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Growing sugarcane could help cool Brazil

- 16:56 18 April 2011 by **Michael Marshall**
- Magazine issue 2809

Good for the environment? (Image: Sipa Press/Rex Features)

Grown as a biofuel, sugarcane has a reputation for guzzling water and fertiliser. But it has a good side: compared to other crops, it cools the landscape.

Scott Loarie of the Carnegie Institution for Science in Stanford, California, and colleagues used satellite data to monitor the effects of sugarcane cultivation in the Brazilian savannah. They found that converting natural vegetation to crops warmed the area by 1.6 °C, but a subsequent switch to sugarcane cooled it by 0.9 °C. That's because sugarcane reflects more of the sun's heat and releases extra water vapour.

Loarie says that if sugarcane is to be grown as a biofuel, it is better to convert farmland – although this leaves less land for growing food, raising prices. Timothy Searchinger of Princeton University says that might lead to more savannah being cleared for food crops, so local temperatures would rise, not fall – something Loarie also emphasises.

Journal reference: *Nature Climate Change*, DOI: 10.1038/nclimate1067

http://www.newscientist.com/article/dn20388-growing-sugarcane-could-help-cool-brazil.html?full=true&print=true

Conservation and farming must learn to live together

- 18 April 2011 by **Achim Steiner**
- Magazine issue 2808

In balance? (Image: Andrzej Krauze)

Agriculture and conservation are on collision course, and that has to change, says the UN Environment Programme director

MILLIONS of people in Africa live in unremitting poverty and hunger. For the foreseeable future, the only way to alleviate their misery is through agricultural development. So it is heartening that the Food and Agriculture Organization and World Bank see great potential for expansion throughout the Guinea Savannah Zone, an area larger than India that stretches across 25 countries from Senegal to Mozambique.

The prospect of development is to be welcomed, but its manner requires careful consideration to avoid threats to sustainability. For example, though Africa retains much of its biodiversity, certain trends are cause for concern. Agricultural expansion into sensitive areas could aggravate declines that are already taking place.

The tension between agricultural development and conservation is not unique to Africa. Increased agricultural production is needed the world over. Between now and 2050, the global population is projected to grow from 6.9 billion to between 8.0 and 9.7 billion. Demand for cereal, oil and sugar crops is expected to double in this time as people consume more meat