can stimulate the body's own production of IGF-I.

"Of course, these possibilities must be tested in carefully constructed clinical trials, so that we discover any undesired effects that must be considered. This is particularly true during the acute phase of a stroke, while treatment during the recovery phase is probably easier and has greater benefit," says David Åberg.

### Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **University of Gothenburg**, via [EurekAlert!](#), a service of AAAS.

### Journal Reference:

1. D. Åberg, K. Jood, C. Blomstrand, C. Jern, M. Nilsson, J. Isgaard, N. D. Åberg. **Serum IGF-I Levels Correlate to Improvement of Functional Outcome after Ischemic Stroke.** *Journal of Clinical Endocrinology & Metabolism*, 2011; DOI: [10.1210/jc.2010-2802](#)

<http://www.sciencedaily.com/releases/2011/05/110516162153.htm>

## Reality of 'Supersolid' in Helium-4 Challenged

ScienceDaily (May 17, 2011) — The long-held, but unproven idea that helium-4 enters into an exotic phase of matter dubbed a "supersolid" when cooled to extremely low temperatures has been challenged in a new paper published recently in *Science*.

Los Alamos National Laboratory researchers Alexander Balatsky and Matthias Graf joined Cornell University physicist J.C. Séamus Davis and others in describing an alternative explanation for behavior of helium-4 that led scientist to believe for nearly 40 years that the substance could hold properties of a liquid and solid at the same time when cooled to near Absolute Zero.

Helium-4 is the same gas used to fill carnival balloons. When cooled to temperatures below minus 452 degrees below zero Fahrenheit, helium-4 becomes a liquid -- and an extraordinary liquid at that. At very low temperatures, helium-4 can become a "superfluid," a liquid without viscosity that can flow unhampered by friction.

When placed under pressure at these low temperatures, helium-4 atoms arrange in an orderly lattice, or solid, which physicists nearly 40 years ago believed could behave in a similarly frictionless manner as a supersolid - - a unique theoretical state of matter in which a bulk lattice of material could move as a single frictionless object.

Physicists came to the idea that helium-4 becomes a supersolid after oscillating liquid helium-4 back and forth in a special apparatus that measured the rotational speed. When the researchers measured these motions under conditions that would induce a solid form of helium-4, they noticed that the oscillation speed increased slightly, as if some part of the mass had come loose and was uninhibited by interaction with the rest of material. This effect was interpreted as evidence of supersolidity, a phase in which some of the mass of a solid does not move with the rest of solid lattice, but rather flows freely through the lattice.

Los Alamos researchers Balatsky and Graf posited that the effect could be described by an entirely different explanation. They believed the change in oscillation speed could have arisen as the result of a gradual "freezing out" of imperfections within the helium-4 lattice. To illustrate on a very basic level, Balatsky uses a rotating egg.

A fresh egg is a mixture of yolk and albumen within a shell. When spun, the interaction of the liquid within the eggshell results in a relatively slow rotation. If the egg is frozen, however, the imperfections within the shell freeze out, and the egg spins much faster -- like the increase in oscillation speed observed in the early torsional oscillation experiments.

To test this simplified analogy, Balatsky, Davis and colleagues devised an experiment using a torsional oscillator that was 10,000 times more sensitive than the ones used in previous experiments. The researchers looked at results of varying temperature at a constant oscillation speed versus results of varying oscillation speeds at constant temperature. They compared the microscopic excitations within solid helium-4 under both conditions and found that the plotted curves were nearly identical.

Perhaps more significantly, the researchers didn't see a sudden, clearly demarked change in the relaxation of microscopic defects at some "critical temperature" during their experiments. Lack of such a sharp demarcation provides evidence against a change in phase of helium-4 to a supersolid.

Instead, it suggests that the earlier observed behavior was the result of everyday physics rather than some exotic behavior.

"While this experiment does not definitively rule out the possibility of the formation of a supersolid in helium-4, the fact that we have provided a reasonable alternative explanation for the observed behavior in earlier experiments weakens the argument that what was being seen was a phase change to a supersolid," Balatsky said.

In addition to Los Alamos researchers Balatsky and Graf, and Cornell physicist Davis, co-authors of the paper include: Ethan Pratt, formerly of Cornell, but now at the National Institute of Standards and Technology; Ben Hunt and graduate student Vikram Gadagkar at the Massachusetts Institute of Technology; and Minoru Yamashita at Kyoto University.

### Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by [DOE/Los Alamos National Laboratory](#).



**Journal Reference:**

1. E. J. Pratt, B. Hunt, V. Gadagkar, M. Yamashita, M. J. Graf, A. V. Balatsky, and J. C. Davis.  
**Interplay of Rotational, Relaxational, and Shear Dynamics in Solid 4He.** *Science*, 13 May 2011: Vol. 332 no. 6031 pp. 821-824 DOI: [10.1126/science.1203080](https://doi.org/10.1126/science.1203080)

<http://www.sciencedaily.com/releases/2011/05/110512150733.htm>

## T'ai Chi Helps Prevent Falls and Improve Mental Health in the Elderly, Review Finds

ScienceDaily (May 16, 2011) — T'ai chi has particular health benefits for older people, including helping to prevent falls and improving mental wellbeing, reveals a review published ahead of print in the *British Journal of Sports Medicine*.

But the Chinese martial art widely practised for its health benefits does not help improve the symptoms of cancer or rheumatoid arthritis and the evidence is contradictory for many other health conditions and symptoms.

The effectiveness of t'ai chi for a variety of medical conditions and symptoms has been assessed in several studies and reviews, but their findings have been contradictory, so researchers from Korea Institute of Oriental Medicine in South Korea and the University of Exeter in the UK decided to compare the conclusions of these reviews to gain a better understanding of the benefits of t'ai chi.

Thirty five relevant reviews assessing t'ai chi were identified from English, Chinese and Korean databases. They looked at the effectiveness of the technique in a variety of disease areas, including cancer, Parkinson's disease, musculoskeletal pain, osteoarthritis, rheumatoid arthritis, cardiovascular disease, high blood pressure, osteoporosis and type 2 diabetes. Some reviews also assessed the benefits of t'ai chi for psychological health, balance and fall prevention, muscle strength and flexibility and improving aerobic capacity.

For several conditions, the findings of the reviews were contradictory. However, there was relatively clear evidence that t'ai chi is effective for fall prevention and improving psychological health and was associated with general health benefits for older people. On the other hand, t'ai chi seemed to be ineffective for the symptomatic treatment of cancer and rheumatoid arthritis.

The authors conclude: "Our overview showed that t'ai chi, which combines deep breathing and relaxation with slow and gentle movements, may exert exercise-based general benefits for fall prevention and improvement of balance in older people as well as some meditative effects for improving psychological health. We recommend t'ai chi for older people for its various physical and psychological benefits. However, t'ai chi may not effectively treat inflammatory diseases. "

### Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **BMJ-British Medical Journal**, via [EurekAlert!](#), a service of AAAS.

### Journal Reference:

1. Myeong Soo Lee, Edzard Ernst. **Systematic reviews of t'ai chi: an overview**. *British Journal of Sports Medicine*, 2011; DOI: [10.1136/bjism.2010.080622](https://doi.org/10.1136/bjism.2010.080622)

<http://www.sciencedaily.com/releases/2011/05/110516201053.htm>

## Which Technologies Get Better Faster?



*Solar panel installation. Researchers found that the greater a technology's complexity, the more slowly it changes and improves over time. (Credit: © Elenathewise / Fotolia)*

ScienceDaily (May 17, 2011) — Some forms of technology -- think, for example, of computer chips -- are on a fast track to constant improvements, while others evolve much more slowly. Now, a new study by researchers at MIT and other institutions shows that it may be possible to predict which technologies are likeliest to advance rapidly, and therefore may be worth more investment in research and resources.

In a nutshell, the researchers found that the greater a technology's complexity, the more slowly it changes and improves over time. They devised a way of mathematically modeling complexity, breaking a system down into its individual components and then mapping all the interconnections between these components.

"It gives you a way to think about how the structure of the technology affects the rate of improvement," says Jessica Trancik, assistant professor of engineering systems at MIT. Trancik wrote the paper with James McNerney, a graduate student at Boston University (BU); Santa Fe Institute Professor Doyne Farmer; and BU physics professor Sid Redner. It appears online this week in the *Proceedings of the National Academy of Sciences*.

The team was inspired by the complexity of energy-related technologies ranging from tiny transistors to huge coal-fired powerplants. They have tracked how these technologies improve over time, either through reduced cost or better performance, and, in this paper, develop a model to compare that progress to the complexity of the design and the degree of connectivity among its different components.

The authors say the approach they devised for comparing technologies could, for example, help policymakers mitigate climate change: By predicting which low-carbon technologies are likeliest to improve rapidly, their strategy could help identify the most effective areas to concentrate research funding. The analysis makes it possible to pick technologies "not just so they will work well today, but ones that will be subject to rapid development in the future," Trancik says.

Besides the importance of overall design complexity in slowing the rate of improvement, the researchers also found that certain patterns of interconnection can create bottlenecks, causing the pace of improvements to come in fits and starts rather than at a steady rate.

"In this paper, we develop a theory that shows why we see the rates of improvement that we see," Trancik says. Now that they have developed the theory, she and her colleagues are moving on to do empirical analysis of many different technologies to gauge how effective the model is in practice. "We're doing a lot of work on analyzing large data sets" on different products and processes, she says.

For now, she suggests, the method is most useful for comparing two different technologies "whose components are similar, but whose design complexity is different." For example, the analysis could be used to compare different approaches to next-generation solar photovoltaic cells, she says. The method can also be



applied to processes, such as improving the design of supply chains or infrastructure systems. "It can be applied at many different scales," she says.

Koen Frenken, professor of economics of innovation and technological change at Eindhoven University of Technology in the Netherlands, says this paper "provides a long-awaited theory" for the well-known phenomenon of learning curves. "It has remained a puzzle why the rates at which humans learn differ so markedly among technologies. This paper provides an explanation by looking at the complexity of technology, using a clever way to model design complexity."

Frenken adds, "The paper opens up new avenues for research. For example, one can verify their theory experimentally by having human subjects solve problems with different degrees of complexity." In addition, he says, "The implications for firms and policymakers [are] that R&D should not only be spent on invention of new technologies, but also on simplifying existing technologies so that humans will learn faster how to improve these technologies."

Ultimately, the kind of analysis developed in this paper could become part of the design process -- allowing engineers to "design for rapid innovation," Trancik says, by using these principles to determine "how you set up the architecture of your system."

#### Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Massachusetts Institute of Technology**. The original article was written by David L. Chandler.

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#### Journal Reference:

1. J. McNerney, J. D. Farmer, S. Redner, J. E. Trancik. **Role of design complexity in technology improvement**. *Proceedings of the National Academy of Sciences*, 2011; DOI: [10.1073/pnas.1017298108](https://doi.org/10.1073/pnas.1017298108)

<http://www.sciencedaily.com/releases/2011/05/110517111536.htm>

## New Cell That Attacks Dengue Virus Identified

ScienceDaily (May 16, 2011) — Mast cells, which can help the body respond to bacteria and pathogens, also apparently sound the alarm around viruses delivered by a mosquito bite, according to researchers at Duke-NUS Graduate Medical School in Singapore.

"It appears the mast cells are activated and call immune system cells to the skin where they clear infection, which limits the spread of infection in the host," said lead researcher Ashley St. John, a Research Fellow with Duke-NUS in the Program in Emerging Infectious Diseases, and the Duke Department of Pathology in Durham, N.C. The research is published in the *Proceedings of the National Academy of Sciences*.

Studying dengue virus in mice, the research team found that mast cells can sense and recognize viruses, and in turn release signaling chemicals to create an immune response.

The scientists chose to study dengue virus, which is common in Singapore, because mosquitos inject the virus through the skin, and skin is rich in mast cells.

They found that mice lacking mast cells had more of the virus in their lymph nodes and increased infection after measured injection with a small dose of dengue virus, compared to mice with normal levels of mast cells. The mast cells produce chemokines, which in turn help to bring some special killer cells into the infected skin to fight and contain the virus.

"It was an important discovery for the field to learn that mast cells could be activated by pathogens like bacteria or parasites," St. John said. "We were excited to learn that mast cells also respond to and promote the clearance of a viral infection."

"The finding is important because to date there are no vaccines or effective therapies for dengue fever," said senior author Soman Abraham, Ph.D., Professor of Pathology and mast-cell expert, also in the Program In Emerging Infectious Diseases.

St. John said that the finding opens new paths to explore. Because mast cells are involved in airway reactions, as during an asthma attack, this new finding might also help scientists study viral infection in the lungs, airways and sinuses.

She noted that other mosquito-borne viruses could also be studied in terms of mast-cell response, like the West Nile virus.

"Now that we know mast cells can recognize viruses, we can better understand how that infection process begins," Abraham said. "Knowing the important role of mast cells in viral infections could help find ways to prevent these infections, perhaps in the form of vaccines." Because mast cells can be deliberately activated and also shut down with small molecules, different approaches can be studied, he said.

Other authors include Abhay P. S. Rathore and Subhash G. Vasudevan of the Duke-NUS Program in Emerging Infectious Diseases, and Han Yap and Mah-Lee Ng of the Department of Microbiology at the National University of Singapore. Dean D. Metcalfe is with the National Institutes of Health in Bethesda, Maryland.

The work was supported by start-up funds from Duke-NUS Graduate Medical School, with additional funding by U.S. National Institutes of Health.

### Story Source:

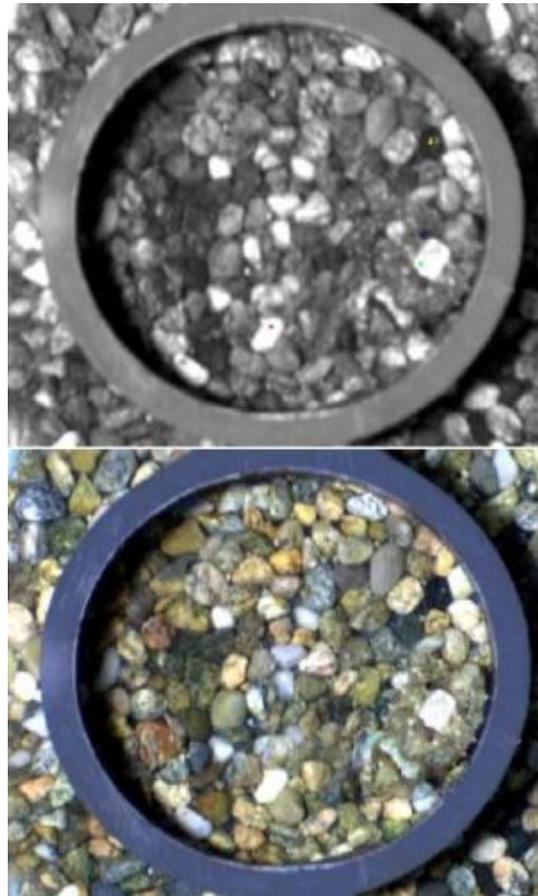
The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by [Duke University Medical Center](#), via [EurekAlert!](#), a service of AAAS.

### Journal Reference:

1. Ashley L. St. John, Abhay P. S. Rathore, Han Yap, Mah-Lee Ng, Dean D. Metcalfe, Subhash G. Vasudevan, Soman N. Abraham. **Immune surveillance by mast cells during dengue infection promotes natural killer (NK) and NKT-cell recruitment and viral clearance.** *Proceedings of the National Academy of Sciences*, 2011; DOI: [10.1073/pnas.1105079108](https://doi.org/10.1073/pnas.1105079108)

<http://www.sciencedaily.com/releases/2011/05/110516161940.htm>

## New Imaging Technology 'Sees' Camouflaged Marine Animals in the Eyes of Their Predators



*Top: Camouflaged cuttlefish. ROI greyscale 2 white 2 black. Bottom: This image shows a calibrated well-camouflaged cuttlefish. (Credit: J.K. Wickiser, West Point)*

ScienceDaily (May 17, 2011) — How could a colorblind animal know how to change its skin color to blend into its surroundings? And what will the animal's predator "see," looking at its prey before and after it hides? These provocative questions are addressed in article published by a collaborative team from the Marine Biological Laboratory (MBL) in Woods Hole, Mass., and the U.S. Military Academy in West Point, N.Y. The article, "Hyperspectral imaging of cuttlefish camouflage indicates good color match in the eyes of fish predators," appears in *Proceedings of the National Academy of Sciences* (PNAS).

"What makes camouflage effective? The answer is that it's an opinion, and that opinion completely depends on who is being asked. Our work presented in this paper takes the field a step closer to quantifying camouflage effectiveness," says J. Kenneth Wickiser, Asst. Prof. in the Department of Chemistry and Life Science at the U.S. Military Academy in West Point.

Understanding the principles of camouflage is not only important in biology, but also provides insights into architecture, advertisement, and defense applications.

For this study, the team studied camouflage in the marine animals known as coleoid cephalopods (octopus, squid, and cuttlefish). Camouflage is the primary defense in these animals and their rapidly adaptable body patterning system is among the most sophisticated in the animal kingdom. The expression of camouflage body patterns in cuttlefish is a visually driven behavior. Previous studies have shown that certain background variables -- such as brightness, contrast, edge and size of objects, etc. -- are essential for eliciting camouflaged body patterns. However, cephalopod eyes lack color perception, thus the vexing question of how they achieve effective camouflage while being colorblind still remains.

Moreover, camouflage studies suffer from the inability to assess the effectiveness of camouflage in the visual space of predators; in short, it is difficult to determine whether a predator actually visually picks out the prey from the background environment. Knowledge of the visual capabilities of many predators is surprisingly lacking. Thus, the team asked, how does a colorblind animal change its color to blend into its surroundings, how do predators actually "see" their prey?

"To tackle this incredibly difficult problem, we put together a team with Chuan-Chin Chiao as a vision expert, Roger Hanlon and his scientists at the MBL as world leaders in cuttlefish and camouflage biology, and combined it with our expertise in hyperspectral imagery analysis at West Point," says Wickiser.

The team exploited a new imaging technology (HyperSpectral Imaging, HSI) to more accurately measure color match between animal and background, and to enable them to model camouflage in the eyes of predators. HSI employs a camera that captures not just 3 narrow windows (Red, Green, Blue -- RGB) like human eyes or typical digital cameras do rather it captures the entire spectrum using 540 windows. In essence, HSI offers the opportunity to "see" things that humans, and many predators, cannot because of the limitations on our eyes. Because of the wealth of information HSI images provide, the scientists could extract a small amount of that data and compile an image from the perspective of a predator.

Importantly, modeling color vision of potential di- and tri-chromatic (RG or RGB capable) fish predators of cuttlefish corroborated the spectral match analysis and revealed that much of the contrast information (which allows a predator to "pick out" a cuttlefish from the background environment) resides in the brightness (luminance) rather than in the color (chromatic) aspect of the reflected light. What this means is that cuttlefish camouflage strategies take away a tool from predators in their ability to pick out their prey from the background and instead leave them with only brightness as a method for prey identification.

These findings (i) indicate the strong potential of HSI technology to evaluate camouflage body patterns simultaneously in the spatial and spectral domains, (ii) provide supporting evidence that cuttlefish can produce color-coordinated camouflage on natural substrates despite lacking color vision, and that (iii) the color aspect of cuttlefish camouflage is highly effective against fish predators. This is the first time that color matching in camouflaged animals has been visualized more realistically through the eyes of their potential predators.

"So much is unknown about how predators actually see their prey. Using hyperspectral imagery tools is a huge advance in getting us the information we need to model predator vision," says Wickiser. "We hope our work takes us one step closer to understanding how a colorblind animal adopts near-perfect camouflage in a variety of backgrounds."

The color-changing abilities of cephalopods have been appreciated since Aristotle's time. Although this topic has received much attention in the past, no quantitative assessment has been made to examine the color match between animal and background. Applying hyperspectral imaging system and modeling the predator's visual system adds a new dimension to quantifying animal camouflage in the eyes of the beholders. The team's findings provide strong support that cuttlefish are capable of hiding in plain sight of their visual predators. Furthermore, this approach may prove to be transformational in the way that color is quantified in sensory studies of camouflage and signaling in the natural world.

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Marine Biological Laboratory**, via EurekAlert!, a service of AAAS.

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#### Journal Reference:

1. Chuan-Chin Chiao, J. Kenneth Wickiser, Justine J. Allen, Brock Genter, Roger T. Hanlon. **Hyperspectral imaging of cuttlefish camouflage indicates good color match in the eyes of fish predators.** *Proceedings of the National Academy of Sciences*, 2011; DOI: [10.1073/pnas.1019090108](https://doi.org/10.1073/pnas.1019090108)

<http://www.sciencedaily.com/releases/2011/05/110516181334.htm>

## Happiness Has a Dark Side

ScienceDaily (May 17, 2011) — It seems like everyone wants to be happier and the pursuit of happiness is one of the foundations of American life. But even happiness can have a dark side, according to the authors of a new review article published in *Perspectives on Psychological Science*, a journal of the Association for Psychological Science. They say that happiness shouldn't be thought of as a universally good thing, and outline four ways in which this is the case. Indeed, not all types and degrees of happiness are equally good, and even pursuing happiness can make people feel worse.

People who want to feel happier can choose from a multitude of books that tell them how to do it. But setting a goal of happiness can backfire, says June Gruber of Yale University, who co-wrote the article with Iris Mauss of the University of Denver and Maya Tamir of the Hebrew University of Jerusalem. It's one of the many downsides of happiness -- people who strive for happiness may end up worse off than when they started.

The tools often suggested for making yourself happy aren't necessarily bad -- like taking time every day to think about things you're happy about or grateful for, or setting up situations that are likely to make you happy. "But when you're doing it with the motivation or expectation that these things ought to make you happy, that can lead to disappointment and decreased happiness," Gruber says. For example, one study by Mauss and colleagues found that people who read a newspaper article extolling the value of happiness felt worse after watching a happy film than people who read a newspaper article that didn't mention happiness -- presumably because they were disappointed they didn't feel happier. When people don't end up as happy as they'd expected, their feeling of failure can make them feel even worse.

Too much happiness can also be a problem. One study followed children from the 1920s to old age and found that those who died younger were rated as highly cheerful by their teachers. Researchers have found that people who are feeling extreme amounts of happiness may not think as creatively and also tend to take more risks. For example, people who have mania, such as in bipolar disorder, have an excess degree of positive emotions that can lead them to take risks, like substance abuse, driving too fast, or spending their life savings. But even for people who don't have a psychiatric disorder, "too high of a degree of happiness can be bad," Gruber says.

Another problem is feeling happiness inappropriately; obviously, it's not healthy to feel happy when you see someone crying over the loss of a loved one or when you hear a friend was injured in a car crash. Yet research by Gruber and her colleagues has found this inappropriate happiness also occurs in people with mania.

Happiness also can mean being short on negative emotions -- which have their place in life as well. Fear can keep you from taking unnecessary risks; guilt can help remind you to behave well toward others.

Indeed, psychological scientists have discovered what appears to really increase happiness. "The strongest predictor of happiness is not money, or external recognition through success or fame," Gruber says. "It's having meaningful social relationships." That means the best way to increase your happiness is to stop worrying about being happy and instead divert your energy to nurturing the social bonds you have with other people. "If there's one thing you're going to focus on, focus on that. Let all the rest come as it will."

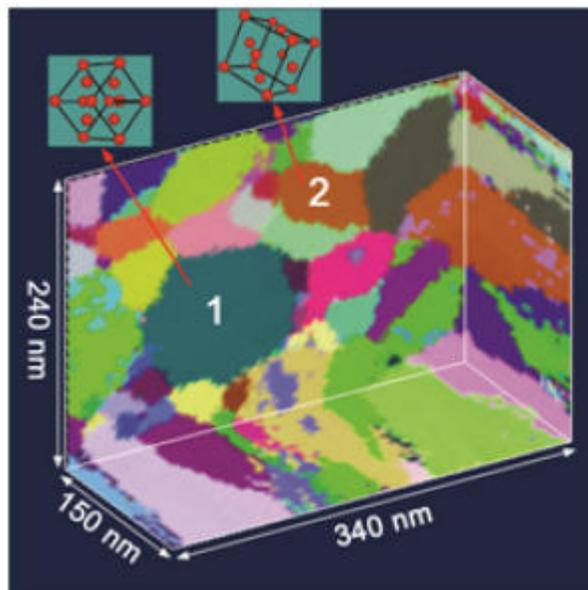
The article is entitled "A Dark Side of Happiness? How, When, and Why Happiness Is Not Always Good."

### Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by [Association for Psychological Science](#), via [EurekAlert!](#), a service of AAAS.

<http://www.sciencedaily.com/releases/2011/05/110516162219.htm>

## Looking Inside Nanomaterials in 3-D



*Three-Dimensional Orientation Mapping in the Transmission Electron. This image shows the arrangement of crystals in a 150nm thick nanometal aluminium film. The crystals have identical lattice structure (arrangement of atoms) but they are orientated in different ways in the 3-D sample as illustrated by the labels 1 and 2. The colours represent the orientations of the crystals and each crystal is defined by volumes of the same colour. The individual crystals of various sizes (from a few nm to about 100 nm) and shapes (from elongated to spherical) are clearly seen and mapped with a resolution of 1 nanometer. (Credit: Image courtesy of Risø National Laboratory for Sustainable Energy)*

ScienceDaily (May 17, 2011) — Scientists from Denmark, China and USA have developed a new method for revealing 3-D images of the structure inside a material.

Most solid materials are composed of millions of small crystals, packed together to form a fully dense solid. The orientations, shapes, sizes and relative arrangement of these crystals are important in determining many material properties.

Traditionally, it has only been possible to see the crystal structure of a material by looking at a cut surface, giving just 2-D information. In recent years, x-ray methods have been developed that can be used to look inside a material and obtain a 3-D map of the crystal structure. However, these methods have a resolution limit of around 100nm (one nanometer is 100,000 times smaller than the width of a human hair).

In contrast, the newly developed technique now published in the journal *Science*, allows 3-D mapping of the crystal structure inside a material down to nanometer resolution, and can be carried out using a transmission electron microscope, an instrument found in many research laboratories.

Samples must be thinner than a few hundred nanometers. However, this limitation is not a problem for investigations of crystal structures inside nanomaterials, where the average crystal size is less than 100 nanometers, and such materials are investigated all over the world in a search for materials with new and better properties than the materials we use today.

For example, nanomaterials have an extremely high strength and an excellent wear resistance and applications therefore span from microelectronics to gears for large windmills. The ability to collect a 3-D picture of the crystal structure in these materials is an important step in being able to understand the origins of their special properties.

An important advantage of such 3-D methods is that they allow the changes taking place inside a material to be observed directly. For example, the mapping may be repeated before and after a heat treatment revealing how the structure changes during heating.

This new technique has a resolution 100 times better than existing non-destructive 3-D techniques and opens up new opportunities for more precise analysis of the structural parameters in nanomaterials.



**Story Source:**

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Riso National Laboratory for Sustainable Energy**.

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**Journal Reference:**

1. H. H. Liu, S. Schmidt, H. F. Poulsen, A. Godfrey, Z. Q. Liu, J. A. Sharon, X. Huang. **Three-Dimensional Orientation Mapping in the Transmission Electron Microscope**. *Science*, 2011; 332 (6031): 833 DOI: [10.1126/science.1202202](https://doi.org/10.1126/science.1202202)

<http://www.sciencedaily.com/releases/2011/05/110516080306.htm>

## Digital Imaging Software to Create a 'Google Earth' View of the Bladder



*The UW scope looks and feels like a piece of angel-hair pasta. In this illustration, the green ball represents the bladder. The UW scope follows a spiraling path, shown with arrows, to image the whole interior. The UW software checks that the scope's path has covered the entire surface of the bladder. (Credit: University of Washington)*

ScienceDaily (May 17, 2011) — Bladder cancer is the fourth-most-common cancer in men and one of the most expensive cancers to treat from diagnosis to death. After initial diagnosis and surgery, patients must return to the urologist at least yearly for a costly, time-consuming and uncomfortable bladder scan. Tumors recur in more than half of patients.

Researchers at the University of Washington are proposing a more automated approach that could be cheaper, more comfortable and more convenient for both doctors and patients. Their system would use the UW's ultrathin laser endoscope, which is like a thin piece of cooked spaghetti, in combination with software that stitches together images from the scope's path to create a full, 3-D panorama of the bladder interior.

The semi-automated scan could be done by a nurse or technician. Resulting images could be reviewed by a urologist at a later time, potentially in another city or country.

"This is trying to bring endoscopy to a more digital, modern age," said co-author Eric Seibel, a UW research associate professor of mechanical engineering. "In the current model a very highly trained person has to do all the manual controls. There's no electronic record, no longitudinal studies, no remote diagnosis and you can't send records anywhere."

The research is being presented in Washington, D.C., at the annual meeting of the American Urological Association.

Currently, urologists conduct bladder exams using an endoscope that's manipulated around the bladder during the roughly 5 minute scan. Because a specialist is required, some patients have to travel long distances for appointments.

Unlike ultrasounds, X-rays and CT scans, endoscopies are only performed by medical doctors. Often no records exist beyond the doctor's notes.

The UW software checks that no part of the organ was missed, so a nurse or technician could administer the procedure -- especially using a small scope that doesn't require anesthesia.

"There's a potential with this technology to semi-automate or fully automate the examination," said Dr.

Michael Porter, a UW assistant professor of urology. "It's a few years down the road, at least, but the potential is there."



The current user interface projects the reconstructed organ onto a spherical ball or onto a flat map. The resulting mosaic matches the images to a single pixel of accuracy. Ultimately, the digital display would incorporate all the original frames, so a doctor could zoom in on an area of interest and observe from all angles at the highest resolution.

"Essentially, I want to give urologists a Google Earth view of the bladder," said co-author Timothy Soper, a UW research scientist in mechanical engineering. "As you move the mouse over the 3-D surface it would show the individual frame showing exactly where that image came from. So you could have the forest and the trees."

Reviewing the resulting panoramic image would likely require less of the urologist's time than performing a manual inspection.

At the meeting, Porter will present the software and the user interface, as well as preliminary results of 3-D panoramas from a commercially available endoscope inserted into a painted glass bulb, a stained pig bladder and a normal human bladder.

The UW software could be used with any endoscope, though the team sees particular benefit in combining it with its flexible endoscope. The UW scope is just 1.5 mm wide, about half the size of its smallest competitor (most bladder scopes are as thick as a pencil, while the UW's is like a strand of angel hair pasta with a tip the size of a grain of rice). It captures finer-grained images than existing flexible endoscopes. The tiny size is possible because of a novel design that swings a single optical fiber back and forth to scan a color image pixel by pixel.

The tip of the UW device will contain a steering mechanism that directs the movement of the scope during the internal exam.

Another advantage of using the UW scope in urology is that it can detect newly approved diagnostic cancer-cell markers that are best seen using low-power lasers, which are already used in the UW device.

Until recently a Japanese company held exclusive rights to develop medical applications for the UW scope. That license expired last month, and UW researchers are now exploring their tool's use for urology. They are waiting for U.S. Food and Drug Administration safety clearance to test the scope for human bladder scans and pursuing funding options. The next step will ask urologists to compare their experience of performing a diagnosis from a live video scan of a human bladder with the 3-D digital recreation.

The research was funded by a grant from the Wallace H. Coulter Foundation in the UW's Department of Bioengineering, and by the UW's Center for Commercialization.

#### **Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of Washington**. The original article was written by Hannah Hickey.

<http://www.sciencedaily.com/releases/2011/05/110516162143.htm>

## Child-Size Mannequin: Hands-on Training Spares Real Patients



*The Ped.IT team at Rice University modified a mannequin that allows medical students to learn what healthy and diseased livers, spleens and lymph nodes should feel like without having to practice on patients.*

*Clockwise from left, Kshitij Manchanda, Michelle Thorson, adviser Amy Middleman of Baylor College of Medicine and Texas Children's Hospital, Minsuk Kwak, Zachary Henderson and adviser Jennifer Arnold, also of Baylor and Texas Children's. (Credit: Jeff Fitlow/Rice University)*

ScienceDaily (May 17, 2011) — Rice University bioengineering students have modified a child-size training mannequin to give medical students hands-on pediatric experience so that real patients can be spared further stress and pain.

The students created Ped.IT, short for Pediatric Evaluation Device Intended for Training, as their senior design project at the request of doctors at Texas Children's Hospital (TCH) who have long recognized the need for students to get hands-on experience in pediatrics without having to subject young patients to additional probing and exams.

"I've been trying since 2003 to develop a mannequin, but I didn't have the bioengineering skills," said Amy Middleman, a pediatrician at TCH and associate professor at Baylor College of Medicine (BCM), which funded the project. "For a long time I've wanted to be able to teach medical students physical exam skills without having to use patients who are not feeling well and whose parents really aren't comfortable with medical students coming in to examine them."

Having tried and failed to work with medical device manufacturers, Middleman found her way to Rice's Oshman Engineering Design Kitchen (OEDK) and its director, Maria Oden, a professor in the practice of engineering education.

Oden pitched the idea to student teams at the start of the fall semester. The four students who stepped up -- Kshitij Manchanda, Zachary Henderson, Minsuk Kwak and Michelle Thorson -- succeeded in modifying a stock medical training mannequin to TCH's specs, with help from their Rice adviser, Renata Ramos, a lecturer in bioengineering.

Ped.IT (which students have dubbed the "MiddleMannequin" in honor of their mentor) began as a hard-shell mannequin donated by a manufacturer, Laerdal. The team replaced the neck and midriff areas of the plastic with simulated skin and added the simulated liver and spleen, that TCH requested. The students went beyond the call of duty by adding simulated lymph nodes, and they left room for more organs to be added by future OEDK teams.

"There are a lot of conditions our mentors at Texas Children's would like to see in a future version of the mannequin, including an enlarged thyroid and tonsils," Henderson said. "They would also like joints that could be popped out of place and put back in."

Computer-controlled actuators in the 4-foot-long mannequin allow medical students to change the organs from normal to enlarged states.

To create the effect, team members spent time at TCH feeling the livers and spleens of patients willing to help. Rice and Texas Children's are in close proximity in Houston's Texas Medical Center.

"We were completely confused about how a liver actually felt," Manchanda said. "Is it as hard as a rock? As soft as a pillow? I didn't know what the middle ground was. So when I felt them, I thought, 'Oh, this feels like Tempur-Pedic.' You could squeeze and it will come back to its shape."

Tempur-Pedic, best known as material for mattresses, was the right stuff for simulating organs. Another material, DermalSol, was used to simulate skin. "I feel like we've set a good groundwork for materials and the way to make a mannequin that is useful for the physical exam," Thorson said.

"We don't have anything like this in pediatrics," said Jennifer Arnold, medical director of the TCH Pediatric Simulation Center and a BCM assistant professor of pediatrics. "In fact, there's nothing quite like this in the adult world, either. I think there are huge possibilities for commercialization."

Arnold is already talking with manufacturers. "Laerdal is interested," she said. "Now we get to take this back to them and say, 'Hey, do you think you would be interested in helping us mass-produce this, so that every medical school -- even, potentially, every nursing school -- could use this to train their students?'"

"This is very sophisticated in what it does right now for physical diagnosis, so I'm very excited. I think there's a need."

"We have been just thrilled," Middleman said. "I've been dreaming about this for years, and it's the students who have really brought this to fruition. I could not be happier. I'm so excited that we've started on the way to developing this."

A video demonstration of Ped.IT is available at <http://www.youtube.com/watch?v=HtgVfBo6bus>

**Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Rice University**.

<http://www.sciencedaily.com/releases/2011/05/110516162151.htm>

## Childhood Physical Abuse Linked to Chronic Fatigue Syndrome, Study Suggests

ScienceDaily (May 17, 2011) — Childhood physical abuse is associated with significantly elevated rates of functional somatic syndromes such as chronic fatigue syndrome, fibromyalgia and multiple chemical sensitivities among women, according to new findings by University of Toronto researchers.

The research will be published in this month's issue of the *Journal of Aggression, Maltreatment & Trauma*. "Women who reported they had been physically abused as children have twice the odds of chronic fatigue syndrome and multiple chemical sensitivities, and 65 per cent higher odds of fibromyalgia" says lead investigator Professor Esme Fuller-Thomson, who holds the Sandra Rotman Chair at U of T's Factor-Inwentash Faculty of Social Work and Department of Family and Community Medicine. "These findings persisted even after controlling for potentially confounding factors such as other adverse childhood experiences, age, race, mental health and adult socioeconomic status."

The study examined statistics from a regional subsample of the 2005 Canadian Community Health Survey involving 7,342 women, 10 per cent of whom reported being physically abused as children. A minority of women reported they had been diagnosed by a health professional with chronic fatigue syndrome (1.3%), fibromyalgia (2.5%), or multiple chemical sensitivities (2.7%).

Co-author Joanne Sulman, from the Department of Social Work at Mount Sinai, says the research not only points to an association between childhood physical abuse and these disorders, but also explores the contribution of confounding psychosocial factors such as other childhood adversities, adult health behaviours and mental health.

"But perhaps the most interesting aspects of the research," says Sulman, "are the questions it raises, such as the mechanisms that link physical abuse to chronic fatigue syndrome, fibromyalgia and multiple chemical sensitivities."

### Story Source:

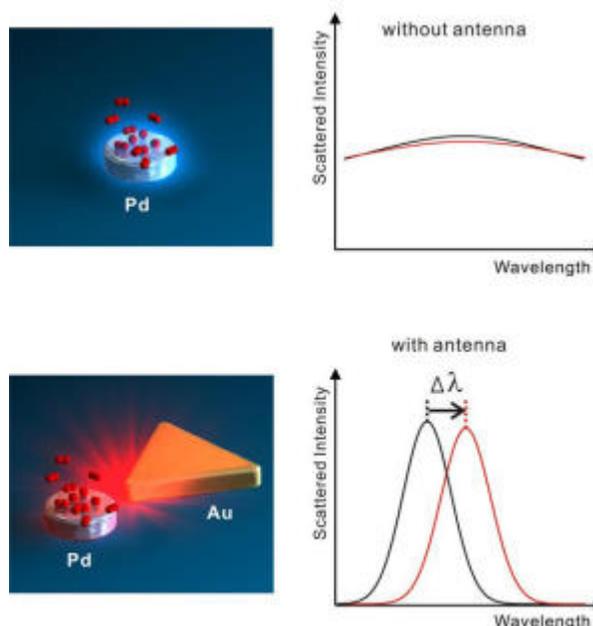
The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by [University of Toronto](#).

### Journal Reference:

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<http://www.sciencedaily.com/releases/2011/05/110516121732.htm>

## Sharpening the Nanofocus



Top figure shows hydrogen (red) absorbed on a palladium nanoparticle, resulting in weak light scattering and barely detectable spectral changes. Bottom figure shows gold antenna enhancing light scattering and producing an easy to detect spectral shift. (Credit: Image courtesy of Alivisatos group)

ScienceDaily (May 17, 2011) — Such highly coveted technical capabilities as the observation of single catalytic processes in nanoreactors, or the optical detection of low concentrations of biochemical agents and gases are an important step closer to fruition. Researchers with the U.S. Department of Energy (DOE)'s Lawrence Berkeley National Laboratory (Berkeley Lab), in collaboration with researchers at the University of Stuttgart in Germany, report the first experimental demonstration of antenna-enhanced gas sensing at the single particle level. By placing a palladium nanoparticle on the focusing tip of a gold nanoantenna, they were able to clearly detect changes in the palladium's optical properties upon exposure to hydrogen.

"We have demonstrated resonant antenna-enhanced single-particle hydrogen sensing in the visible region and presented a fabrication approach to the positioning of a single palladium nanoparticle in the nanofocus of a gold nanoantenna," says Paul Alivisatos, Berkeley Lab's director and the leader of this research. "Our concept provides a general blueprint for amplifying plasmonic sensing signals at the single-particle level and should pave the road for the optical observation of chemical reactions and catalytic activities in nanoreactors, and for local biosensing."

Alivisatos, who is also the Larry and Diane Bock Professor of Nanotechnology at the University of California, Berkeley, is the corresponding author of a paper in the journal *Nature Materials* describing this research. The paper is titled "Nanoantenna-enhanced gas sensing in a single tailored nanofocus." Co-authoring the paper with Alivisatos were Laura Na Liu, Ming Tang, Mario Hentschel and Harald Giessen. One of the hottest new fields in technology today is plasmonics -- the confinement of electromagnetic waves in dimensions smaller than half-the-wavelength of the incident photons in free space. Typically this is done at the interface between metallic nanostructures, usually gold, and a dielectric, usually air. The confinement of the electromagnetic waves in these metallic nanostructures generates electronic surface waves called "plasmons." A matching of the oscillation frequency between plasmons and the incident electromagnetic waves gives rise to a phenomenon known as localized surface plasmon resonance (LSPR), which can concentrate the electromagnetic field into a volume less than a few hundred cubic nanometers. Any object

brought into this locally confined field -- referred to as the nanofocus -- will influence the LSPR in a manner that can be detected via dark-field microscopy.

"Nanofocusing has immediate implications for plasmonic sensing," says Laura Na Liu, lead author of the *Nature Materials* paper who was at the time the work was done a member of Alivisatos' research group but is now with Rice University. "Metallic nanostructures with sharp corners and edges that form a pointed tip are especially favorable for plasmonic sensing because the field strengths of the electromagnetic waves are so strongly enhanced over such an extremely small sensing volume."

Plasmonic sensing is especially promising for the detection of flammable gases such as hydrogen, where the use of sensors that require electrical measurements pose safety issues because of the potential threat from sparking. Hydrogen, for example, can ignite or explode in concentrations of only four-percent. Palladium was seen as a prime candidate for the plasmonic sensing of hydrogen because it readily and rapidly absorbs hydrogen that alters its electrical and dielectric properties. However, the LSPRs of palladium nanoparticles yield broad spectral profiles that make detecting changes extremely difficult.

"In our resonant antenna-enhanced scheme, we use double electron-beam lithography in combination with a double lift-off procedure to precisely position a single palladium nanoparticle in the nanofocus of a gold nanoantenna," Liu says. "The strongly enhanced gold-particle plasmon near-fields can sense the change in the dielectric function of the proximal palladium nanoparticle as it absorbs or releases hydrogen. Light scattered by the system is collected by a dark-field microscope with attached spectrometer and the LSPR change is read out in real time."

Alivisatos, Liu and their co-authors found that the antenna enhancement effect could be controlled by changing the distance between the palladium nanoparticle and the gold antenna, and by changing the shape of the antenna.

"By amplifying sensing signals at the single-particle level, we eliminate the statistical and average characteristics inherent to ensemble measurements," Liu says. "Moreover, our antenna-enhanced plasmonic sensing technique comprises a noninvasive scheme that is biocompatible and can be used in aqueous environments, making it applicable to a variety of physical and biochemical materials."

For example, by replacing the palladium nanoparticle with other nanocatalysts, such as ruthenium, platinum, or magnesium, Liu says their antenna-enhanced plasmonic sensing scheme can be used to monitor the presence of numerous other important gases in addition to hydrogen, including carbon dioxide and the nitrous oxides. This technique also offers a promising plasmonic sensing alternative to the fluorescent detection of catalysis, which depends upon the challenging task of finding appropriate fluorophores. Antenna-enhanced plasmonic sensing also holds potential for the observation of single chemical or biological events.

"We believe our antenna-enhanced sensing technique can serve as a bridge between plasmonics and biochemistry," Liu says. "Plasmonic sensing offers a unique tool for optically probing biochemical processes that are optically inactive in nature. In addition, since plasmonic nanostructures made from gold or silver do not bleach or blink, they allow for continuous observation, an essential capability for *in-situ* monitoring of biochemical behavior."

This research was supported by the DOE Office of Science and the German ministry of research.

#### Story Source:

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

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#### Journal Reference:

1. Na Liu, Ming L. Tang, Mario Hentschel, Harald Giessen, A. Paul Alivisatos. **Nanoantenna-enhanced gas sensing in a single tailored nanofocus**. *Nature Materials*, 2011; DOI: [10.1038/nmat3029](https://doi.org/10.1038/nmat3029)

<http://www.sciencedaily.com/releases/2011/05/110517162034.htm>

## Coffee May Reduce Risk of Lethal Prostate Cancer in Men



*Men who regularly drink coffee appear to have a lower risk of developing a lethal form of prostate cancer, according to a new study. What's more, the lower risk was evident among men who drank either regular or decaffeinated coffee. (Credit: © Sandra Cunningham / Fotolia)*

ScienceDaily (May 17, 2011) — Men who regularly drink coffee appear to have a lower risk of developing a lethal form of prostate cancer, according to a new study led by Harvard School of Public Health (HSPH) researchers. What's more, the lower risk was evident among men who drank either regular or decaffeinated coffee.

The study was published May 17, 2011, in an online edition of the *Journal of the National Cancer Institute*. "Few studies have specifically studied the association of coffee intake and the risk of lethal prostate cancer, the form of the disease that is the most critical to prevent. Our study is the largest to date to examine whether coffee could lower the risk of lethal prostate cancer," said senior author Lorelei Mucci, associate professor of epidemiology at HSPH. Lethal prostate cancer is cancer that causes death or spreads to the bones.

Prostate cancer is the most frequently diagnosed form of cancer and the second leading cause of cancer death among U.S. men, affecting one in six men during their lifetime. More than 2 million men in the U.S. and 16 million men worldwide are prostate cancer survivors.

"At present we lack an understanding of risk factors that can be changed or controlled to lower the risk of lethal prostate cancer. If our findings are validated, coffee could represent one modifiable factor that may lower the risk of developing the most harmful form of prostate cancer," said lead author Kathryn Wilson, a research fellow in epidemiology at HSPH.

The researchers chose to study coffee because it contains many beneficial compounds that act as antioxidants, reduce inflammation, and regulate insulin, all of which may influence prostate cancer. Coffee has been associated in prior studies with a lower risk of Parkinson's disease, type 2 diabetes, gallstone disease, and liver cancer or cirrhosis.

The study examined the association between coffee consumption and the risk of prostate cancer, particularly the risk for aggressive prostate cancer among 47,911 U.S. men in the Health Professionals Follow-Up Study who reported their coffee consumption every four years from 1986 to 2008. During the study period, 5,035 cases of prostate cancer were reported, including 642 fatal or metastatic cases.

Among the findings:

- Men who consumed the most coffee (six or more cups daily) had nearly a 20% lower risk of developing any form of prostate cancer.
- The inverse association with coffee was even stronger for aggressive prostate cancer. Men who drank the most coffee had a 60% lower risk of developing lethal prostate cancer.
- The reduction in risk was seen whether the men drank decaffeinated or regular coffee, and does not appear to be due to caffeine.
- Even drinking one to three cups of coffee per day was associated with a 30% lower risk of lethal prostate cancer.

- Coffee drinkers were more likely to smoke and less likely to exercise, behaviors that may increase advanced prostate cancer risk. These and other lifestyle factors were controlled for in the study and coffee still was associated with a lower risk.

The results from this study need to be validated in additional populations that have a range of coffee exposure and a large number of lethal prostate cancer cases. If confirmed, the data would add to the list of other potential health benefits of coffee. The authors currently are planning additional studies to understand specific mechanisms by which coffee may specifically lower the risk of lethal prostate cancer.

The study was supported by the National Cancer Institute at the National Institutes of Health, the American Institute for Cancer Research, and the Prostate Cancer Foundation.

**story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Harvard School of Public Health**, via EurekAlert!, a service of AAAS.

**Journal Reference:**

1. Kathryn M. Wilson, Julie L. Kasperzyk, Jennifer R. Stark, Stacey Kenfield, Rob M. van Dam, Meir J. Stampfer, Edward Giovannucci, Lorelei A. Mucci. **Coffee Consumption and Prostate Cancer Risk and Progression in the Health Professionals Follow-up Study**. *Journal of the National Cancer Institute*, May 17, 2011 DOI: [10.1093/jnci/djr151](https://doi.org/10.1093/jnci/djr151)

<http://www.sciencedaily.com/releases/2011/05/110517162030.htm>

## Experimental Treatment Offers Relief from Painful Prostate Condition, Study Suggests



*Urology professor Curtis Nickel leads a study into chronic prostatitis/chronic pelvic pain in men and find that treatment with a selective alpha blocker may relieve symptoms and improve quality of life. (Credit: Photo by Stephen Wild)*

ScienceDaily (May 17, 2011) — New findings show that treatment with a specific alpha blocker helps reduce symptoms and improve quality of life for men with chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS).

The alpha-blocker, known as silodosin, works by selectively relaxing the muscles in the bladder neck and prostate. The treatment is already approved in Canada, the United States, the EU and Japan to treat painful symptoms of another prostate gland condition, benign prostatic hyperplasia, commonly referred to as an enlarged prostate.

Despite being the most common form of prostatitis, CP/CPPS is the most misunderstood and difficult to treat because the symptoms are very similar to other conditions and requires a significant degree of testing and screening to identify.

"Antibiotics are commonly used as a treatment, but are not typically effective, probably because CP/CPPS does not seem to be caused by a bacterial infection," explains lead researcher Curtis Nickel, a professor in the Department of Urology, practicing urologist at Kingston General Hospital, and Canada Research Chair in Urologic Pain and Inflammation.

CP/CPPS is a debilitating condition characterized by persistent discomfort in the lower pelvic area including the bladder area, testicles, and penis. Symptoms can be severe and include painful and frequent urination and difficult or painful ejaculation. The cause of the condition is unknown.

In Dr. Nickel's study, approximately 60 per cent of men reported feeling better after treatment with silodosin versus 30 per cent of participants who were given a placebo. The number of patients who reported feeling better is higher than in a similar study he ran several years ago that tested the effects of a different alpha blocker.

Dr. Nickel, along with his Prostatitis Research Group at Kingston General Hospital and Queen's University, has been studying CP/CPPS for the past two decades. He has been the principal investigator of over a dozen international clinical trials evaluating therapies for chronic prostatitis. His research studies are supported by the Canadian Institute of Health Research, US National Institutes of Health and industry, including Watson Pharmaceuticals who provided the support for this particular clinical trial.

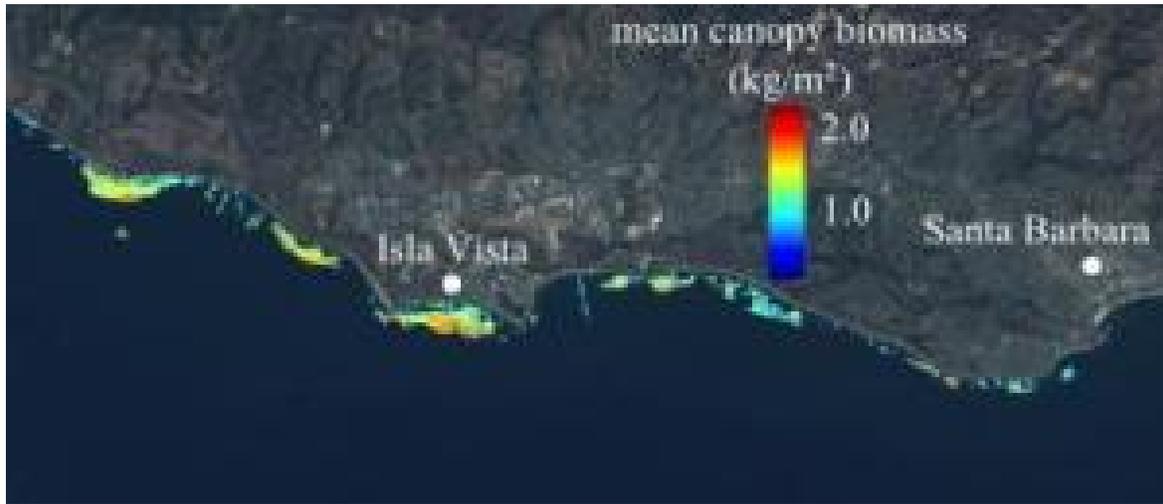
Dr. Nickel presented his results at May 17 American Urological Association annual meeting in Washington DC. The study results will appear in an upcoming issue of the *Journal of Urology*.

### Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Queen's University**.

<http://www.sciencedaily.com/releases/2011/05/110517151303.htm>

## Scientists Track Environmental Influences on Giant Kelp With Help from Satellite Data



*This is a giant kelp canopy off coast of Santa Barbara, as viewed by Landsat 5. (Credit: UCSB)*

ScienceDaily (May 17, 2011) — Scientists at UC Santa Barbara have developed new methods for studying how environmental factors and climate affect giant kelp forest ecosystems at unprecedented spatial and temporal scales.

The scientists merged data collected underwater by UCSB divers with satellite images of giant kelp canopies taken by the Landsat 5 Thematic Mapper. The findings are published in the feature article of the May 16 issue of *Marine Ecology Progress Series*.

In this marriage of marine ecology and satellite mapping, the team of UCSB scientists tracked the dynamics of giant kelp -- the world's largest alga -- throughout the entire Santa Barbara Channel at approximately six-week intervals over a period of 25 years, from 1984 through 2009.

David Siegel, co-author, professor of geography and co-director of UCSB's Earth Research Institute, noted that having 25 years of imagery from the same satellite is unprecedented. "I've been heavily involved in the satellite game, and a satellite mission that goes on for more than 10 years is rare. One that continues for more than 25 years is a miracle," said Siegel. Landsat 5 was originally planned to be in use for only three years. Forests of giant kelp are located in temperate coastal regions throughout the world. They are among the most productive ecosystems on Earth, and giant kelp itself provides food and habitat for numerous ecologically and economically important near-shore marine species. Giant kelp also provides an important source of food for many terrestrial and deep-sea species, as kelp that is ripped from the seafloor commonly washes up on beaches or is transported offshore into deeper water.

Giant kelp is particularly sensitive to changes in climate that alter wave and nutrient conditions. The scientists found that the dynamics of giant kelp growing in exposed areas of the Santa Barbara Channel were largely controlled by the occurrence of large wave events. Meanwhile, kelp growing in protected areas was most limited by periods of low nutrient levels.

Images from the Landsat 5 satellite provided the research team with a new "window" into how giant kelp changes through time. The satellite was built in Santa Barbara County at what was then called the Santa Barbara Research Center and launched from Vandenberg Air Force Base. It was designed to cover the globe every 16 days and has collected millions of images. Until recently these images were relatively expensive and their high cost limited their use in scientific research.

However, in 2009, the entire Landsat imagery library was made available to the public for the first time at no charge. "In the past, it was not feasible to make these longtime series, because each scene cost over \$500," said Kyle C. Cavanaugh, first author and UCSB graduate student in marine science. "In the past, you were lucky to get a handful of images. Once these data were released for free, all of a sudden we could get hundreds and hundreds of pictures through time."

Giant kelp grows to lengths of over 100 feet and can grow up to 18 inches per day. Plants consist of bundles of ropelike fronds that extend from the bottom to the sea surface. Fronds live for four to six months, while individual plants live on average for two to three years. According to the article, "Giant kelp forms a dense floating canopy at the sea surface that is distinctive when viewed from above. ... Water absorbs almost all incoming near-infrared energy, so kelp canopy is easily differentiated using its near-infrared reflectance signal."

Cavanaugh explained that, thanks to the satellite images, his team was able to see how the biomass of giant kelp fluctuates within and among years at a regional level for the first time. "It varies an enormous amount," said Cavanaugh. "We know from scuba diver observations that individual kelp plants are fast-growing and short-lived, but these new data show the patterns of variability that are also present within and among years at much larger spatial scales. Entire forests can be wiped out in days, but then recover in a matter of months." Satellite data were augmented by information collected by the Santa Barbara Coastal Long Term Ecological Research Project (SBC LTER), which is based at UCSB and is part of the National Science Foundation's Long Term Ecological Research (LTER) Network. In 1980, the NSF established the LTER Program to support research on long-term ecological phenomena. SBC LTER became the 24th site in the LTER network in April of 2000. The SBC LTER contributed 10 years of data from giant kelp research dives to the current study.

The scientists said that interdisciplinary collaboration between geographers and marine scientists is common at UCSB and is a strength of its marine science program.

Daniel C. Reed, co-author and research biologist with UCSB's Marine Science Institute, is the principal investigator of SBC LTER. Reed has spent many hours as a research diver. He explained: "Kelp occurs in discrete patches. The patches are connected genetically and ecologically. Species that live in them can move from one patch to another. Having the satellite capability allows us to look at the dynamics of how these different patches are growing and expanding, and to get a better sense as to how they are connected. We can't get at that through diver plots alone. The diver plots, however, help us calibrate the satellite data, so it's really important to have both sources of information."

The fourth author of the paper is Philip E. Dennison. He received his Ph.D. in geography at UCSB and is now an associate professor in the Department of Geography at the University of Utah.

The research team received funding from NASA and the National Science Foundation.

#### Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by [University of California - Santa Barbara](#), via [EurekAlert!](#), a service of AAAS.

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#### Journal Reference:

1. KC Cavanaugh, DA Siegel, DC Reed, PE Dennison. **Environmental controls of giant kelp biomass in the Santa Barbara Channel, California.** *Marine Ecology Progress Series*, 2011; DOI: [10.3354/meps09141](https://doi.org/10.3354/meps09141)

<http://www.sciencedaily.com/releases/2011/05/110517141459.htm>

## Diamond Aerogel: New Form of Diamond Is Lighter Than Ever



*A diamond aerogel has been hammered out of a microscopic anvil. (Credit: Image by Kwei-Yu Chu/LLNL) ScienceDaily (May 17, 2011) —* By combining high pressure with high temperature, Livermore researchers have created a nanocrystalline diamond aerogel that could improve the optics for something as big as a telescope or as small as the lenses in eyeglasses.

Aerogels are a class of materials that exhibit the lowest density, thermal conductivity, refractive index and sound velocity of any bulk solid. Aerogels are among the most versatile materials available for technical applications due to their many exceptional properties. This material has chemists, physicists, astronomers, and materials scientists utilizing its properties in myriad applications, from a water purifier for desalinating seawater to installation on a NASA satellite as a meteorite particle collector.

In new research appearing in the May 9-13 online edition of the *Proceedings of the National Academy of Sciences*, a Livermore team created a diamond aerogel from a standard carbon-based aerogel precursor using a laser-heated diamond anvil cell.

A diamond anvil cell consists of two opposing diamonds with the sample compressed between them. It can compress a small piece of material (tens of micrometers or smaller) to extreme pressures, which can exceed 3 million atmospheres. The device has been used to recreate the pressure existing deep inside planets, creating materials and phases not observed under normal conditions. Since diamonds are transparent, intense laser light also can be focused onto the sample to simultaneously heat it to thousands of degrees.

The new form of diamond has a very low density similar to that of the precursor of around 40 milligrams per cubic centimeter, which is only about 40 times denser than air.

The diamond aerogel could have applications in antireflection coatings, a type of optical coating applied to the surface of lenses and other optical devices to reduce reflection. Less light is lost, improving the efficiency of the system. It can be applied to telescopes, binoculars, eyeglasses or any other device that may require reflection reduction. It also has potential applications in enhanced or modified biocompatibility, chemical doping, thermal conduction and electrical field emission.

In creating diamond aerogels, lead researcher Peter Pauzauskie, a former Lawrence fellow now at the University of Washington, infused the pores of a standard, carbon-based aerogel with neon, preventing the entire aerogel from collapsing on itself.

At that point, the team subjected the aerogel sample to tremendous pressures and temperatures (above 200,000 atmospheres and in excess of 2,240 degrees Fahrenheit), forcing the carbon atoms within to shift their arrangement and create crystalline diamonds.

The success of this work also leads the team to speculate that additional novel forms of diamond may be obtained by exposing appropriate precursors to the right combination of high pressure and temperature.



Livermore researchers on the project include: Jonathan Crowhurst, Marcus Worsley, Ted Laurence, Yinmin "Morris" Wang, Trevor Wiley, Kenneth Visbeck, William Evans, Joseph Zaug and Joe Satcher Jr.

**Story Source:**

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

**Journal Reference:**

1. P. J. Pauzauskie, J. C. Crowhurst, M. A. Worsley, T. A. Laurence, A. L. D. Kilcoyne, Y. Wang, T. M. Willey, K. S. Visbeck, S. C. Fakra, W. J. Evans, J. M. Zaug, J. H. Satcher. **Synthesis and characterization of a nanocrystalline diamond aerogel**. *Proceedings of the National Academy of Sciences*, 2011; DOI: [10.1073/pnas.1010600108](https://doi.org/10.1073/pnas.1010600108)

<http://www.sciencedaily.com/releases/2011/05/110517132646.htm>

## Reforestation Research in Latin America Helps Build Better Forests



*Diogenes Ibarra measures the growth of native tree saplings to see how they perform in different environmental settings in Panama. (Credit: STRI archives)*

ScienceDaily (May 17, 2011) — A tropical forest is easy to cut down, but getting it back is another story. In a special issue of the journal *Forest Ecology and Management*, leading researchers at the Smithsonian in Panama and across Latin America offer new insights on reforestation based on 20 years of research.

"Twenty years ago, we had almost no information about how to build a forest," said Jefferson Hall, staff scientist at the Smithsonian and lead editor of the new special issue of *Forest Ecology and Management*.

"People either planted one of four non-native species -- teak, pine, eucalyptus or acacia -- or they used a trial-and-error process with other species that was not always successful. Now we can be smart about which trees we plant at a given site, and we understand much more about what motivates land owners and rural farmers to put this know-how to work."

Forests keep water clean, control soil erosion, store carbon, shelter animals and provide plants that offer pharmacological benefits. Forests also contribute to global-scale economic activity in the form of ecosystem services. The Agua Salud project in the Panama Canal watershed, funded by the HSBC Climate Partnership and featured in the special issue, is a 700-hectare experiment that examines the ecosystem services forests provide: water for people and the Canal, carbon storage to mitigate global warming and biodiversity protection in one of the crucial biological corridors between North and South America.

"Native tropical forests are some of the richest storehouses on earth," said Eldredge Bermingham, director of the Smithsonian Tropical Research Institute. "Now the science behind tropical forest restoration is at a level of sophistication that reforestation projects can be planned to target multiple goals -- to store carbon, manage water and conserve biodiversity, buffer old-growth forests from destruction and provide a strong return on investment."

Managing forests for ecosystem services requires tradeoffs. A hectare of teak stores as much carbon as a native forest after 20 years, but will shelter far less biodiversity. In the Agua Salud experiment researchers plant mixtures of native species. Their data predict that some mixtures will surpass the carbon-storage capability of teak and the ability to support other plants and animals.

Plantation soils in one experiment lost a huge amount of carbon in less than 10 years. Another experiment not far away showed soil-carbon levels under similarly aged secondary forest did not change. This juxtaposition suggests that while secondary forests may not store as much aboveground carbon as carefully tended plantations, they do a better job of maintaining soil carbon stocks. The information highlights potential tradeoffs in ecosystem services with land management and points the way to the next generation of ecosystem service research.

### Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Smithsonian Tropical Research Institute**, via [EurekAlert!](#), a service of AAAS.

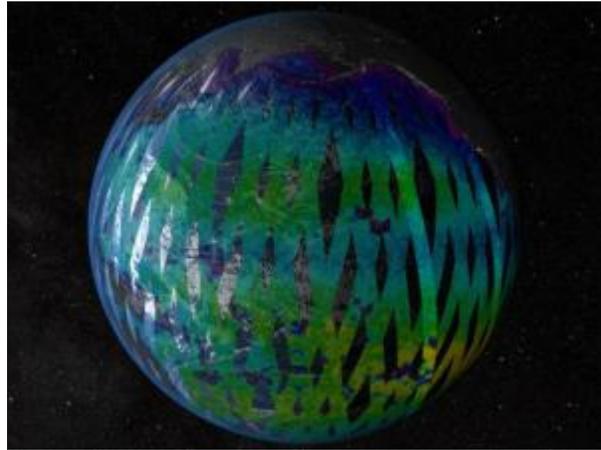


**Journal Reference:**

1. Jefferson S. Hall, Mark S. Ashton, Eva J. Garen, Shibu Jose. **The ecology and ecosystem services of native trees: Implications for reforestation and land restoration in Mesoamerica.** *Forest Ecology and Management*, 2011; 261 (10): 1553 DOI: [10.1016/j.foreco.2010.12.011](https://doi.org/10.1016/j.foreco.2010.12.011)

<http://www.sciencedaily.com/releases/2011/05/110517132642.htm>

## Aquarius to Illuminate Links Between Salt, Climate



*Simulated Ocean Salinity Data: Simulated ocean salinity data for NASA's Aquarius instrument. Aquarius, launching this June aboard the international Aquarius/SAC-D observatory, will map the salinity of the surface of the global ice-free ocean every seven days for at least three years, providing data on a key missing variable in Earth satellite studies that links ocean circulation, the water cycle and climate. (Credit: NASA) ScienceDaily (May 17, 2011) —* When NASA's salt-seeking Aquarius instrument ascends to the heavens this June, the moon above its launch site at California's Vandenberg Air Force Base won't be in the seventh house, and Jupiter's latest alignment with Mars will be weeks in the past, in contrast to the lyrics of the song from the popular Broadway musical "Hair." Yet for the science team eagerly awaiting Aquarius' ocean surface salinity data, the dawning of NASA's "Age of Aquarius" promises revelations on how salinity is linked to Earth's water cycle, ocean circulation and climate.

Salinity -- the concentration of salt -- on the ocean surface is a key missing puzzle piece in satellite studies of Earth that will improve our understanding of how the ocean and atmosphere are coupled and work in tandem to affect our climate. While satellites already measure sea surface temperature and winds, rainfall, water vapor, sea level, and ocean color, measurements of ocean surface salinity have, until quite recently, been limited to sparse data collected from ships, buoys and a small number of airborne science campaigns. From those limited data, we know ocean surface salinity varies by only about five parts per thousand globally. Yet a change of just a fraction of one part per thousand can influence the circulation of the ocean. Knowing the salinity of the ocean surface can also help scientists trace Earth's water cycle -- the process that circulates freshwater from the ocean to the atmosphere to the land and back again to the ocean through rainfall, evaporation, ice melt and river runoff. Aquarius, the primary science instrument on the Aquarius/Satélite de Aplicaciones Científicas (SAC)-D spacecraft built by Argentina's national space agency, Comisión Nacional de Actividades Espaciales, will help scientists study these complex, interrelated processes and their link to climate.

Recent studies have shown Earth's water cycle is speeding up in response to climate change, which affects global precipitation patterns. Currently, scientists study the water cycle by making inferences from measurements of how much water is discharged from rivers and by measuring precipitation and evaporation rates using satellites like NASA's Tropical Rainfall Measuring Mission.

"About 80 percent of Earth's water cycle takes place over the ocean," said Aquarius Principal Investigator Gary Lagerloef of Earth & Space Research, Seattle. "By measuring ocean surface salinity, Aquarius will be able to track how the water cycle is changing in response to climate change."

### Salinity and the Deep Blue Sea

While surface winds drive currents in the upper ocean, deep below the surface, it's a different story. There, ocean circulation is dominated by changes in the density of seawater. These changes are determined by salinity and temperature. The saltier and colder the water, the more dense it is. In parts of the world, cool, high-salinity surface waters become so dense that they sink to great depths, where they become part of deep ocean currents. Found in all ocean basins, these deep currents are interconnected and play an important role in regulating Earth's climate by transporting heat globally.

By revealing changes in patterns of global precipitation and evaporation and showing how these changes may affect ocean circulation, Aquarius will help improve predictions of future climate trends and short-term climate events, such as El Niño and La Niña.

#### 'A Spoon of Salt in a Lake'

Gautama Siddhartha, the founder of Buddhism, once said, "A spoon of salt in a glass of water makes the water undrinkable. A spoon of salt in a lake is almost unnoticed."

Such is the challenge faced by the scientists who designed Aquarius. Since ocean surface salinity generally averages just 32 to 37 parts per thousand around the globe, it's very hard for a satellite to detect its signal. The salinity differences between El Niño and La Niña are very small -- only about one part per thousand.

Aquarius employs new technologies to be able to detect changes in ocean surface salinity as small as about two parts in 10,000, equivalent to about one-eighth of a teaspoon of salt in a gallon of water. Its unique, advanced design combines three radiometers, which measure the salinity signal, with a scatterometer that compensates for the effects of ocean surface "roughness" (waves). The result is expected to be the most accurate salinity data ever measured from space.

Scientists will combine Aquarius' maps of global ocean surface salinity with in-ocean salinity measurements to generate routine maps of ocean salinity distribution. Later in the mission, Aquarius data will be inter-calibrated and combined with complementary data from the European Soil Moisture and Ocean Salinity satellite.

#### Peering Into a Crystal Ball (of Salt)

Scientists believe Aquarius will lead to exciting and unexpected new discoveries -- a "mind's true liberation" of sorts. They will be able to accurately calculate the rate at which surface ocean circulation transports freshwater. They'll see how salinity is affected by melting ice, freshwater flowing into the ocean, and fluxes of freshwater to and from the atmosphere from rainfall and evaporation. They'll be able to better study how ocean waters mix vertically. And they'll greatly reduce uncertainties in calculating the ocean's freshwater budget (the net difference between freshwater lost in the ocean through evaporation and freshwater added to the ocean by precipitation and runoff).

Perhaps nowhere is the potential for discovery from Aquarius higher than in the Southern Ocean. "Today's salinity maps don't show many features in the Southern Ocean," said Yi Chao, Aquarius project scientist at NASA's Jet Propulsion Laboratory, Pasadena, Calif., which jointly built Aquarius with NASA's Goddard Space Flight Center, Greenbelt, Md. "This is because data there are so sparse. Yet the Southern Ocean is one of the key deepwater formation areas in the world and is one of the key drivers of deep ocean circulation and heat transport."

Other areas of particular interest to Aquarius researchers include:

- The Central North Atlantic, where salinity has been observed to be increasing, and the region has been getting more arid
- The Nordic and Labrador Seas, where dense water forms at the surface and sinks to deep layers in the ocean. Aquarius should be able to observe the year-to-year effects of ice melting on the circulation between Greenland and Iceland.
- The Indian Ocean and Bay of Bengal, which have a very large salinity signal but have been less frequently measured than the Atlantic and Pacific oceans

And then there's the Arctic Ocean, which has seen significant changes in sea ice cover in recent years.

Aquarius will provide some salinity measurements over the Arctic during its ice-free seasons, though the Aquarius signal is less sensitive over cold water.

Aquarius' prime mission will last at least three years, long enough to map year-to-year variations in salinity that will allow researchers to develop the methodology for and demonstrate the usefulness of salinity as a climate data record.

Aquarius data will eventually be used to improve the accuracy of climate forecast models. Ocean surface salinity is not currently well represented in models used by the United Nations' Intergovernmental Panel on Climate Change in its assessment reports.

Lagerloef likened Aquarius to an explorer of an unexplored frontier. "We'll see the ocean in a whole different light. When the first Earth science satellites launched in the 1970s, we saw ocean eddies for the first time and



got our first glimpse of the tremendous turbulence of the ocean. With Aquarius, we're going to see things we don't currently see. It's as though the blinders will be removed from our eyes."

For more information on Aquarius, visit: <http://www.nasa.gov/aquarius> .

**Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **NASA/Jet Propulsion Laboratory**.

<http://www.sciencedaily.com/releases/2011/05/110517115210.htm>

## Landslides: How Rainfall Dried Up Panama's Drinking Water



*Heavy rains cause landslides on the steep slopes of the Panama Canal watershed, releasing large quantities of sediment into rivers and streams. (Credit: Robert Stallard)*

ScienceDaily (May 17, 2011) — An aerial survey of landslides has helped scientists evaluate the effect of a prolonged tropical storm on the water supply in the Panama Canal watershed. To understand the long-term effects of a prolonged tropical storm in the Panama Canal watershed, Robert Stallard, staff scientist at the Smithsonian Tropical Research Institute and research hydrologist at the U.S. Geological Survey, and Armando Ubeda, the LightHawk Mesoamerica program manager, organized four flights over the watershed to create a digital map of landslide scars.

Two feet of heavy rain inundated the Panama Canal watershed between Dec. 7 and 10, 2010. Landslides tore down steep slopes, choking rivers with sediment and overwhelming Panama City's water-treatment plant. Flooding closed the Panama Canal for the first time since 1935. Despite the deluge, the influx of sediments in the water forced authorities to shut down the plant, leaving a million residents of central Panama without clean drinking water for nearly a month.

LightHawk, a conservation organization based in the U.S., donates flights for research and conservation efforts. Retired United Airlines captain David Cole flew the Cessna 206 aircraft, and the four flights yielded images of 191 square miles (495 square kilometers) of watershed. Stallard observed numerous new landslide scars left behind by the December storm, supporting his prediction that landslides supplied much of the suspended sediment that disrupted Panama's water supply.

The new watershed erosion map will allow Stallard and collaborators from the Panama Canal Authority to calculate the landslide risk of future storms and direct strategies to minimize the effect on Panama's water supply.

Tropical hydrologists agree that river-borne sediment originates from surface erosion or from deep erosion from landslides. In 1985, Stallard predicted that "deep erosion, not shallow surface erosion, is the primary process controlling the chemistry and sediment levels in many tropical rivers that pass through mountainous areas." Few studies have been conducted to test this prediction.

Deforestation of steep slopes is the primary factor determining the number of landslides. Six decades of aerial photographs analyzed by USGS researchers in similar landscapes in Puerto Rico showed that landslide frequency doubles outside protected nature preserves, and that roads and infrastructure make landslides eight times more likely. Although landslides happen in natural forests, the objective is to limit their impact through appropriate land-use practices.

"With development, landslide intensity increases dramatically," said Stallard. "In its history, the Panama Canal watershed has experienced huge floods. It's still hard to say whether future floods will be accompanied by disastrous landslides like those produced by Hurricane Mitch in Central America." In 1998, Hurricane Mitch swept across Honduras, Guatemala, Nicaragua and El Salvador causing more than 10,000 deaths and incalculable economic damage. Panama's proximity to the equator puts the country outside the usual hurricane zone, but prolonged tropical storms may occur.



Erosion control is possible. Partnering with the Panama Canal Authority and Panama's Environmental Authority, the Smithsonian is conducting a 700 hectare experiment in the canal watershed funded by the HSBC Climate Partnership to compare the effects of land-use choices, such as cattle ranching or reforestation with native tree species on water supply, carbon storage and biodiversity. Stallard hopes that this research will provide new information about which land uses provide a steady supply of clean water for the Canal. With the first rains in May, the eight-month wet season begins anew in central Panama. Drinking water flows freely, the rivers are clear and the Panama Canal is open for business. But bare slopes of past landslides continue to create secondary erosion, which will dislodge sediments from the steep, rainy and rugged Panama Canal watershed in 2011. The long-term effects of the 2010 storm may continue as renewed interruptions in the water supply in 2011.

**Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Smithsonian Tropical Research Institute**.

<http://www.sciencedaily.com/releases/2011/05/110517110321.htm>

## Mitigating Mummy Berry Disease of Blueberry



ARS scientists are examining the responses of today's blueberry cultivars to the fungus that causes mummy berry. (Credit: Photo courtesy of University of Georgia Plant Pathology Archive, Bugwood.org.)

ScienceDaily (May 17, 2011) — Blueberries may be nutritional powerhouses, but some types are no match for the fungus *Monilinia vaccinii-corymbosi*, which causes "mummy berry" disease.

Fortunately, U.S. Department of Agriculture (USDA) scientists have more than 100 years of experience in blueberry breeding and cultivation. Geneticist Mark Ehlenfeldt and plant pathologist James Polashock embody the latest generation.

They work for USDA's Agricultural Research Service (ARS). With ARS colleagues, they have conducted comprehensive studies examining the responses of today's blueberry cultivars to infection by the fungus, which wages its attack in two stages.

During the first, the blighting stage, small, cup-shaped structures bearing the fungus' spores sprout from berries concealed among leaf litter in the ground. Wind spreads the spores to nearby plants, infecting newly emerging shoots and leaves. During the second phase, the fungus penetrates the berry, causing it to shrink, shrivel and turn whitish—hence the "mummy" reference. Eventually, the mummified fruit drops to the ground and overwinters, setting the stage for a new round of infection the following spring.

In a *HortScience* study, the researchers analyzed blighting-resistance data collected from 125 cultivars over two to six years, and fruit-infection-resistance data from 110 cultivars over two to five years.

They then ranked the cultivars' mummy-berry resistance using statistical methods devised by statistician Matthew Kramer with the ARS Biometrical Consulting Services in Beltsville, Md. Ehlenfeldt and Polashock are with the ARS Genetic Improvement of Fruits and Vegetables Research Laboratory in Beltsville, but are stationed at the Philip E. Marucci Center for Blueberry and Cranberry Research and Extension in Chatsworth, N.J.



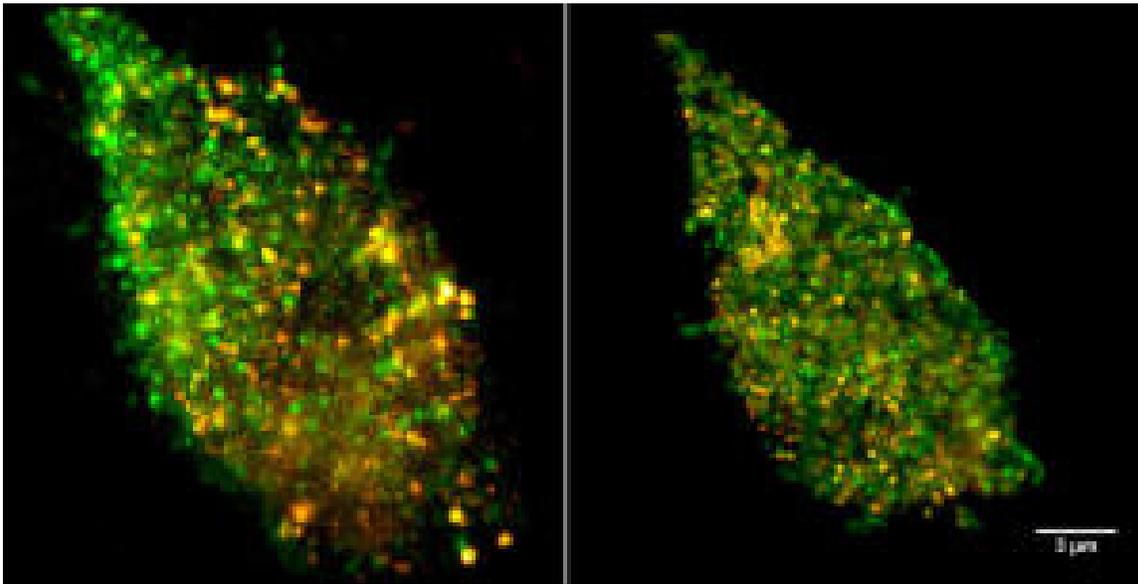
"Brunswick" and "Bluejay" were among several blueberry cultivars that withstood both fungal infection stages.

**Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **United States Department of Agriculture - Research, Education and Economics**. The original article was written by Jan Suszkiw.

<http://www.sciencedaily.com/releases/2011/05/110517110317.htm>

## Secrets of Plague Unlocked With Stunning New Imaging Techniques



*The difference between what was previously seen on the cell surface (left image) is dramatically different from what Jeri Timlin, Jesse Aaron, and Bryan Carson are now able to image (right). Orange areas correspond to the bacterial lipopolysaccharide (LPS), derived from *E. coli*, and the green areas correspond to the cell's TLR4 receptors. (Credit: Jeri Timlin, Jesse Aaron and Bryan Carson)*

ScienceDaily (May 16, 2011) — Researchers at Sandia National Laboratories have developed a super-resolution microscopy technique that is answering long-held questions about exactly how and why a cell's defenses fail against some invaders, such as plague, while successfully fending off others like *E.coli*. The approach is revealing never-before-seen detail of the cell membrane, which could open doors to new diagnostic, prevention and treatment techniques.

"We're trying to do molecular biology with a microscope, but in order to do that, we must be able to look at things on a molecular scale," says Jesse Aaron, postdoctoral appointee at Sandia Labs.

The cell membrane is a bustling hub of activity on a miniscule scale. While providing structure and housing the cell's interior, the membrane regulates movement of materials in and out of the cell, controls adhesion to other objects and coordinates the cell's communications and subsequent actions through signaling. Receptor proteins on the surface of immune cells, known as toll-like receptors (TLRs), are tasked with recognizing intruders, or antigens. The TLR4 member of this receptor family responds to certain types of bacteria by detecting lipopolysaccharides (LPS) present on their surface. TLR4 proteins then alert the cell and activate an immune response.

Using imaging techniques they developed, Sandia researchers Aaron, Jeri Timlin and Bryan Carson discovered that TLR4 proteins cluster in the membrane when confronted with LPS derived from *E.coli*, which increases cell signaling and response. Interestingly, LPS derived from the bacteria that cause plague, *Yersinia pestis*, do not cause the same effects. This could explain why some pathogens are able to thwart the human immune system.

The plague studies marked the first time such small events have been imaged and compared, the Sandia researchers said. Previously, even the most sophisticated optical microscopes could not image the cell surface with enough spatial resolution to see the earliest binding events, due to the diffraction barrier, which limits what can be resolved using visible light.

"With more traditional visualization methods, you can't see the level of detail you need. It's important to look at not only what's present, but also when and where it's present in the cell," Timlin said.

The technique used by Timlin and Aaron builds on superresolution capabilities developed in recent years, but goes another step by adding dual-color capabilities to the relatively new stochastic optical reconstruction

microscopy, or STORM. The combination enables the Sandia team to get a more complete picture by simultaneously imaging LPS and TLR4 receptors on the membrane.

"Current light microscopy capabilities are akin to looking out the window of an airplane and seeing the irrigation circles. You know that plants are there, but you can't tell what kinds of plants they are or what shape the leaves are," said Carson, a Sandia immunologist who was an integral part of the project. "But with this technology, it's like zooming in and seeing the leaves and the structure of the plants. That buys you a lot in terms of understanding what's happening within a cell and specifically how the proteins involved interact." In 2009, the National Institutes of Health awarded Timlin a five-year, \$300,000-a-year innovation grant. Next on the team's agenda is developing the capability to image live cells in real time using spectral Stimulated Emission Depletion, or STED. "We're working toward using a version of superresolution that's much more live-cell friendly, and extending that in terms of what colors are available to do multiple colors, while maintaining the live-cell friendliness. I see this as a beginning of a long development in this type of imaging technology," Timlin said.

Potential applications likely will expand as the technology reveals previously unattainable details of cell signaling. Eventually, the Sandia team would like to be able to visualize protein/protein interactions. "Every biological process that goes on in your body is somehow controlled by proteins forming complexes with other proteins or complexes in the membrane, so this would give you this ability to look, with high spatial resolution and multiplexed color capabilities, at four or more things in a living cell, which can't be done very easily right now. It can be done in pieces, but we want to see the whole biological process," Timlin said.

The technology has exciting potential in immunology and drug discovery. Improved imaging could show the mechanisms viruses use to invade cells, which might lead to drugs that would block entry. "We're hoping to do something like label the viral particles and watch them in real time, or as close as we can to real time, in the internalization process," Carson said. "With the superresolution technique, we can actually watch them move through the membrane and see if there are other structures being recruited by the virus to the site of internalization."

Sandia originally developed the technology in support of its biological national security programs, but the team wants to expand the technology into other areas such as biofuels to better understand where and when different pigments are located on the membrane of oil-producing algae. This would provide valuable insight into their photosynthesis functions, which could lead to more efficient biofuel production.

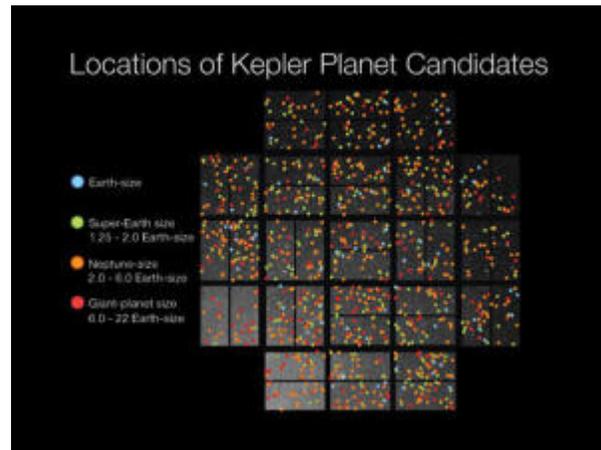
"A lot of this work is in its early stages, but we're encouraged by what we're seeing and excited about its future potential," Aaron said.

#### **Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **DOE/Sandia National Laboratories**.

<http://www.sciencedaily.com/releases/2011/05/110516141548.htm>

## New SETI Survey Focuses on Kepler's Top Earth-Like Planets



UC Berkeley's SETI survey will target the most Earth-like of the 1,235 Kepler Objects of Interest. (Credit: Courtesy of NASA/Ames Research Center, W. Stenzel)

ScienceDaily (May 16, 2011) — Now that NASA's Kepler space telescope has identified 1,235 possible planets around stars in our galaxy, astronomers at the University of California, Berkeley, are aiming a radio telescope at the most Earth-like of these worlds to see if they can detect signals from an advanced civilization. The search began on May 8, when the Robert C. Byrd Green Bank Telescope -- the largest steerable radio telescope in the world -- dedicated an hour to eight stars with possible planets. Once UC Berkeley astronomers acquire 24 hours of data on a total of 86 Earth-like planets, they'll initiate a coarse analysis and then, in about two months, ask an estimated 1 million SETI@home users to conduct a more detailed analysis on their home computers.

"It's not absolutely certain that all of these stars have habitable planetary systems, but they're very good places to look for ET," said UC Berkeley graduate student Andrew Siemion.

The Green Bank telescope will stare for about five minutes at stars in the Kepler survey that have a candidate planet in the star's habitable zone -- that is, the planet has a surface temperature at which liquid water could be maintained.

"We've picked out the planets with nice temperatures -- between zero and 100 degrees Celsius -- because they are a lot more likely to harbor life," said physicist Dan Werthimer, chief scientist for SETI@home and a veteran SETI researcher.

Werthimer leads a 30-year-old SETI project on the world's largest radio telescope, the Arecibo receiver in Puerto Rico, which feeds data to SETI@home for a detailed analysis that could only be done on the world's largest distributed computer. He was involved in an early SETI project with the previous Green Bank telescope, which collapsed in 1988, as well as with the Allen Telescope Array (ATA), which also conducted a broader search for intelligent signals from space run by the SETI Institute of Mountain View, Calif. The ATA went into hibernation mode last month after the SETI Institute and UC Berkeley ran out of money to operate it.

"With Arecibo, we focus on stars like our sun, hoping that they have planets around them that emit intelligent signals," Werthimer said. "But we've never had a list of planets like this before."

The radio dish in rural West Virginia was needed for the new search because the Arecibo dish cannot view the area of the northern sky on which Kepler focuses. But the Green Bank telescope also offers advantages over Arecibo. UC Berkeley's SETI observations piggyback on other astronomical observations at Arecibo, and is limited in the wavelength range it can observe, which centers on the 21 centimeter (1420 MHz) line where hydrogen emits light. These wavelengths easily pass through the dust clouds that obscure much of the galaxy.

"Searching for ET around the 21 centimeter line works if civilizations are broadcasting intentionally, but what if planets are leaking signals like 'I Love Lucy'?" Werthimer said. "With a new data recorder on the Green Bank telescope, we can scan a 800 megaHertz range of frequencies simultaneously, which is 300 times the range we can get at Arecibo."



Thus, one day on the Green Bank telescope provides as much data as one year's worth of observations at Arecibo: about 60 terabytes (60,000 gigabytes) in all, Siemion said. If they recorded a similar chunk of the radio spectrum from Arecibo, SETI@home would be overwhelmed with data, since the Arecibo sky survey observes nearly full time for years on end.

"It's also great that we will completely span the water hole, a canonical place to look for intentional signals from intelligent civilizations," Siemion said.

The water hole is a relatively quiet region of the radio spectrum in the universe and a range of wavelengths not significantly absorbed by material between the stars and galaxies. The water hole is bounded on one end by the 21 cm emissions from neutral hydrogen and on the other by the 18 cm emissions from the hydroxyl ion (OH). Because life is presumed to require the existence of liquid water, and water is composed of hydrogen and hydroxyl, this range was dubbed the water hole and seen as a natural window in which water-based life forms would signal their existence. That makes the water hole is a favorite of SETI projects.

"This is an interesting place, perhaps a beacon frequency, to look for signals from extraterrestrial civilizations," Siemion added.

The 86 stars were chosen from the 1,235 candidate planetary systems -- called Kepler Objects of Interest, or KOIs with the help of Kepler team member Geoffrey Marcy, professor of astronomy at UC Berkeley. UC Berkeley's targets include the 54 KOIs identified by the Kepler team as being in the habitable temperature range and with sizes ranging from Earth-size to larger than Jupiter; 10 KOIs not on the Kepler team's habitable list but with orbits less than three times Earth's orbit and orbital periods greater than 50 days; and all systems with four or more possible planets.

After the Green Bank telescope has targeted each star, it will scan the entire Kepler field for signals from planets other than the 86 targets.

A coarse analysis of the data by Werthimer and his team will be followed by a more thorough analysis by SETI@home users, who will be able to see whether they are analyzing Green Bank data as opposed to Arecibo data. The complete analysis for intelligent signals could take a year, Werthimer said.

"If you extrapolate from the Kepler data, there could be 50 billion planets in the galaxy," he said. "It's really exciting to be able to look at this first batch of Earth-like planets."

The Green Bank telescope is operated by the National Radio Astronomy Observatory, with funds provided by the National Science Foundation (NSF). SETI@home is supported by NSF, NASA and private donations.

#### **Story Source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of California - Berkeley**.

<http://www.sciencedaily.com/releases/2011/05/110516102333.htm>

## Persuasive Speech: The Way We, Um, Talk Sways Our Listeners



*People who engage in frequent short pauses may be more successful in convincing others than those who are perfectly fluent. (Credit: © Yuri Arcurs / Fotolia)*

ScienceDaily (May 16, 2011) — Want to convince someone to do something? A new University of Michigan study has some intriguing insights drawn from how we speak.

The study, presented May 14 at the annual meeting of the American Association for Public Opinion Research, examines how various speech characteristics influence people's decisions to participate in telephone surveys. But its findings have implications for many other situations, from closing sales to swaying voters and getting stubborn spouses to see things your way.

"Interviewers who spoke moderately fast, at a rate of about 3.5 words per second, were much more successful at getting people to agree than either interviewers who talked very fast or very slowly," said Jose Benki, a research investigator at the U-M Institute for Social Research (ISR).

For the study, Benki and colleagues used recordings of 1,380 introductory calls made by 100 male and female telephone interviewers at the U-M ISR. They analyzed the interviewers' speech rates, fluency, and pitch, and correlated those variables with their success in convincing people to participate in the survey.

Since people who talk really fast are seen as, well, fast-talkers out to pull the wool over our eyes, and people who talk really slow are seen as not too bright or overly pedantic, the finding about speech rates makes sense. But another finding from the study, which was funded by the National Science Foundation, was counterintuitive.

"We assumed that interviewers who sounded animated and lively, with a lot of variation in the pitch of their voices, would be more successful," said Benki, a speech scientist with a special interest in psycholinguistics, the psychology of language.

"But in fact we found only a marginal effect of variation in pitch by interviewers on success rates. It could be that variation in pitch could be helpful for some interviewers but for others, too much pitch variation sounds artificial, like people are trying too hard. So it backfires and puts people off."

Pitch, the highness or lowness of a voice, is a highly gendered quality of speech, influenced largely by body size and the corresponding size of the larynx, or voice box, Benki says. Typically, males have low-pitched voices and females high-pitched voices. Stereotypically, think James Earl Jones and Julia Child.

Benki and colleagues Jessica Broome, Frederick Conrad, Robert Groves and Frauke Kreuter also examined whether pitch influenced survey participation decisions differently for male compared to female interviewers. They found that males with higher-pitched voices had worse success than their deep-voiced colleagues. But they did not find any clear-cut evidence that pitch mattered for female interviewers.

The last speech characteristic the researchers examined for the study was the use of pauses. Here they found that interviewers who engaged in frequent short pauses were more successful than those who were perfectly fluent.

"When people are speaking, they naturally pause about 4 or 5 times a minute," Benki said. "These pauses might be silent, or filled, but that rate seems to sound the most natural in this context. If interviewers made no pauses at all, they had the lowest success rates getting people to agree to do the survey. We think that's because they sound too scripted."



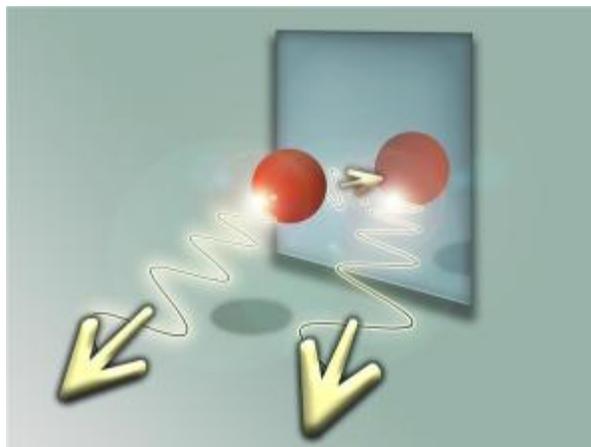
"People who pause too much are seen as disfluent. But it was interesting that even the most disfluent interviewers had higher success rates than those who were perfectly fluent."  
Benki and colleagues plan to continue their analyses, comparing the speech of the most and least successful interviewers to see how the content of conversations, as well as measures of speech quality, is related to their success rates.

**Story Source:**

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

<http://www.sciencedaily.com/releases/2011/05/110515122507.htm>

## The Atom and Its Quantum Mirror Image: Physicists Experimentally Produces Quantum-Superpositions, Simply Using a Mirror



*Towards the mirror or away from the mirror? Physicists create atoms in quantum superposition states. (Credit: Image courtesy of Vienna University of Technology)*

ScienceDaily (May 16, 2011) — Standing in front of a mirror, we can easily tell apart ourselves from our mirror image. The mirror does not affect our motion in any way. For quantum particles, this is much more complicated. In a spectacular experiment in the labs of the University of Heidelberg, a group of physicists at the University Heidelberg, together with colleagues at TU Munich and TU Vienna extended a 'thought experiment' by Einstein and managed to blur the distinction between a particle and its mirror image.

The results of this experiment have now been published in the journal *Nature Physics*.

### Emitted Light, Recoiling Atom

When an atom emits light (i.e. a photon) into a particular direction, it recoils in the opposite direction. If the photon is measured, the motion of the atom is known too. The scientists placed atoms very closely to a mirror. In this case, there are two possible paths for any photon travelling to the observer: it could have been emitted directly into the direction of the observer, or it could have travelled into the opposite direction and then been reflected in the mirror. If there is no way of distinguishing between these two scenarios, the motion of the atom is not determined, the atom moves in a superposition of both paths.

"If the distance between the atom and the mirror is very small, it is physically impossible to distinguish between these two paths," Jiri Tomkovic, PhD student at Heidelberg explains. The particle and its mirror image cannot be clearly separated any more. The atom moves towards the mirror and away from the mirror at the same time. This may sound paradoxical and it is certainly impossible in classical physics for macroscopic objects, but in quantum physics, such superpositions are a well-known phenomenon.

"This uncertainty about the state of the atom does not mean that the measurement lacks precision," Jörg Schmiedmayer (TU Vienna) emphasizes. "It is a fundamental property of quantum physics: The particle is in both of the two possible states simultaneously, it is in a superposition." In the experiment the two motional states of the atom -- one moving towards the mirror and the other moving away from the mirror -- are then combined using Bragg diffraction from a grating made of laser light. Observing interference it can be directly shown that the atom has indeed been traveling both paths at once.

### On Different Paths at the Same Time

This is reminiscent of the famous double-slit experiment, in which a particle hits a plate with two slits and passes through both slits simultaneously, due to its wave-like quantum mechanical properties. Einstein already discussed that this can only be possible if there is no way to determine which path the particle actually chose, not even precise measurements of any tiny recoil of the double slit plate itself. As soon as there even a theoretically possible way of determining the path of the particle, the quantum superposition breaks down.

"In our case, the photons play a role similar to the double slit," Markus Oberthaler (University of Heidelberg) explains. "If the light can, in principle, tell us about the motion of the atom, then the motion is unambiguously determined. Only when it is fundamentally undecidable, the atom can be in a superposition state, combining

both possibilities." And this fundamental undecidability is guaranteed by the mirror which takes up the photon momentum.

#### **Quantum Effect -- Using Only a Mirror**

Probing under which conditions such quantum-superpositions can be created has become very important in quantum physics. Jörg Schmiedmayer and Markus Oberthaler came up with the idea for this experiment already a few years ago. "The fascinating thing about this experiment," the scientists say, "is the possibility of creating a quantum superposition state, using only a mirror, without any external fields." In a very simple and natural way the distinction between the particle and its mirror image becomes blurred, without complicated operations carried out by the experimenter.

#### **source:**

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Vienna University of Technology**.

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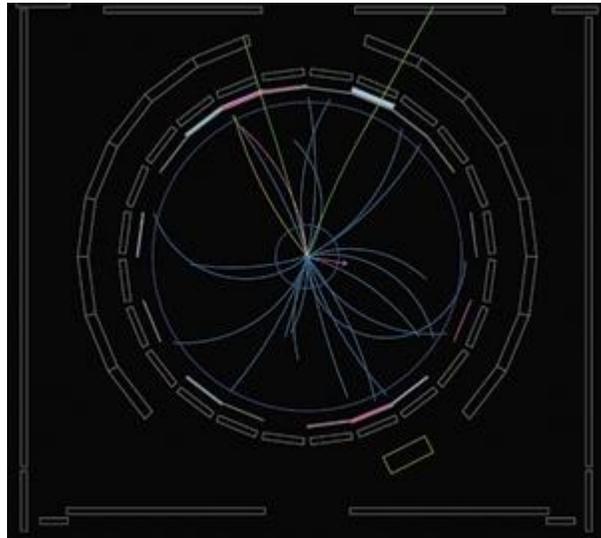
#### **Journal Reference:**

1. Jiří Tomkovič, Michael Schreiber, Joachim Welte, Martin Kiffner, Jörg Schmiedmayer, Markus K. Oberthaler. **Single spontaneous photon as a coherent beamsplitter for an atomic matter-wave.** *Nature Physics*, 2011; DOI: [10.1038/nphys1961](https://doi.org/10.1038/nphys1961)

<http://www.sciencedaily.com/releases/2011/04/110405084252.htm>

## Weird 'unparticle' boosted by Tevatron signal

- 19 May 2011 by [Kate McAlpine](#)
- Magazine issue [2813](#)



Do B mesons hold the answer? (Image: Fermilab/SPL)

ELASTIC "unparticles" could explain a mysterious signal glimpsed at a particle collider a year ago. That would link a tenuous but intriguing idea to one of the biggest mysteries in physics: why matter prevails over antimatter in the universe.

"I think this will increase the unparticle's credibility as a theory," says Run-Hui Li of Yonsei University in Seoul, South Korea, the leader of one of two teams proposing the link.

Matter and antimatter are thought to have been created in equal amounts after the big bang, yet something has caused matter to be far more dominant than antimatter, at least in our patch of the universe.

A possible explanation is that some physical processes favour matter. For example, according to the standard model of particle physics, particles known as B mesons constantly switch, or mix, between their matter and antimatter forms. Because it is slightly easier for an anti-B meson to become a normal B meson than vice versa, an imbalance accrues. This "uneven mixing" gets transferred to the particles produced when B mesons decay, but alone is not big enough to explain the observed matter-antimatter asymmetry.

Previously, several teams have glimpsed examples of asymmetry even larger than the standard model predicts. In May 2010, researchers at the Fermi National Accelerator Laboratory in Batavia, Illinois, reported a 1 per cent preference for the number of B mesons produced in their particle smasher, the Tevatron ([arxiv.org/abs/1005.2757](http://arxiv.org/abs/1005.2757)). This is 40 times larger than the imbalance predicted by the standard model.

Two separate groups now suggest an explanation for this larger asymmetry lies in the unparticle, a hypothetical entity conjured up in 2007 by theorist Howard Georgi of Harvard University. Georgi suggested that a property known as scale invariance - seen in fractal-like patterns that remain unchanged even when you zoom in and out to different scales, like the branching of redwood trees and the jagged edges of coastlines -



could apply to individual particles too. The charge and spin of unparticles would be fixed but, counter-intuitively, their mass would somehow vary depending on the scale at which an observer viewed the particle.

Such unparticles could play a role in a popular proposed extension to the standard model, known as supersymmetry.

Xiao-Gang He and his colleagues at Shanghai Jiao Tong University in China calculate that unparticles might also affect the lifetimes of B mesons. That is because quantum mechanics dictates that if they exist, "virtual" versions must exist too. Such transient unparticles would pop in and out of existence and could sometimes affect the lifetimes of real B mesons. And if this influence differed between the B meson and its antimatter counterpart, it could enhance the already uneven mixing predicted by the standard model enough to account for the mysterious Tevatron signal (*Journal of Physics Letters B*, DOI: [10.1016/j.physletb.2011.03.001](https://doi.org/10.1016/j.physletb.2011.03.001)).

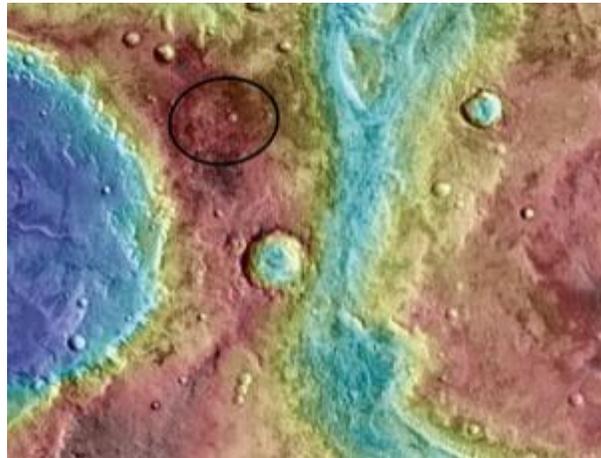
The unparticle's elastic mass means it could conceivably have avoided detection in the Tevatron until now. A separate group led by Li has come to a similar conclusion [arxiv.org/abs/1012.0095](https://arxiv.org/abs/1012.0095).

Bruce Hoeneisen, a member of the Fermilab team that saw the B meson imbalance in 2010, says other options, including new types of quarks not currently included in the standard model, could explain the Tevatron signal. He also cautions that the Tevatron finding requires confirmation.

<http://www.newscientist.com/article/mg21028136.400-weird-unparticle-boosted-by-tevatron-signal.html?full=true&print=true>

## Where should NASA land its next Mars rover?

- 19 May 2011 by **David Shiga**
- Magazine issue 2813.



Mawrth Vallis, lovely in August (Image: JPL/NASA)

**Win a piece of Mars:** See [here](#) for a chance to win your very own Martian meteorite

WITH NASA's rover Curiosity due to blast off for Mars in November, the debate over the most interesting place to send it is coming to a head. The stakes are high: the \$2.5 billion mission offers the best chance yet of finding hints of past life on the planet.

Curiosity, aka the Mars Science Laboratory, weighs 900 kilograms. The biggest and most capable rover yet by far, it is the first to carry instruments designed specifically to detect complex carbon-based molecules that could signal life. It will also lay the groundwork for a future mission that will drill below the surface, where organic material would be better preserved. "Awesome science is going to come out of this," says John Mustard of Brown University in Providence, Rhode Island.

Curiosity will land in August 2012, and over the past few years scientists have put together a shortlist of the best sites for it to explore. This week, researchers debated the merits of the four finalists ([see below](#), with a map [here](#)) at a meeting in Monrovia, California. "They all have deposits that appear to have been put in place by running water," says Ross Irwin of the Planetary Science Institute, which is based in Tucson, Arizona.

One key factor in deciding between them is the distance Curiosity would have to drive to get to the site's most interesting rocks. "If you have to wait six months to do the science you want, that's going to be a nail-biting six months," Mustard says, explaining that the rover or its instruments could potentially break down along the way.

Another point of contention is whether it is necessary to understand the site's basic history. For example, it is agreed that a river once flowed into a lake in Eberswalde crater, leaving behind a fan of sediment. That is the sort of feature that traps organic material on Earth, so if it were chosen, scientists would know what to look for and where.

Mawrth Vallis (circled above) is more mysterious. It has clay minerals that must have formed in liquid water, but the water's source is unclear. Still, it has the oldest rocks of all the sites, offering a unique window into the first few hundred million years of Martian history. "That's when life got started on Earth," says Mustard, suggesting the same might be true of Mars.

NASA will decide on a landing site in June or July.

### **Proposed landing sites**

#### **Gale Crater**

A 5-kilometre-high mountain of sedimentary rock that probably formed in the presence of water rises in the middle of the crater. The rocks, which include clays, form distinct layers laid down progressively over time. This offers a gold mine of information about past climate conditions on Mars, probably over a longer time span than any of the other sites. It's too dangerous to land on the mountain itself, so the rover would drive there from the crater's periphery. But the landing site has interesting science of its own to offer, boasting a fan of sediment from a river that once flowed into the crater.

#### **Mawrth Vallis**

This is the most mysterious of the sites and appears to be the oldest. Some of its rocks probably date to just 500 million years after Mars formed. Clay minerals are especially abundant here, but it is unclear whether the water that formed them came from lakes, rivers or underground reservoirs. That means researchers have a hazier idea of what they might find here. The rover could land directly on the clay-rich area, though, rather than having to drive there.

#### **Eberswalde Crater**

A river once flowed into this crater lake, dumping a huge fan of sediment on its floor. The river may have run for thousands of years, giving any life plenty of time to get a foothold here. The sediment may have trapped organic material that could be a sign of any such life, but the terrain containing the sediment fan is too rugged to land on. Curiosity would drive there from a flatter part of the crater, which was once a lake bed.

#### **Holden Crater**

Right next to Eberswalde, it hosts several fans of sediment that were deposited by water that gushed into the crater in several places. The fans are good places to look for trapped organic material. There are also outcrops that might be the remains of hot springs, which would be good places to look for signs of past life. The area containing the fans in Holden crater is flat enough to land on. However, it is not clear whether Holden hosted a long-lived lake like the one in Eberswalde.

<http://www.newscientist.com/article/mg21028136.800-where-should-nasa-land-its-next-mars-rover.html>

## 'Lonely planets' may outnumber star-hosted worlds

- 18:00 18 May 2011 by **MacGregor Campbell**



Orphaned planets may be quite common (Image: NASA/JPL-Caltech/R Hurt)

"Lonely" planets, hurled into empty space after gravitational tussles with their siblings, may be 50 per cent more common than planets orbiting stars.

Most planet search techniques turn up worlds close to stars, because they are easier to detect. But microlensing – in which a planet passes in front of a background star, temporarily magnifying its light – can find more distant ones.

Takahiro Sumi of Osaka University in Japan and colleagues observed 50 million stars in the Milky Way at least once an hour for about two years to hunt for such signals. They found 10 objects of about Jupiter's mass that did not seem to have host stars.

Their technique cannot rule out the existence of host stars for these objects, but it does suggest that any stars are at least as far away from the planets as Saturn is from the sun. They argue that the paucity of planets imaged at wide separations from their host stars suggests that about three-quarters of the 10 new objects are not bound to stars.

### **Precise alignment**

Ten objects does not sound like a lot, but microlensing events are very rare, because they require the precise alignment of a background star, the planet "lens" and Earth. So the researchers say the new observations imply that lonely planets are 50 per cent more common than planets that have host stars and nearly twice as common as stars in the galaxy.

Steinn Sigurdsson of Pennsylvania State University in University Park is not convinced by the team's argument that 75 per cent of the newly found objects are actually not bound to any star. But he says the work does suggest that a large number of planets do float free through the galaxy.

Sara Seager of the Massachusetts Institute of Technology says the new study suggests that planets are frequently thrown out of their planetary nests through gravitational interactions with other members of their



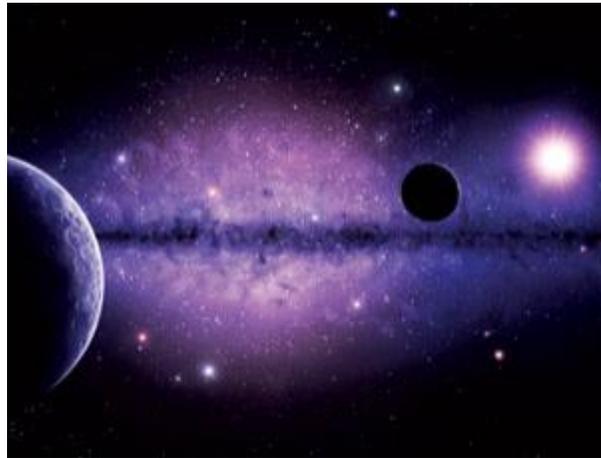
brood. Sumi agrees: "The discovery of these unbound planets inform us how many planets have been created and ejected from their orbit."

*Nature*, DOI: 10.1038/nature10092

<http://www.newscientist.com/article/dn20491-lonely-planets-may-outnumber-starhosted-worlds.html>

## No place like home: Our lonesome solar system

- 18 May 2011 by **Lee Billings**
- Magazine issue 2812



Our galaxy is home to many solar systems - but how many like our own? (Image: Mark Garlick/SPL)

*Two decades of searching have failed to turn up another planetary system like ours. Should we be worried?*

IT WAS David Latham's misfortune that his email was time-stamped 1 April 1988. An astronomer at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, he was engaged in the then faintly disreputable task of searching for planets orbiting other stars. As he excitedly wrote to a colleague, he had found something: a body orbiting an ordinary yellow star, known only by its catalogue designation HD 114762, some 130 light years from Earth.

For Latham's peers, this was nothing more than an April Fool. If the object had been a planet, it would have gone against all we thought we knew about how planets - and indeed solar systems - could look.

Two decades on, planet-hunting is high fashion, and Latham has been vindicated. With hundreds of worlds known and more being discovered every week, planets and solar systems that break the rules are commonplace. In fact, they could well be the rule. It's time to ask the question: is our solar system actually the odd one out?

Sophisticated ideas about the formation and evolution of planetary systems go back to the philosopher Immanuel Kant, who in 1755 noted that the solar system's planets all orbit in the same plane around the sun's equator. This led him to the "nebular hypothesis": that the sun formed as a great cloud of gas and dust collapsed inward, and worlds coalesced in a spinning disc of material around its midriff. Looking to the heavens, Kant saw fuzzy spiral wisps that he interpreted as such nascent solar systems.

We now know these are galaxies, not solar systems, but the nebular hypothesis has remained at the heart of our ideas about planetary formation. Four decades after Kant first proposed it, the French mathematician and astronomer Pierre-Simon Laplace reformulated the theory in the precise, calculable terms of Newtonian gravity. Recently, computers capable of crunching through many millennia of world-making in a single afternoon have allowed us to model the process and produce a menagerie of planets like those in our neighbourhood.



And so we came to believe that our solar system's story was universal. "Politically, socially, religiously - it's human nature to adopt the environments within which we live as universal norms," says Geoff Marcy of the University of California, Berkeley, the doyen of planet hunters who has more confirmed alien worlds to his name than anyone else.

The idea that planets coalesced serenely from a rotating disc of gas and dust led to a seemingly reasonable set of rules about how solar systems should look. First, only rocky planets resembling Earth and Mars could populate the hot inner regions close to a star; giant planets like Jupiter would be restricted to the cooler outer regions, where ice, gas and dust can readily stick together and snowball to enormous sizes. Second, giant planets could not grow much bigger than Jupiter before their feedstock of gas and dust would be depleted. Third, planets would have more or less circular orbits in a plane around their star's equator.

Latham's putative planet broke all three rules. It had an estimated mass 11 times that of Jupiter, yet was close to its star, with an orbit similar to Mercury's in our solar system. It also raced around its orbit in a highly eccentric manner, tracing a squashed, elongated oval rather than a near-perfect circle.

"The theoreticians weren't ready to accept it," says Latham. "It was three strikes and you're out." By the time he and his colleagues came to publish a paper about their discovery in May 1989, they meekly termed it a "probable brown dwarf" - in other words, a failed star (Nature, vol 339, p 38).

In the event, it was a drop of rain before a storm. In 1995, Michel Mayor and Didier Queloz of the Geneva Observatory in Switzerland discovered a gas-giant planet with a mass similar to Jupiter's in a scorching four-day orbit around the sun-like star 51 Pegasi (Nature, vol 378, p 355). Within a year, Marcy and his colleague Paul Butler, both then at San Francisco State University in California, had confirmed that discovery, and also found two more "hot Jupiters". Later that year, they confirmed Latham's discovery as a planet.

It was clear we had ignored a fundamental rule of science. "We had been judging the cosmic diversity of planetary systems based on a sample size of one," says Marcy.

If these were the first hints that our solar system was not normal, they were not the last. Other planets were soon caught breaking all sorts of rules: orbiting in the opposite direction to their star's spin, coming packed in close orbits like sardines in a can, or revolving on wildly tilted orbits far away from their star's equator (see diagram).

There are many good reasons to believe that planets do form in circular orbits in more or less the same plane, as Kant had suggested. But it appears they do not always stay that way. Soon enough, theorists began to supply the necessary creation stories. Young worlds might drag against dust and gas yet to be hoovered up into a planet, losing momentum and spiralling inwards towards their star to be consumed or, perhaps, to become hot Jupiters. Others might tussle gravitationally with another member of their brood, with the loser being flung out into the void and the winner left in a disturbed, elliptical orbit.

The reality of such restless young planets soon began to rewrite our solar system's history, too. Uranus and Neptune seem rather large for their positions in the extremities of the solar system, where the sluggish pace of detritus orbiting the sun would have slowed the accretionary processes of planet-building. It is plausible that they formed closer to Jupiter and Saturn, and a gravitational tussle between these two giants scattered them out to their present orbits. Such ructions might also have hurled water-rich comets into the dry inner solar system, which could explain massive crater fields on our moon, and perhaps even the existence of oceans on Earth (New Scientist, 25 November 2006, p 40).

That is still a relatively sedate history on the evidence of other solar systems, yet it did not occur to us to ask whether our neck of the woods might be strange. The multiplicity of oddball planets, we thought, said more about the limitations of our observations than the prevalence of solar systems like ours.

This is because almost all the early discoveries were made using the Doppler, or radial velocity, technique. This looks for changes to stars' motion caused by tiny gravitational tugs from orbiting planets. Such tugs are bigger for more massive planets orbiting closer in - so if hot Jupiters can exist at all, it is no surprise that we see very many of them.

A similar bias affects transit photometry, a technique first demonstrated in 2000 by two teams, one involving Latham and one involving Marcy (*The Astrophysical Journal*, vol 529, p [L41](#) and [L45](#)). If a planet happens to be aligned so that during its orbit it crosses, or transits, the face of its star as viewed from Earth, its shadow can be detected as a slight dimming in the star's light.

With sufficient sensitivity this method can detect smaller rocky planets in a star's habitable zone where liquid water can exist. Finding planets of any size in a system's outer reaches is more problematic. Here, the large separation between the planet and the star reduces the probability of transit alignments, and the greater time between transits makes observation even more unlikely. Viewed from afar Jupiter, for example, would cross the face of the sun only once every 12 years.

Not seeing the outer reaches of solar systems is a big stumbling block to finding one that resembles ours - and one that might support life. "We need to understand things further out if we want to understand a system's habitability at all," says [Scott Gaudi](#) of Ohio State University in Columbus. Comets unleashed by wandering giant planets may have supplied the water that kicked Earth into life, but equally could exterminate any life already present on an inner planet. Finding and categorising outer giants in other solar systems would be a significant step towards understanding how likely such processes are.

A decade ago, Gaudi and his colleague Andrew Gould set out to find planets of Jupiter, Saturn, Uranus and Neptune's ilk using a technique called gravitational microlensing. This exploits Einstein's prediction that massive objects bend the fabric of space. If a star passes in front of a much more distant background star, it will focus the light from the distant star just as a lens would. If the foreground star has planets, they can produce a smaller, secondary focusing effect, the size of which depends on the planets' masses and orbital distances.

### Wandering giants

The chances of seeing this effect are astronomically low; large swathes of sky with hundreds of thousands of stars must be monitored to catch its rare occurrences, only a handful of which can be conclusively ascribed to planets. Crucially, though, the secondary lensing effect is strongest when the planet is both large and well-separated from its star - like Jupiter, in other words.

Gould and Gaudi's first analysis in 2000 took in the sparse microlensing data then available, and drew a blank: there seemed to be no giant planets out there in the right place at all. Since then, tens of millions of stars have been tracked, providing thousands more microlensing events. In January last year, the duo announced the results of a new statistical analysis. Starting with the assumption that all the solar systems spotted would have outer planets like ours, they concluded that, given possible variations in how the planets would be configured, six such systems should have been seen. In fact, the tally was one: a red dwarf star with two outer planets analogous to Jupiter and Saturn (*Science*, vol 319, p [927](#)).

Ramped-up Doppler searches have had a little more success, discovering about 20 Jupiter-sized exoplanets in Jupiter-like orbits. But only two or three of these planets are on near-circular orbits. The rest are eccentrically

wandering giants that make life difficult not just for our theories, but for life itself. Their odd orbits would almost undoubtedly disrupt the circular paths of any accompanying Earth-like worlds, potentially casting them into the star or ejecting them from the system.

All this makes the status of our solar system increasingly clear. "Our system is a rarity, there's no longer a question about that," says Marcy. "The only question that remains is, just how rare is it?"

It is an opportune moment to ask: NASA's Kepler space telescope, launched in May 2009, promises a flood of new planets of all sizes. Early indications are that solar systems like ours are as elusive as ever. Take the system Kepler-11, revealed with great fanfare in February this year (Nature, vol 470, p 53). Its six transiting planets are between two and four times the size of Earth, and five of them would be within the orbit of Mercury. Based on their size and estimated density, all six worlds appear to be composed mainly of ice and gas, as if they formed far from their star.

How they migrated inward so gracefully is a mystery. Any ancient convulsions, we had supposed, would leave migrating worlds' orbits out of kilter. But Kepler-11's architecture is proportionally flatter than a vinyl record - far flatter than the planetary orbits in our own solar system, which lie around the equator of our sun only to within about 5 degrees either way. A third of the candidate planets found by Kepler so far seem to reside in similarly pancake-like configurations, implying a history even more sedate than ours.

"The diversity of these planetary systems tells us that our own is but one example in a very wide range," says Andrew Howard, a planet-hunter at the University of California, Berkeley. But it is not quite time to give up on another solar system that looks like ours, he adds. For Kepler to "find" a planet, that planet must transit across its star three times. Given a planned mission lifetime of three and a half years, Earth would have made the cut - just. But it would take 36 years for Jupiter to make the grade, 90 for Saturn, and even longer for Uranus and Neptune. "If we were looking from outside we still wouldn't have detected most of our solar system," says Howard.

### **The search for a second Earth**

While astronomers seek a planetary system that mimics the architecture of our own, the number of Earth-like worlds is another open question.

In October last year, Andrew Howard and Geoff Marcy of the University of California, Berkeley, released a census of planets orbiting within a quarter of the Earth-sun distance of 150 nearby sun-like stars. A few per cent have close-in planets Jupiter's size or greater, about twice as many have Neptune-mass planets, and at least 12 per cent harbour planets three times Earth's mass, the smallest in the sample. This trend would suggest that one in four sun-like stars have close-in planets Earth's size (Science, vol 330, p 653).

"It tells us that nature makes small planets," says Howard. And while life as we know it would be burned out on these planets, if there are that many planets close in, there are presumably quite a few further out at Earth-like distances. NASA's Kepler spacecraft is looking for transiting worlds in more than 150,000 stars within a small patch of sky in the constellations of Cygnus and Lyra. Its latest batch of data, unveiled on 2 February, contained around 1200 candidate planets, despite representing only a tenth of Kepler's slated three and a half year mission time. Tantalisingly, a handful of them were about the size of Earth.

*Lee Billings is a freelance writer based in New York*

<http://www.newscientist.com/article/mg21028122.700-no-place-like-home-our-lonesome-solar-system.html>

## Sailbots head for the high seas

- 17 May 2011 by **Jacob Aron**
- Magazine issue 2812.



Protei might clear oil spills one day (Image: Cesar Harada, Hunter Daniel, Markiko Toyoji)

PEOPLE have been sailing the world for centuries, but ask a robot to do the same and it quickly falls down.

Last year Mark Neal, a computer scientist at the University of Aberystwyth, UK, oversaw the launch of Pinta, a robotic sailing boat that set off from the west coast of Ireland in an attempt to be the first automaton to cross the Atlantic Ocean. His team lost communication with the boat just over two days later. The voyage was still an achievement: "Forty-nine hours is the longest period of unattended autonomous sailing that has happened," says Neal.

When uncrewed aircraft can master flight so readily, it might seem strange that it is so hard for a robot to sail a boat. In fact, the challenges are very different. "Some of the longest unmanned aerial vehicle (UAV) flights are a day or two. If something stays up for 24 hours, that's a pretty outstanding achievement," says Neal. In contrast, a useful robo-boat needs to run for months using only sails and solar power ([see "Why build a robot sailor?"](#)). During that time the solar panels could get caked with salt, the craft could be damaged, and barnacles and weed could grow on the rudder.

What's more, while UAVs have to cope with weather changes, the conditions they operate in are fairly stable compared with those of the ocean, Neal says. "The boat needs to deal flexibly with an unpredictable environment," says Roland Stelzer of the Austrian Society for Innovative Computer Sciences in Vienna. Stelzer is in charge of Roboat, an automated 3.75-metre-long boat that has won the World Robotic Sailing Championship for the past three years by successfully completing tasks including a 24-hour endurance race and navigation between tightly spaced buoys.

Stelzer puts Roboat's success down to its computer "brain", which mimics two human sailing abilities. One system plots the best route by calculating the heading that takes best advantage of wind speed and direction in relation to the destination.

The other keeps the boat on the desired course. It does this by considering factors like how far the boat is heeling and whether waves have pushed it off course, and then adjusting the rudder position to make both small corrections and sudden turns.

However, each competition took place within 4 kilometres of the shore. "We had to monitor the boat all the time either from shore or on a chasing boat," Stelzer says.

The Pinta is smaller and less sophisticated, in case the boat is lost at sea. Stelzer's craft might be robust enough to cross the Atlantic, but he is reluctant to try - losing such an expensive rig would be a huge setback.

Instead, the first robotic sailors to spend long periods at sea may come from the Protei project, which aims to build autonomous craft for cleaning up oil spills. Conceived by designer Cesar Harada, who also leads the project, the boats have a unique articulated design that allows the hull to flex in order to best use the wind while turning.

The hardware is open source, meaning that anyone can work on or modify the design and help solve problems. "It's a collaboration with people worldwide contributing their best knowledge and enthusiasm," says Peim Wirtz, who manages the project from the V2 centre in Rotterdam, the Netherlands. The concepts behind Protei have undergone small-scale tests, and the team will now build a full-scale prototype after raising nearly \$35,000 on the crowd-funding website Kickstarter last month. "We have over 300 backers that thought the initiative was worth sponsoring," says Wirtz.

So will we see robots sail the seas any time soon? Wirtz hopes to complete the Protei prototype by September and Pinta will be making another transatlantic attempt at the same time. "If we didn't think it was possible, we wouldn't be trying," Neal says. "Someone will do it, and I'd like that to be us."

### **Why build a robot sailor?**

A boat that sails itself would be a nice bit of tech, but what are the practical benefits? A craft using only sails and solar power would be ideal for long-term missions, says Roland Stelzer of the Austrian Society for Innovative Computer Sciences.

"In the future, autonomous sailing boats will be used for tasks such as maritime monitoring, reconnaissance and surveillance, and carbon dioxide-neutral transportation of goods," he says. Robotic sailboats could also operate in swarms, allowing them to tackle large-scale problems like gathering meteorological data in remote stretches of ocean or measuring water pollution. They could even be used to rescue refugees.

<http://www.newscientist.com/article/mg21028126.400-sailbots-head-for-the-high-seas.html>

## Laser-guided wheelchair helps visually impaired

17:49 19 May 2011

Healthcare

Lasers

*Jacob Aron, technology reporter*



*(Image: Luleå*

*University of Technology)*

Researchers at the Luleå University of Technology in Sweden have developed an electric wheelchair that lets visually impaired users "see" their surroundings.

The vehicle uses a laser to scan its environment and create a 3D map of potential obstacles such as nearby people or open doors. It alerts the wheelchair driver to these hazards via vibrating touch feedback, which lets them feel when they need to move out of the way using the wheelchair's joystick.

Daniel Ahlmark, one of the researchers who is himself visually impaired, tested the system last week in a crowded corridor. He was able to successfully avoid obstacles along the way, saying the driving the wheelchair "is like using a white cane."

The chair isn't quite ready to roll in to production though, as the researchers say there is room for improvement. The current laser system can only sense objects at a certain height, so they plan to develop a 3D camera system instead to fully map the surrounding environment.

<http://www.newscientist.com/blogs/onepercent/2011/05/laser-guided-wheelchair-helps.html>

## 2020 vision: Eat a printed dinner in your printed home

- 19 May 2011 by **Bobbie Johnson**
- Magazine issue 2812.



Hot off the press (Image: Loungepark/Stone/Getty)

It's early evening and you pull the car into the drive of your new home that was erected in just two days. Since it is your wife's birthday, you are clutching a personalised gold necklace that you picked up from the printer. For dinner tonight, you won't need to do any chopping or peeling - ingredients just go straight into your kitchen fabricator.

Creating objects, buildings and food on demand will soon become commonplace, thanks to 3D printing. To produce an object, a 3D printer pipes out the chosen material - metal or plastic, say - one thin layer at a time to build up the required shape. Early printers used plaster or resins, which were sometimes brittle or slow to dry. New materials, such as ABS plastics and photopolymers, offer greater flexibility and robustness to help 3D printers create a wider variety of objects.

Smaller scale 3D printing is already used for making personalised jewellery and customised industrial parts. And it is increasingly being employed on a grander scale - for example, in trial projects where buildings are constructed by huge gantry robots that pour fast-setting concrete.

Biofabrication is also being combined with 3D printing to produce artificial bones. Sangeeta Bhatia, at the Massachusetts Institute of Technology, who has created tissue that can be used to bioprint human livers, knows what she is hoping for: "Someday, personalised organs on demand." Combined with other tissue culture methods, this could reduce possible complications by producing organs that are tailored to fit the recipient's needs precisely. No more using adult organs for children, for instance.

It's a dramatic example, but it demonstrates how far the influence of 3D printers could reach as their price falls. Industrial manufacturing could be transformed, with companies able to deliver many more designs and parts on demand. Alternatively, consumers could bypass large-scale manufacturing altogether and have objects printed locally or in their own homes. Global import and export patterns could shift dramatically.

Eventually, almost anything could conceivably be printed, copied or customised. Conjuring up anything you want could be as easy as pushing a button.



## Lexicon of tomorrow: FAB

### -verb

To create an object using a 3D printer. Short for "fabricate". *John fabbed a pretty necklace for his wife's birthday*

<http://www.newscientist.com/article/mg21028121.700-2020-vision-eat-a-printed-dinner-in-your-printed-home.html?full=true&print=true>

### Static charge provides clue to age of fingerprints

- 19 May 2011 by **Wendy Zukerman**
- Magazine issue 2812.

JUSTICE will be done more often: a new method of fingerprint analysis could not only detect prints but also reveal when they were made.

Techniques for capturing a fingerprint are far from perfect. Besides the well-known method of dusting, there are several more sophisticated ways of detecting fingerprints, but all have limitations. Software analysis and chemical agents can often enhance a fingerprint, but can sometimes muddle the pattern instead. And while atomic force microscopy can pick up fingerprint residues precisely, the technique scans such a small area at a time that it can often take hours to assemble a single print.

Now Robert Prance and colleagues at the University of Sussex in Brighton, UK, have developed a way to capture fingerprints by looking at the small amount of static charge left behind when a finger makes contact with an insulating surface such as plastic or glass.

The team passed an electrode over two fingerprints on a piece of plastic and measured the change in voltage as it passed over the surface. Within 75 minutes, the technique had revealed the prints with "comparable quality to conventional fingerprint images", says Prance.

By performing the same measurement each day for 14 days, the team was also able to show how the charge decayed over time (*Forensic Science International*, DOI: [10.1016/j.forsciint.2011.02.024](https://doi.org/10.1016/j.forsciint.2011.02.024)).

While the method still needs to be tested on different surfaces and under various conditions, Prance says it could be used to work out when a fingerprint was made.

The technique could therefore provide clues as to when a crime was committed, or exclude people from an investigation if their fingerprints were made before or after the crime is known to have taken place. "This is a significant advantage over more conventional fingerprint enhancement methods," says Glenn Porter, a forensic scientist at the University of Western Sydney, Australia.

The main limitation of the technique is that it only works with prints left on insulating surfaces. If a fingerprint is left on a conducting material, such as a metal bullet casing, the charge deposited would simply flow away.

<http://www.newscientist.com/article/mg21028126.800-static-charge-provides-clue-to-age-of-fingerprints.html>

## Don't invent, evolve

- 18 May 2011 by **Paul Marks**
- Magazine issue [2812](#). **[Subscribe and save](#)**



Evolving invention (Image: Ed Honowitz/The Image Bank/Getty)

We are on the cusp of a new era in the history of invention. That's the implication of software that can automatically "evolve" technology, and create designs that often no human would come up with. It's already transforming fields as diverse as robot locomotion, computer security and drug design.

Genetic algorithms mimic natural selection by describing a design as if it were a genome constructed from segments. Each segment describes a parameter of the invention, varying from its shape, say, to much finer grained aspects, such as electrical resistance or a chemical's molecular affinities. By randomly changing some segments - or "mutating" them - the algorithm improves the design. The best results are then bred together to improve things further.

Until now your average desktop computer didn't have the processing power to crunch through millions of generations and chuck out the undesirable mutants. That's now changed, so genetic algorithms are poised to have a profound effect on R&D, says John Koza at Stanford University in California, who has pioneered their use in engineering design. He has "bred" designs for efficient radio antennas this way. What's really interesting, he says, is that it is not always clear why the evolved invention works: no human would have

come up with his antenna's weird, zigzag shape. In addition, software can be set to design around existing patents.

Evolved invention is catching on in all sorts of fields, says Robert Plotkin, whose 2009 book *Genie in the Machine* tracked the rise of the technique. Drug discovery firms are becoming big users, for instance, evolving new molecular mechanisms to reach receptors no human would have thought of. The technique has also been used to improve the walking gaits of robots. "Most of the evolved inventions are not necessarily dramatic - but they are producing a steady stream of improvements," says Hod Lipson, a roboticist at Carnegie Mellon University in Pittsburgh, Pennsylvania. "The big picture is that they are having a profound cumulative effect in accelerating innovation."

Still, don't expect to hear inventors admitting they use genetic algorithms anytime soon: they will likely still take the credit for the work, says Lipson.

### **Lexicon of tomorrow: EVO**

#### **-noun**

An invention created by a genetic algorithm. *Sean patented his evo*

<http://www.newscientist.com/article/mg21028121.600-2020-vision-dont-invent-evolve.html>

## Renewable oil: Ancient bacteria could fuel modern life

- 18 May 2011 by **Ferris Jabr**

Magazine issue 2813.



Sun in, biofuel out (Image: Joule Unlimited, inc)

*Microbes with tweaked DNA can convert sunlight and carbon dioxide into oil, but will it ever power our cars?*

I'M STARING at a tank filled with bubbling liquid the colour of steamed spinach. Swimming inside are photosynthetic cyanobacteria. Although their kind are extremely common, these bacteria differ from their wild counterparts. Their DNA has been tweaked so that, given light, water and carbon dioxide, they secrete alkanes - the primary components of diesel.

Biotechnology company Joule Unlimited of Cambridge, Massachusetts, which grows the bacteria, envisions a future in which swathes of desert are packed with photobioreactors. These huge tanks, churning with the same spinach-green soup now in front of me, will pump out alkanes as the sun shines. There's another advantage to this solar-powered oil: the CO<sub>2</sub> the bacteria inhale could come from industry. Firms would no longer have to invest in technology to bury the greenhouse gas safely.

Understandably, such an optimistic vision has attracted plenty of press interest. But until now Joule has been tight-lipped about what the media has dubbed a "magic bug". My conversations at Joule, and a look at some of the firm's recently acquired patents, offer tantalising hints that the underlying science is sound.

Biofuels have been around for a while. Joule's system is an unusual member of the "third generation" of the technology. The first-generation fuels stalled largely because they had to compete with the food industry. Their feedstock, a mixture of sugars, starches and oils, came from sugarcane and corn. The second generation produced fuels from inedible cellulose and non-food crops, which are difficult to break down cost-effectively into the simple molecules found in fuels.

The latest biofuels are derived from microbes that can live on land unfit for crops and generate nearly engine-ready chemicals. Competition between third-generation biofuel developers is fierce (see "Invest and hope for the best"), but Joule has made impressive strides towards commercial success.

Most of its competitors use algae that squirrel away oil within their cells, but Joule's magic bugs are cyanobacteria that secrete the alkanes they generate, which float to the surface of the reactor for convenient collection. Even better, the alkanes have chains of carbon 13 to 19 molecules long, an ideal length for diesel, says Dan Robertson, Joule's senior vice-president of biological sciences.

Previous scientific studies provide evidence that some microbes, including a number of cyanobacteria, can synthesise alkanes. The genetic pathways involved have been unclear, but Joule's patents and a 2010 paper published by biotech rival LS9, based in San Francisco (*Science*, DOI: [10.1126/science.1187936](https://doi.org/10.1126/science.1187936)), suggest that both firms have pinpointed the genes and enzymes involved in species such as *Thermosynechococcus elongatus*, which inhabits hot springs. Robertson says that Joule has enhanced the expression of these genes and encouraged the microbes to secrete their alkanes. It helps that the DNA in prokaryotic cyanobacteria is easier to manipulate because it is not protected by a nucleus.

Microbiologists have become so adept at this kind of manipulation that they can coax bacteria to divert "the vast majority of their energy" into producing useful chemicals, says Cameron Coates, who is trying to produce fuels from microbes at the Scripps Institution of Oceanography in San Diego, California. Robertson says that Joule's microbes can convert 90 per cent or more of the carbon they fix during photosynthesis into alkanes or alcohols that can be used in fuels.

"Anything over 80 per cent to me is a surprise," says [Himadra Pakrasi](#), who researches cyanobacteria at Washington University in St Louis, Missouri. Coates agrees: "I haven't seen any peer-reviewed publication that backs up that figure. We won't know if they are accomplishing those yields until they show it at a large scale."

Coates may not have long to wait. Joule already has a pilot plant covering 0.8 hectares in Leander, Texas. On 5 May, the firm announced that it had secured 486 hectares in Lea County, New Mexico, for a plant to produce ethanol and diesel. The project may be scaled up to 2000 hectares.

With its engineered microbes, Joule claims to be able to produce ethanol at a rate of 93,000 litres per hectare per year, suggesting its New Mexico site will generate 45 million litres per year, rising to nearly 200 million litres if the site is expanded to 2000 hectares.

But what works in theory might not work in practice: so far no company has been able to mass-produce fuels using engineered microorganisms.

"From a scientific view a lot of what they say is possible, but it needs to be tested on a big scale," says [Louis Sherman](#), who studies cyanobacteria at Purdue University in West Lafayette, Indiana. "The theory sounds nice, but I want to see what happens after they have been in operation for a year or two. There are problems you can't anticipate."

### **Invest and hope for the best**

The third generation of biofuels is attracting millions of dollars of investment. In 2009 oil giant ExxonMobil committed \$600 million to develop algal biofuels with Craig Venter, the genome-sequencing pioneer. Such major investments are rare, but Venter can still expect some stiff competition.

Using cyanobacteria that secrete rather than store their oil, as does Joule of Cambridge, Massachusetts, saves the money that would be wasted cracking open oily cells. But it is not the only option.

San Francisco-based biotech firm [LS9](#) is also trying to harness cyanobacteria's knack of turning sunlight and CO<sub>2</sub> into oil. But instead of enhancing the expression of these genes in cyanobacteria themselves - as Joule is



doing - LS9 decided to transfer the genes to the laboratory workhorse *Escherichia coli*. Unlike cyanobacteria, *E. coli* must be fed to grow. But Stephen del Cardayre, vice-president of research and development at LS9, says the firm's approach has advantages. "One reason we chose *E. coli* is that it is one of the fastest growing organisms known," he says.

More speculatively, bacteria living in oxygen-poor soils or ocean sediments could provide an alternative route to third-generation fuels, according to Derek Lovley at the University of Massachusetts, Amherst. Lovley and colleagues have been generating electricity using *Geobacter*. To produce energy through cellular respiration, *Geobacter* transfers electrons to metals like iron in its oxygen-poor environments. Poke in a pair of electrodes and you can harness those electrons to generate a current, says Lovley.

By lowering the potential of the electrodes, Lovley discovered he could reverse the flow of electrons and force the bacteria to offload them onto carbon inside their cells to form acetate. With engineering, the bacteria could be made to turn that acetate into biofuel - an idea so new that Lovley is still working on proving the concept.

Promising as these technological advances seem, commercial success is not guaranteed. In 2006, high-profile start-up GreenFuels Technologies built an ambitious pilot plant at the Redhawk power plant in Arizona, designed to turn the plant's waste CO<sub>2</sub> into algal biofuel *New Scientist*, 6 October 2006, p 28. Although GreenFuels Technologies raised more than \$70 million in investments, it went bust in May 2009 because of the cost of maintaining its growth chambers and the difficulty of handling unpredictable algal growth.

<http://www.newscientist.com/article/mg21028136.200-renewable-oil-ancient-bacteria-could-fuel-modern-life.html?full=true&print=true>

## Wind is Japan's strongest alternative to nuclear

- 18 May 2011 by [Andy Coghlan](#)

Magazine issue [2813](#).



Northern Japan has ample potential for wind power (Image: Gyro Photography/Amanaimages/Corbis)

TWO months after the [explosions](#) and [radiation leaks](#) at the Fukushima Daiichi nuclear power plant in Japan, the prime minister, Naoto Kan, has [announced that the country will not build any new reactors](#).

If Kan really means it, the government will have to abandon the plans for expanding nuclear power it adopted only last year. To make up the energy shortfall, Kan has set the ambitious goal of using renewables.

That is most likely to mean wind, according to a [report released last month](#) by the Ministry of the Environment. There is "an extremely large introduction potential of wind power generation", it says, especially in the tsunami-hit north-east of the country.

"The potential of wind is huge because of the contribution from offshore generation with Japan's long coastline," agrees Tetsunari Iida, founder of the Institute for Sustainable Energy Policies in Tokyo, who advocates a 100 per cent switch to renewable energy by 2050. At present, Japan produces just 3 per cent of its electricity from renewables: solar, wind and geothermal. Nuclear contributes 30 per cent.

Taking into account wind strength, available land and the potential for offshore farms, the report estimates that Japan could install wind turbines with a capacity of up to 1500 gigawatts. More realistic estimates in the report suggest that with appropriate financial incentives, turbines with a capacity of 24 to 140 GW could be installed. Assuming the turbines operate a quarter of the time, this would provide up to 35 GW of electricity on average, matching the combined output of about 40 of Japan's existing 54 nuclear reactors.

Next in line is solar energy, which the report estimates could provide between 69 and 100 GW without taking up any productive agricultural land.

Perhaps surprisingly, given Japan's 120 active volcanoes and the 28,000 hot springs associated with them, [geothermal energy](#) scarcely figures in the ministry's report. At best, it says, only 14 GW is available, but much of that is inaccessible because of restrictions on development in national parks. At other sites, exploiting geothermal energy would disrupt springs currently used as spas.



A switch to renewables will require huge amounts of new infrastructure. This will need to be paid for by offering special tariffs as incentives for providers to feed energy from renewable sources into the grid. By coincidence, on the morning of 11 March - the day of the earthquake - the Japanese cabinet approved proposals that would achieve this. "It's under review by the parliament, and could provide a really big push for renewables if it's passed," says Iida.

The contribution from renewables to Japan's electricity supply is currently almost static, having increased from 3.1 to 3.3 per cent between 2008 and 2009. Iida blames "poor policy support" for this lack of growth. So it is possible that as the shock of Fukushima fades, support for renewables will go the same way. However, polls reported this week suggest that two-thirds of Japanese back a shift away from nuclear power.

<http://www.newscientist.com/article/mg21028136.600-wind-is-japans-strongest-alternative-to-nuclear.html>

## Sound test could identify 'locked-in' patients

- 19:00 12 May 2011 by Catherine de Lange



Anything going on in there? ([comascience.org/ULg](http://comascience.org/ULg))

It's the nightmare scenario: people think you are in a vegetative state when you are not. While some people with serious brain damage are totally unaware of their surroundings, others are in a "minimally conscious" state (MCS). These patients have some level of awareness but may be unable express it to those around them because of the injuries to their brain.

The discovery of a signalling pathway in the brain that is different in the two conditions could open the way to an easy and objective way of telling whether a particular patient has any remaining consciousness, even if they can't respond in an obvious way.

Being able to distinguish between these states would make it easier to decide whether or not to turn off life support-machines.

At present, making these assessments is time-consuming and subjective, and misdiagnoses are common, says Mélanie Boly from the University of Liège in Belgium.. An estimated 40 per cent of those thought to be in a vegetative state may actually be conscious on some level.

### EEG test

Now Boly and her colleagues think they have discovered a new way of telling these patients apart. They played irregular sounds to eight people previously diagnosed as being in a vegetative state, 13 people in a minimally conscious state and a healthy control group. All of the subjects were wired up to an electroencephalograph (EEG) machine, which can read brain activity through electrodes placed on the scalp.

When Boly's team compared how the three groups responded to the sounds, they found that the brains of healthy and MCS patients generated a much longer signal than patients in a vegetative state.

To explain this difference, Boly turned to a type of mathematics called dynamic causal modelling. "It uses the information we know about the brain – how neurons are connected for example – to see which processes might explain this activity at the scalp level."

The analysis pointed to a specific feedback mechanism between the temporal cortex, which is responsible for auditory processing, and a higher-level brain area called the frontal cortex. Both healthy and MCS subjects were able to send signals between these brain areas in both directions. In vegetative state patients, signals could pass from the auditory area to the frontal cortex, but not in the opposite direction.

Boly believes the loss of this so-called "top-down" process is what causes unconsciousness in brain-damaged patients, and that it can therefore be used to identify MCS patients. If further research backs up these findings, EEG could be used at the bedside of severely brain-damaged patients to diagnose their state of consciousness, Boly says.

Neuroscientist Nicholas Schiff at Weill Cornell Medical College in New York advises caution, however. The findings are ambiguous, he says, because of the small number of patients involved in the study. "Before it can be accepted as a diagnostic tool we need to test more patients," Boly says.

Journal reference: *Science*, DOI: 10.1126/science.1202043

<http://www.newscientist.com/article/dn20471-sound-test-could-identify-locked-in-patients.html>

## Gut reactions: the microbes that make you

- Updated 11:22 19 May 2011 by [Claire Ainsworth](#)
- Magazine issue [2812](#).



Your gut microbes act like an extra organ with many functions (Image: Steve Gschmissner/SPL)

*The moment we're born, microbes start building our internal ecosystems. **New Scientist** explores why your body's biodiversity matters*

AT WASHINGTON University's state-of-the-art Genome Institute they take an unusual interest in baby poo. They hope that studying fresh stool samples from the local neonatal unit will help them unlock the mystery of necrotising enterocolitis, a bowel disease that kills up to 5 per cent of premature babies. The disease obviously involves bacteria, yet it has proved impossible to pin the blame on just one microbe, suggesting that it may not be an infectious disease in the conventional sense. One possibility is that it is caused by a breakdown in the relationship between the gut bacteria and the body. If so, an abnormal combination of bacterial species in their stools may indicate which babies will get the disease. This is what they are looking for at Washington University in St Louis, Missouri.

The research is part of a bigger endeavour called the [International Human Microbiome Consortium](#), which aims to identify and study all the microbes living in and on our bodies. It is transforming our understanding of the organisms that colonise our gut. It turns out that the "germs" we do our best to exterminate with antibacterial sprays are not our enemies after all. In fact, we are locked in an intimate and vital relationship with them, and it shapes our physical development, helps train our immune systems and equips us with a set of metabolic abilities we would otherwise lack. Each of us is part of a vast and complex microbe-human ecosystem - less an individual than a "superorganism".

This realisation is forcing researchers to develop a more holistic approach to studying human biology. Instead of viewing necrotising enterocolitis as a regular infectious disease, for example, we may come to see it as nothing short of an ecological disaster - a catastrophic failure in interaction between species. Likewise, illnesses such as Crohn's disease and even common conditions such as obesity and diabetes could all have roots in our relationship with our gut flora. In fact, the increasing prevalence of such conditions suggests that our internal ecosystems may be under threat from our modern lifestyles, with profound consequences for our health. We may soon be worrying as much about the biodiversity inside our bodies as we do about our external environment.

Microbiologists researching the human microbiome are fond of citing statistics and no wonder, for the numbers are jaw-dropping. The average person is home to about 100 trillion,  $10^{14}$ , microbes - mostly bacteria but also some viruses, fungi, protozoans and archaeans. You are in a minority in your own body: microbial cells outnumber your cells by 10 to 1. Your microbes contribute perhaps a couple of kilograms to your body weight and they are everywhere, colonising your gut, mouth, skin, mucous membranes and genitals. In fact, the only time anyone is free from microbes is in the womb. You are born 100 per cent human, but die 90 per cent microbial. Between these two events lies a vista of unexplored ecology that helps make us what we are.

Nowhere is the transformation from individual to superorganism more dramatic than in the gut, which is home to the vast majority of our microbiome. During a normal birth, a baby picks up vaginal and faecal microbes from its mother. Babies born by caesarean section acquire a different suite of microbes from the hands of people who deliver them. In the first few months of life, gut flora undergoes several dramatic shifts as different species take root and blossom, responding to a baby's developing immune system and changes in its environment and diet. There are big differences between individuals depending on whether or not the infant is breastfed, for example. By age 3, the mature gut microbiome is in place, with the majority of microbes residing in the colon. Each of us carries hundreds of species from a total possible repertoire of more than 1000 different microbes (*Nature*, vol 464, p 59). The variation between individuals probably reflects factors such as genetic make-up, lifestyle, environment and diet. However, many microbial species are shared by us all, and the latest findings suggest that the overall ecological composition of microbes in any human gut falls into one of three basic groups, or "enterotypes" (*Nature*, DOI: [10.1038/nature09944](https://doi.org/10.1038/nature09944)).

There is no doubt that we would be in serious trouble without this internal menagerie. A balanced and healthy gut flora helps keep disease-causing microbes at bay by occupying their preferred niches. Gut flora are also involved in the development of the immune system. The gut, being on the front line with the germ-infested outside world, contains a large amount of immune tissue, which learns to distinguish microbial friends from foe by sampling the gut flora. In mice lacking a microbiome, immune tissue fails to mature properly and carries fewer of the molecules that sense and react to pathogens. Microbes even help shape the gut. Microvilli - the tiny folds that form the gut lining and increase the surface area through which food can be absorbed - develop abnormally in microbe-free mice.

Findings like these support the idea that our gut microbes act collectively to create a greater whole, a sort of extra organ with its own functions. But exploring how exactly the gut microbes interact has been difficult because the vast majority of them cannot be cultured in the lab. That all changed with the advent of genome technology. The ability to extract DNA directly from samples and sequence it spawned a wealth of studies that build a picture of what is living inside us - or at least, at the far end of the gut, where the faecal samples originate. It turns out that our colons are dominated by two main bacterial phyla, the Firmicutes and the Bacteroidetes, with smaller numbers of Proteobacteria. A tiny minority of the flora are fungi and protozoa, about which little is known. The same goes for the viruses that lurk in the gut, preying on the bacteria there. These seem to comprise mostly unknown species and vary hugely from one individual to another (*Nature*, vol 466, p 334).

Another approach, called metagenomics, is exploring what these gut microbes are capable of. Unlike conventional genome studies, which focus on individual organisms, this entails collecting all the genes in an ecosystem to create a global "metagenome" - effectively a parts list for the biological functions of that ecosystem. The most detailed inventory to date was published in 2010 by Metagenomics of the Human Intestinal Tract (MetaHIT), a European Union-based consortium. The researchers studied faecal samples taken from 124 European adults and found a staggering 3.3 million different microbial genes, meaning that they outnumber our own human gene set about 150-fold (*Nature*, vol 464, p 59). Not everyone had every microbial gene, but by comparing the individuals in the study the team identified a set of genes we all share. Capable of more than 6000 biochemical functions, this "minimal metagenome" represents the core genes needed for the survival of the entire ecosystem.

So what do these genes do? Many seem to be plugging metabolic gaps in our own genome. It is common knowledge that we are unable to synthesise enough vitamin B or any vitamin K without our gut flora, but microbes assume many other useful functions. For example, they contain genes that convert complex carbohydrates into simpler molecules called short-chain fatty acids, an important energy source accounting for between 5 and 15 per cent of our requirements. Other core genes break down plant cellulose and complex sugars such as pectin, found in fruit and vegetables, which allows us to digest foods we could not handle without them.

Gone is the idea that gut flora had a passive role in regulating our biochemistry. "We are now persuaded that they are very much more active," says Jeremy Nicholson at Imperial College London. He has found that your gut microbiome even affects your ability to metabolise and respond to the painkiller paracetamol (acetaminophen) (*Proceedings of the National Academy of Sciences*, vol 106, p 14728). The MetaHIT project also found microbial genes that seem to be involved in metabolising drugs and other non-dietary compounds, such as toxins and food additives. It looks as if drug companies will have to take our microbial metagenomes, as well as our own human genomes into account when designing new drugs. Personalised medicine just became vastly more complicated.

It is also becoming clear what can happen when our relationship with gut flora goes awry. Among the participants in the MetaHIT project was a group of people with inflammatory bowel diseases such as ulcerative colitis and Crohn's disease. Previous research suggested that this group would have a lower diversity of bacterial species in their guts. Sure enough, those in the MetaHIT study had 25 per cent fewer microbial genes than healthy people. Meanwhile, research in mice indicates that the balance of microbes in the gut can play a part in the development of type 2 diabetes. People with the disease harbour a greater proportion of Bacteroidetes bacteria than Firmicutes, according to research published last year (*PLoS One*, vol 5, p e9085).

Gut flora might also be associated with obesity. When a team led by Jeffrey Gordon from Washington University in St Louis took microbes from the guts of lean and obese mice and transplanted them into germ-free mice, they found that those with the microbiome of obese mice put on significantly more weight (*Nature*, vol 444, p 1027). Subsequent studies indicate that the microbiomes of obese humans have a greater ability to harvest energy from food (*Obesity*, vol 18, p 190).

While these associations are suggestive, it is not yet clear whether our gut microflora actually cause health problems or whether they simply change as a consequence. The system is so complex it will be hard to prove causation. With luck more detailed studies of the structure of the microbial communities in healthy and sick individuals will be a starting point for developing therapies. These might include drugs, probiotics, foods that alter the behaviour of our gut ecosystems, and even faecal transplants (*New Scientist*, 22 January, p 8). And this is just the beginning. The US Human Microbiome Project alone is being funded to the tune of \$115 million. It aims to study the microbiomes of 300 individuals, in the gut as well as numerous other sites in the body, analysing some 12,000 samples and investigating diseases including Crohn's and necrotising enterocolitis.

Meanwhile, other researchers are wondering whether the link with gut microbes might help explain why obesity, diabetes, autoimmune diseases and certain cancers are on the rise in western cultures. Could our modern lifestyles be having detrimental effects on the ecology of our microbiome? "We're exposed to all kinds of weird and wonderful foods that we didn't have before, and our environment is much cleaner," says Nicholson. That's not all - our tendency to overuse antibiotics could be inflicting lasting damage on our microbiomes. A study published this year showed that gut flora composition alters dramatically in response to a course of antibiotics, before starting to rebuild itself after about a week (*Proceedings of the National Academy of Sciences*, vol 108, p 4554). "It does mostly bounce back but certainly not quite all the way," says Les Dethlefsen from Stanford University in California, one of the research team. He speculates that repeated disturbances of the ecological balance of the gut microbiome could permanently shift the functioning of the

ecosystem - an alteration that would then be passed down from parent to child. "Every time we perturb the community, there is a roll of the dice," he says.

Working out what all this means, not to mention unpicking the staggeringly complex relationship between us, our microbes and all our genomes is one of the most daunting tasks today's biologists face. So it is perhaps fitting that tackling these hugely complex questions, will require cooperation across a diverse range of disciplines, forming a scientific superorganism if you like.

*When this article was first posted, the first paragraph of the body copy incorrectly said that necrotising enterocolitis kills up to 1 in 5 premature babies.*

### **Stool pigeon**

What do you carry around with you everywhere that betrays more about you than your passport or driver's licence? It's the contents of your colon: your faeces. A new study shows that the abundance of certain bacterial genes in your faeces correlates with your age, sex, body mass index and nationality. Increasing age, for example, is associated with an increase in the genes for enzymes needed to break down starches in the diet. Men seem to have more biochemical pathways for the synthesis of the amino acid aspartate than women. The microbiomes of people with higher BMIs were richer in genes involved in harvesting energy from gut contents. And people from different countries had small subsets of genes associated with their nationality (*Nature*, DOI: [10.1038/nature09944](https://doi.org/10.1038/nature09944)).

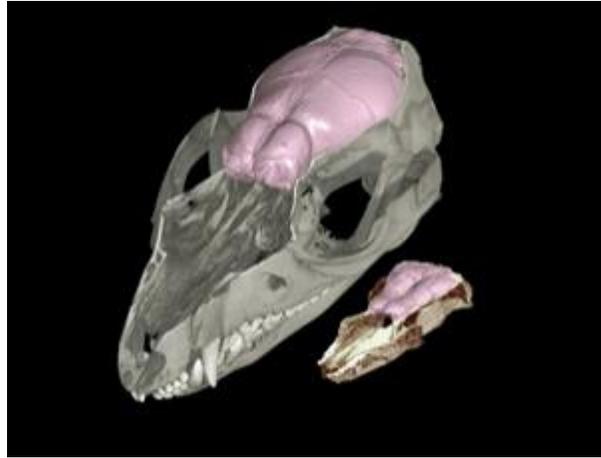
As well as being intriguing, a focus on faeces could help fight disease. Further studies could identify links between certain bacterial genes and common conditions such as colorectal cancer, obesity, metabolic syndrome, diabetes and cardiovascular disease, says Peer Bork from the European Molecular Biology Laboratory in Heidelberg, Germany. If so, faecal tests could provide early diagnoses - and prognoses - for conditions where the sooner treatment starts the better. Stool samples could also be monitored over time to track the progress or development of a condition. "You have a daily output," says Bork. "If you know what you are looking for, you can develop cheap tests."

*Claire Ainsworth is a science writer based in Southampton, UK*

<http://www.newscientist.com/article/mg21028122.600-gut-reactions-the-microbes-that-make-you.html>

## Early mammals were brainy and nosy

- 19:00 19 May 2011 by **Ferris Jabr**



My, what big olfactory bulbs you have (Image: Matt Colbert/University of Texas at Austin)

The early Jurassic might be famous as the point in prehistory that dinosaurs began to grow into giants, but something else was growing larger at that time too: the brains of early mammal-like animals. That could be because smell and touch were vital for their survival during the age of the dinosaurs.

In the 1980s, palaeontologist Timothy Rowe visited the fossil collection at Harvard University with an earnest request: could he please crack open a rare, 190-million-year-old skull of a tiny mammal to determine the shape of its brain? The eyes of Harvard's curators widened behind their spectacles; their lips pursed; their brows wrinkled.

"The standard response was, 'No way! Sit on your hands and be patient, and sooner or later we'll have non-destructive techniques to answer those questions,'" Rowe recalls. "It was so frustrating because I really wanted to know what the brain was like, but these fossils were treated like a Rembrandt or a Vermeer."

Three decades later, Rowe's waiting is over. His team at the University of Texas at Austin recently used high-resolution X-ray computed tomography (CT) to create 3D maps of the skulls of two ancient mammals, faithfully reproducing the shapes of the brains they once contained. The digital moulds suggest that their brains evolved to meet the need for acute senses of smell and touch.

### There will be mammals

Rowe examined fossil Jurassic skulls from China, remains of the pygmy shrew-like creatures *Morganucodon oehleri* and *Hadrocodium wui* – animals so old that they may in fact be forerunners to true mammals.

Mammals have rather large brains for their body size compared with other animals. The difference is the neocortex: a six-layered hunk of brain tissue that is much larger and more complex in mammals. As expected, the digital brains of the early mammals had big neocortices – but something else contributed to their overall size.

Staring back at Rowe from the computer screen were two prominent bumps on the front of the brains: the olfactory bulbs, where smell is processed (see image, top right). The bulbs were much larger than Rowe expected, suggesting that smell was extremely important for early mammals, just as it is for certain mammals today, such as bears and bloodhounds.

Tucked in the wrinkly folds of the digital brains the researchers found evidence of strong motor coordination skills and a keen sense of touch. Rowe speculates that the animals depended on specialised hair follicles attached to nerves to learn about their environments, as some mammals now use whiskers. We know that even these early mammals were covered in hair because a fossil of one of them, *Castorocauda lutrasimilis*, remarkably preserves evidence of a thick pelt that covered its body.

"The story of becoming a mammal is the story of developing the most sensitive and high-resolution olfactory system," says Rowe, "and secondary to that is touch and motor skills."

### **Respectable smell**

"It's a beautifully done paper," says Lori Marino, who studies the evolution of mammalian brains at Emory University in Atlanta, Georgia. "It's important work because up to now we haven't had a whole lot of information about what parts of the brain have expanded in different groups. It tells us something about our preconceptions of how the mammalian brain evolved: it wasn't just the neocortex that expanded. It gives a new respectability to smell."

The evident importance of smell and touch to these tiny proto-mammals hints at their lifestyle. The 190-million-year-old animals probably navigated dark burrows and skittered through leaf litter hunting insects – activities greatly helped by sensitive smell and touch.

"Having a great sense of smell is also consistent with the idea these mammals may have been nocturnal," explains Rowe. Despite recent evidence of nocturnal behaviour in dinosaurs, it's generally thought that most of these animals were active at day and asleep at night. "That's when the mammals came out. With a great sense of smell, it doesn't matter if it's dark," he says. "Smell might be what made it possible for early mammals to come out and find food and mates. In the early Jurassic, that was what drove their evolution."

Journal reference: *Science*, DOI: 10.1126/science.1203117

<http://www.newscientist.com/article/dn20493-early-mammals-were-brainy-and-nosy.html>

### The grand delusion: Egotist, moi?

- 19 May 2011 by **Graham Lawton**
- Magazine issue 2812.



Our inflated opinion of ourselves starts young (Image: By Melissa M'Lou/Getty)

How's your driving? If you are anything like the average person, you probably think it is pretty good. One study found that 74 per cent of drivers believed themselves to be better than average behind the wheel. And, perversely, those who had been in a crash were slightly more confident about their abilities than drivers who had not been.

This, of course, does not reflect reality. Unless there are a handful of truly dreadful drivers, not everybody can be better than average. And yet if you ask people to rate themselves on almost any positive trait - competence, intelligence, honesty, originality, friendliness, reliability and many others - most put themselves in the better-than-average category. Ask them similar questions about negative traits and they will rate themselves as less likely than average to possess them.

This egotistic illusion has been imaginatively dubbed the "better-than-average effect". It is incredibly pervasive, yet goes largely unnoticed. In an ironic twist, most people believe themselves to be more resistant than average to having an inflated opinion of themselves.

We also inflate our opinions of loved ones. Around 95 per cent of people rate their partner as smarter, more attractive, warmer and funnier than average. And as anyone who has endured a 30-something dinner party will testify, parents almost universally rate their children as cleverer, cuter and more developmentally advanced than their peers.

The better-than-average effect is just one of a number of positive illusions - ways we kid ourselves that we are special. Another is optimism bias, a well-established effect characterised by unrealistic expectations about the future. Most people expect to live longer, healthier and more successful lives than average while underestimating their chances of getting divorced, falling ill or having an accident. And the more (or less) desirable the outcome, the stronger people believe it will (or won't) happen to them.

Where do such illusions come from? According to Jonathon Brown at the University of Washington in Seattle, one of the originators of the theory of positive illusions, it all starts in childhood. "Parents create them by fawning over their children," he says.

The fawning doesn't stop there. Throughout life, we have an innate tendency to divide the world into "us" and "them". As soon as you forge a connection with someone, you become part of their in-group - and humans are hard-wired to see members of their in-group more positively than they see others. In this way we all sign up to various mutual appreciation societies that exaggerate our virtues, ignore our faults and look down on outsiders. No wonder most of us feel excessively positive about ourselves.

Far from being pathological, though, positive illusions are now viewed as being a marker of a healthy mind. People who don't harbour them are more likely to be clinically depressed - a state called depressive realism.

But however deluded you are about yourself, chances are you are even more so about how you think others perceive you.

Everybody wonders and worries about how they come across to others, and most of us think we have a pretty good handle on it. But we don't. "People are nowhere near as good at it as they think," says Nicholas Epley, a behavioural scientist at the University of Chicago.

That is not to say we are completely useless. If you think of yourself as generous, for example, other people probably do too. Just not quite to the extent you might like.

From moment to moment, however, we are surprisingly poor at intuiting how we are coming across. This is largely down to something called the "spotlight effect" - the deluded belief that everything you do and say is being closely observed and scrutinised. "Because we're so aware of ourselves it can be easy to think that others are noticing us when they're not," says Epley.

As a result, we blow everything out of proportion. "Say you spill water on yourself so it looks like you peed your pants," says Epley. "You assume everyone is going to notice. But they don't, because the world doesn't really revolve around you." People also assume that their emotional states are broadcast to all and sundry when in fact they are largely invisible.

It also works the other way. If you do or say something you think is especially clever or admirable, you're likely to overestimate the extent to which other people will notice. Most of the time they won't even register because they are too busy tending to their own ego.

The central problem is that you know yourself too well. "You're an expert on yourself," says Epley. "That means you notice all kinds of subtle things about yourself that others simply don't. They see general characteristics."

This is compounded by the fact that we have difficulty guessing what other people are thinking. "We have imperfect tools for getting into their minds," says Epley. "We watch their faces and behaviour and try to get some sense of what they're thinking, but behaviour doesn't always reflect attitudes very well."

Surprisingly, our lack of insight doesn't disappear when we're around people we know well: accuracy does go up, but only slightly. There is even evidence that your ability to read the mind of your spouse actually drops after the first year of marriage. "People are actually better at knowing how well they're communicating with a stranger. You believe you know your partner very well as you spend more time together, but this can actually create more of an illusion of insight than actual insight," says Epley.



Perhaps the area where we have the least insight is physical appearance. Everybody knows what they look like, but when it comes to judging how we look, we're absolutely hopeless. For example, if you ask people to locate a photograph of themselves in a sea of faces they find it faster if it has been morphed to look more attractive, suggesting we all think we're better looking than we actually are.

"When we ask people to rate how attractively they will be rated by somebody else and correlate it with actual ratings of attractiveness, we find no correlation," says Epley. "Zero! This still shocks me. For crying out loud, you ought to get some sense of whether you're hot or not. But it seems not."

<http://www.newscientist.com/article/mg21028122.400-the-grand-delusion-egotist-moi.html>

### Calculations may have overestimated extinction rates

- 18 May 2011 by **Debora MacKenzie**
- Magazine issue 2813.



It's all to do with habitat loss (Image: Christian Ziegler/Getty)

THE destruction of nature is driving species to extinction - but perhaps not as rapidly as has been thought. While the most widely publicised estimates predict the loss of natural habitat will condemn 18 to 35 per cent of all species to extinction by 2050, these figures could be about twice as high as the actual number - all because of a mathematical error that has gone unnoticed for decades.

We still face an extinction crisis, warn Stephen Hubbell of the University of California, Los Angeles, and Fangliang He of Sun Yat-sen University in Guangzhou, China. But the pair's work will allow biologists to more precisely define how habitat destruction leads to extinction.

It is impossible to accurately measure extinction rates. Dozens of new species are identified each year, and counting those that disappear is hard because many are small and live in poorly studied, mainly tropical environments.

Instead, extinction rates are often predicted from a mathematical model based on habitat loss, which is more easily measured. The larger the area you survey, the more species you encounter. Ecologists calculate a curve called the species area relationship (SAR) for an ecosystem by measuring the area they must survey to encounter the first individual of each successive species. To establish the number of extinctions caused by habitat destruction, they run the SAR calculation in reverse.

"We had a feeling there were problems with this, but we could not say why mathematically," Hubbell says. So Hubbell and He checked the method using data from forest plots located all over the world. The pair could calculate the SAR for each plot, and also see what happened to species unique to these plots if they "destroyed" a certain area of each plot in their mathematical model. As the area of destruction widened, these species began to die out. But after each simulated loss of habitat, "more species always remained than were expected from the SAR", says Hubbell.

The pair's analysis explains why. Using the reverse SAR method, biologists have assumed that a species is lost with the destruction of an area of habitat equivalent to the area needed to first encounter it. But in reality,

the species is lost only with destruction of the habitat area that includes every individual of the species, which is always larger. Consequently, the SAR method loses species too fast.

The duo developed a model relating extinction rate instead to the entire area occupied by a species. Using the forest data, and extensive data sets on birds, they found that the SAR gave extinction rates that were between 83 and 165 per cent higher than those their method produced (*Nature*, DOI: 10.1038/nature09985).

Similarly detailed information does not exist for most of the world's species, making it difficult to apply Hubbell and He's model more generally. "As a rule of thumb, we might correct traditional extinction rates by dividing them by factor of 2 to 2.5," says He.

Jean-Christophe Vié, deputy head of species survival at the International Union for the Conservation of Nature, agrees better baseline data on species is badly needed. He says IUCN doesn't use the SAR method. But, he points out, "a twofold miscalculation doesn't make much difference to an extinction rate now 100 to 1000 times the natural background".

Hubbell and He agree: "Mass extinction might already be upon us."

### Conservation under scrutiny

Improvements to the science of extinction come at a good time: conservation scientists are about to come under the kind of scrutiny now experienced by climate scientists. In October, countries in the Convention on Biological Diversity plan to launch an Intergovernmental Platform on Biodiversity and Ecosystem Services, a scientific advisory panel similar to the Intergovernmental Panel on Climate Change.

There have been calls for this for a long time. Now the challenge will be to reach a consensus – a lack of which may have allowed some researchers to make inflated claims, says Carsten Rahbek of the University of Copenhagen, Denmark. "Scientists working for conservation organisations have used the SAR method (see main story) to get high estimates [of extinction rates]."

However, the increasing scarcity of funding to gather basic data on what species are where will make consensus-building difficult. At the same time, research will face greater scrutiny as countries work to meet biodiversity treaty obligations. For example, the European Union's biodiversity strategy, published this month, aims to use some of the EU's massive farm budget to fund ecosystem services, such as boosting bee populations.

<http://www.newscientist.com/article/mg21028136.300-calculations-may-have-overestimated-extinction-rates.html?full=true&print=true>

### The grand delusion: Head full of half-truths

- 18 May 2011 by **Graham Lawton**
- Magazine issue 2812.



Where were you on 9/11? Your memory might be deceiving you (Image: Chao Soi Cheong/AP/PA)

I remember it like it was yesterday. It's a warm and sunny English afternoon and I'm playing outside in the garden. Suddenly a shiny silver aircraft appears in the clear blue sky. My mother picks me up and points to it; neighbours come out of their houses to watch. The aeroplane is Concorde, climbing out of Heathrow airport on one of its earliest flights.

I can play this memory over and over in my head as easily as watching a YouTube clip, and yet I know it almost certainly cannot be real. Even though Concorde could have passed over our house on test flights, I only lived there until 1971, when I was barely out of nappies. And Concorde was white, not silver.

Where does the mismatch between my memory and reality come from? "We've known since the 1960s that memory isn't like a video recording - it's reconstructive," says psychologist David Gallo of the University of Chicago. The collection of snapshots known as "autobiographical memory" is not a true and accurate record of your past - it is more like a jumble of old diary entries, photographs and newspaper clippings. "Your memory is often based on what you've seen in a photograph or stories from parents or siblings rather than what you can actually recall," says Kimberley Wade, a memory researcher at the University of Warwick in the UK.

In other words, one of the most important components of your self-identity - your autobiographical memory - is little more than an illusion.

If that sounds implausible, consider that over the past three decades psychologists have demonstrated beyond any doubt that memory is staggeringly fallible and suggestible.

Most of the evidence comes from false-memory research, where psychologists deliberately plant fake memories into people's heads. In one famous experiment, Wade and colleagues used doctored photographs and fake parental testimony to convince people they had been taken on a fictitious hot air balloon ride as a child. In another, pioneering researcher Elizabeth Loftus, now at the University of California, Irvine, planted memories of meeting Bugs Bunny at Disneyland - impossible, as Bugs is a Warner Bros character.

The success rate of such flagrant manipulation is only about 30 per cent, but Gallo says that everybody's memory is susceptible to some extent. "It's an automatic consequence of how our brains process information," he says. "You cannot remember everything so your mind summarises and remembers the gist of experiences. You form associations and draw inferences. That gives memory great power, but it comes at a cost."

It's one thing to implant memories in a controlled lab setting, but how often does it happen in real life? "We don't have a firm grasp on that," says Gallo. "How could you really know, without some measure of what actually happened or some corroborating evidence?" Even so, he says the fact that memory is so easily tricked in the laboratory suggests that it must be in daily life too.

There are a number of lines of evidence that this is the case. Some of the best come from studying "flashbulb" memories of momentous events such as the terrorist attacks of 9/11 or the death of Princess Diana. Many people have a vivid recollection of what they were doing when they heard the news of such events, and are very confident that these memories are accurate. But guess what: these memories turn out to be wrong a surprising amount of the time.

Within days of 9/11, psychologists at the University of Illinois at Chicago asked nearly 700 people where they were, what they were doing, how they heard the news and who they were with at the time. A year later they asked them again. More than half of the participants had changed their story on at least one count - while still expressing supreme confidence that their memories were accurate.

Flashbulb memory is also highly suggestible. In 2002, psychologists from the University of Portsmouth in the UK went to a local shopping centre and asked people about their memories of the death of Diana, including whether they had seen "the footage" of the actual crash. Nearly half said they had, despite the fact that no footage exists. An even higher percentage of people confidently "remembered" seeing non-existent TV footage of a Boeing 747 crashing in Amsterdam, the Netherlands, in 1992.

If such vivid and confidently held memories can be so riddled with inaccuracy and open to revision, it is probably true that all autobiographical memories are suspect. "I don't think you can put a figure on it, but I'd be confident that the vast majority are not 100 per cent accurate," says Wade.

Again, there is evidence that this is the case. When researchers at the University of Canterbury in New Zealand asked twins about their shared childhood, they discovered that most pairs have at least one disputed memory - an event they are both convinced happened to them and not to their twin. Gallo also suggests that spousal arguments, which often revolve around disputed accounts of the same event, is an area ripe for exploration.

It also turns out that my Concorde memory is not that unusual. Last year, Giuliana Mazzoni at the University of Hull in the UK found that 20 per cent of people have autobiographical memories that they do not believe to be true, often because they contradict established fact.

Does it matter that our autobiographical memories are flawed? "In some ways it's terrifying to think just how spectacularly wrong they might be," says Wade. "Memories are part of your narrative, part of your self-identity." There are legal ramifications too. If you witnessed a crime and were asked to give testimony about it in court, how confident would you be of giving an accurate report?

In many other respects, though, it matters not. My memory of seeing Concorde has no material effect on my life. In fact, according to Wade, the illusory quality of memory is now seen as a strength rather than a weakness. Memory is no longer conceived as being exclusively about the past, but as part of a generalised "mental time travel" module that allows us to construct and test future scenarios based on past experience. If



memory were inflexible that would not be possible. It seems having a head full of half-truths is the price we pay for being able to see the future.

<http://www.newscientist.com/article/mg21028122.300-the-grand-delusion-head-full-of-halftruths.html?full=true&print=true>

## Anger, Politics and the Wisdom of Uncertainty

Angry citizens, new research confirms, are motivated citizens. But they are not motivated to seek out new information. But anxious citizens do.

By Lee Drutman



*New research confirms that angry citizens are motivated citizens, but they are not motivated to seek out new information in the way that anxious citizens might. (Images from Flickr.com)*

To say that these are angry political times is perhaps to state the obvious. Commentators and analysts bemoan the lost civility, wondering what is to be done. But here's something hopeful: New understanding of how emotions operate in politics might help us to better manage these emotions as a society.

The first thing to know about anger is where it comes from. Research suggests it begins with a threat (in these political times, say, rising economic insecurity). But whether it gets translated into anger depends on a few things.

First, it matters how the threat is described. If there's somebody or even some institution to blame, it turns out people are much more likely to get angry.

In a paper titled "Fight or Flight? When Political Threats Arouse Public Anger and Fear" (presented at a recent conference but yet unpublished), University of Michigan political science professors Ted Brader and Nicholas Valentino and University of Memphis political science professor Eric W. Groenendyk report on

experiments in which they found that respondents react differently to fictitious news reports on outsourcing and a viral outbreak. News articles that identify individuals and organizations as the culprits generate significantly more anger than those that ascribe it to impersonal causes. Without someone to blame, respondents mostly just grow fearful and anxious.

Anger is also more likely to arise when individuals feel as though they have some control over the situation — that they have a sense of political efficacy, and the resources and experience to know how to get involved in the first place. Again, without a feeling of control, fear predominates.

This matters, because people act differently when they are angry as opposed to when they are simply afraid or anxious.

For one, anger tends to inspire individuals to engage in more political activities than they would otherwise. “The one thing that seems particularly true about anger is that it is powerfully mobilizing,” said Brader. “It’s a very high-energy emotion.”

In a recent *Journal of Politics* article titled “Election Night’s Alright for Fighting: The Role of Emotions in Political Participation,” Brader, Groenendyk, Valentino and two other colleagues (Michigan political scientist Vincent L. Hutchings and Michigan doctoral student Krysha Gregorowicz) reported on experiments and crunched American National Election Studies data to show that when citizens get angry, they get active.

In an experimental manipulation, the researchers used “an emotional induction task” — asking participants to recall and write about an experience that made them either angry, anxious or enthusiastic. After the manipulation, subjects were given questions about their intention to participate in politics. Anger inducement boosted intention to participate by one-third of an act out of five possible acts; anxiety and enthusiasm had no effect.

Similarly, survey data on citizen self-reports of anger are predictive of campaign participation, whereas fear and enthusiasm are not. In particular, voters who report anger are much more likely to engage in what political scientists describe as “costly” activities (because they require extra resources): attending rallies, donating money, volunteering for campaigns.

“Anger gets people engaged,” said Brader. “There’s a tendency among scholars and others to say that things like negative advertising are bad. But our paper points out that negative emotions like anger can bring people out and get people more involved. So the consequences aren’t all bad.”

And Groenendyk notes: “If anger is on your side, and it’s mobilizing people to get involved, anger can be a great thing.”

A particular danger of anger seems to be closed-mindedness. Research finds that when citizens get angry, they close themselves off to alternative views and redouble their sense of conviction in their existing views. Fear and anxiety, on the other hand, seem to promote openness to alternative viewpoints and a willingness to compromise.

“Fear alerts you that something is amiss in your environment and draws your attention and says you should consider your action,” said Groenendyk. “Anger tends to move people beyond that and suggests to them to invest resources in participation and pursue riskier strategies that might cost them something.”

The research also shows the stronger your partisan identity the more likely you are to get angry. In many respects, this becomes a self-sustaining feedback loop in which anger deepens the grooves of activism, and

the habits and confidence of political engagement that follow lead citizens to get angrier even more easily in the future.

There are also additional dangers. “Anger pushes people in directions that are punitive and aggressive,” said Brader. “That can be appropriate in its time and place. If somebody attacks America, it’s good to have the capability to mobilize Americans or to get people to fight.

“But anger can be an issue if it’s creating motivations to lash out. Does it stop at just spreading leaflets or voting? Or does it extend to punching opponents or throwing a brick. Politicians might be unleashing it for their own purposes, but it’s unleashing a powerful force that’s hard to control.”

Historically, anger in politics has gone up and down depending on who is in power. In “Election Night’s Alright For Fighting” the authors charted feelings of political anger between 1980 and 2004 (the research was done before the 2008 numbers). Anger toward the Democratic candidates peaked in 1980 and 1996; anger toward a Republican candidate peaked in 1984, 1992, and especially 2004.

Not surprisingly, these were all years in which an incumbent of that party was running for re-election. “Incumbents have a record and so they can be blamed,” said Groenendyk.

And blame, of course, is a pre-requisite for anger. One can almost be sure anger will be widespread wherever we look 2012.

In many respects, anger and fear in politics pose a delicate tension between competing democratic values. On the one hand, anger promotes what many observers see as civic virtues of increased participation, but it also tends to close people off from new information, to drive people to their respective sides and to encourage aggressive and punitive actions — all hallmarks of increased political polarization.

Anger also arises out of and promotes a politics of blame, but a politics of blame (which we tend not to like) is sometimes hard to disentangle from a politics of accountability (which we tend to like).

Alternately, a political culture with less accountability and fewer habits of participation would produce more pure anxiety, which research suggests would lead people to seek out more alternative sources of information and also be more willing to embrace compromise (which we also like).

Perhaps the best we can hope for among politicians and commentators is more self-awareness of the consequences of how they describe the world, particularly in how they ascribe blame. But for those who hope for more compromise and thoughtfulness among the public, maybe the answer is to spend more time acknowledging the complexities and ambiguities of public problems, trying to reduce certainty and blaming that leads to anger.

If the goal is to get people to think more carefully, maybe a little bit of the anxiety of uncertainty might not be such a bad thing after all.

[http://www.miller-mccune.com/politics/anger-politics-and-the-wisdom-of-uncertainty-31026/?utm\\_source=Newsletter161&utm\\_medium=email&utm\\_content=0517&utm\\_campaign=newsletters](http://www.miller-mccune.com/politics/anger-politics-and-the-wisdom-of-uncertainty-31026/?utm_source=Newsletter161&utm_medium=email&utm_content=0517&utm_campaign=newsletters)

## Sept. 11 Mood Study Based on Texting Is Flawed

Research that showed a steady rise in anger among Americans in the wake of the terrorist attacks on Sept. 11, 2001, is apparently invalid.

By Tom Jacobs



*As a way of gauging the public mood on Sept. 11, the study was groundbreaking. However, the researchers now concede it was seriously flawed.*

Last September, we reported on an imaginatively designed study that attempted to document how the mood of the nation shifted in the wake of the terrorist attacks on Sept. 11, 2001.

German researchers analyzed the content of text messages sent to more than 85,000 American pagers on that day, and found indications of anger — that is, the use of words such as “hate” or “annoyed” — rose steadily as the hours went by. In contrast, the number of words indicating sadness or anxiety stayed relatively steady.

As a way of gauging the public mood, the study was groundbreaking. However, the researchers now concede it was seriously flawed.

Psychologist Cynthia Pury of Clemson University did her own analysis of the data, and discovered that 36 percent of the anger words noted in the study “were in nearly identically worded messages.” These were computer-generated instructions to reboot, and they included the word “critical.”

In this context, “critical” was a call to urgent action rather than a cutting remark. But the original researchers counted each appearance of the term as an indication of anger.

Pury published her findings in a letter to the journal *Psychological Science* on May 9. Four days later, the original research team, led by Mitja Back of Johannes Gutenberg University Mainz, conceded she was correct.

“We did not anticipate that emotionally irrelevant, automatically generated messages (i.e. messages that described a ‘critical’ server problem) would be incorrectly classified ... as anger-related, and at the same time show a non-random time course (i.e., a dramatic increase over time),” they write. “Although this unexpected confound did not affect our findings for sadness or anxiety, it did distort our findings for anger.”

Pury’s analysis agreed with theirs, in that it “showed a strong increase in anger after the first attack,” the German researchers write. “However, this rise in anger did not continue throughout the day. Pury found a substantially lower overall correlation between anger-related words and time than we found in our original analysis.”

So...never mind. Or, at least be wary of untried methods of data collection. Perhaps Americans got angrier during the course of September 11, 2001, but this data does not prove it.

<http://www.miller-mccune.com/culture/sept-11-mood-study-based-on-texting-is-flawed-31356/>

## Being Frugal May Be More Genetic Than Learned

**If cheapskates are born and are not entirely the product of learned behavior, as a growing body of research suggests, policies to promote frugal living may do little good.**

By David Villano



*Being frugal is in vogue, and that may be a good thing for some. Researchers suggest that genetics play a larger role in consumer behavior than once thought. (DNY59 / istockphoto.com)*

Shopping at garage sales, collecting soap slivers and other dollar-stretching habits — often derided as neurotic obsessions of the frugal mind — can now be blamed on the thrifty ways of a long-forgotten ancestor. Genetics, researchers say, has a far greater effect on consumer behavior than once thought.

In a study of identical twins, which was published in the April edition of *Journal of Consumer Research*, marketing professors Itamar Simonson of Stanford University and Aner Sela of the University of Florida report that individual consumer preferences — for such products as chocolate, hybrid cars, movies and jazz — are genetically linked. Those preferences, the authors suggest, are a reflection of individual “prudence” — an inheritable predisposition to living “in the mainstream” or “on the edge” or somewhere in between. Prudent people are more cost conscious and more averse to reckless spending.

“People are born with a tendency to be more or less prudent,” Simonson says, “which would suggest that they are born with a tendency to be more or less frugal.”

Other researchers are working to explain the biological mechanism behind being frugal. Marketing professor Scott Rick of the University of Michigan has conducted brain imaging to reveal that frugal people quite literally “feel” the pain of spending in a way that other people do not. In one study, volunteers were shown images of consumer products, followed by their prices. In frugal people, the matching of product with price activated a part of the brain called the insula, a kind of neural distress center associated with such unpleasanties as perceived mistreatment by others, social exclusion and even a foul odor.

In his paper “Tightwads and Spendthrifts,” (co-authored by George Loewenstein of Carnegie Mellon University and Cynthia Cryder, now with Washington University in St. Louis), Rick argues that frugal people anticipate the pain associated with spending money, whereas spendthrifts have little reference point for such pain and, therefore, spend like there’s no tomorrow. The study, also in the *Journal of Consumer Research*, reports that tightwads (frugal consumers) account for roughly 25 percent of the population, while spendthrifts account for another 25 percent.

(Rick’s latest research includes the surprising finding that cheapskates and spendthrifts often marry each other, but the relationships rarely last).

Though frugal behavior often occurs independently of financial resources — some of the cheapest people I know have the most money — the present economic downturn has ushered penny-pinching from the closet of consumerism and into the mainstream. Living on the cheap has become a cottage industry with web sites, blogs and a stream of recent books with titles like *The Cheapskate Next Door: The Surprising Secrets of Americans Living Happily Below Their Means* and *In CHEAP We Trust: The Story of a Misunderstood American Virtue*.

Frugality is in vogue.

But researchers like Rick are now saying individual consumer choice is less adaptable than once thought, meaning the sudden caché of living on the cheap is unlikely to attract many lasting converts. (Like many in the field, Rick believes frugal behavior is not entirely a genetic predisposition but also may reflect early environmental influences such as parental spending habits).

“I don’t know how many enduring changes [in behavior] you can encourage,” he says.

Such wisdom is an apposite counterpoint to the pundits and marketing consultants who’ve terrified retailers and economists alike by predicting that the trauma of the Great Recession could zap the consumer mojo for a generation or more, spawning a “new normal” of cautious spending behavior. A 2009 Gallup Poll found that a third of Americans were choosing to spend less and expected to keep it that way. More recently a report from management consultants Booz & Co. warned of a “new frugality” that could endure long after the economy recovers. “Frugal behavior,” the report explains, “is now considered trendy by many shoppers, and will continue for years to come.”

But recent consumer spending figures seem to contradict that argument, and nowadays, few retailers are losing sleep over the “new normal” nightmare. Holiday sales in December surged from a year earlier, surprising most analysts, and in the last quarter of 2010 personal income inched up just 1.7 percent, but consumer spending rose 4.4 percent — the fastest rate of growth since early 2006. So much for frugal chic; ingrained habits are hard to break.

While this may be good news for the economy as a whole (consumer spending accounts for two-thirds of our all-important gross domestic product), the hardwiring of spending behavior may prove an insurmountable challenge for anyone promoting consumer restraint as a remedy for global warming, resource depletion, rising food prices and other intractable problems of an ever-crowded planet. (The world’s wealthiest 10 percent account for nearly 80 percent of all private consumption, reports the World Bank).

Such a conclusion is reached in the paper “An examination of the values that motivate socially conscious and frugal consumer behaviours” that appeared last year in the *International Journal of Consumer Studies*. The University of Surrey’s Tim Jackson, along with co-authors Miriam Pepper and David Uzzell, report their findings that social and ecological considerations have little bearing on the motivations of frugal shoppers.



As such, notes Pepper, now a community activist in Australia, “[frugality] does not yet represent a fully developed moral challenge to consumerism.”

In fact, the authors suggest, collective frugality at a meaningful scale would require something quite simple but something few people are willing to consider: lower income. The paper’s sobering conclusion quotes noted U.K. sociologist Colin Campbell, who has written extensively on consumer behavior: “Consumerism probably reflects the moral nature of contemporary existence as much as any other widespread moral practice; significant change here would therefore require no minor adjustment to our way of life, but the transformation of our entire civilization.”

[http://www.miller-mccune.com/business-economics/being-frugal-may-be-more-genetic-than-learned-31479/?utm\\_source=Newsletter162&utm\\_medium=email&utm\\_content=0524&utm\\_campaign=newsletters](http://www.miller-mccune.com/business-economics/being-frugal-may-be-more-genetic-than-learned-31479/?utm_source=Newsletter162&utm_medium=email&utm_content=0524&utm_campaign=newsletters)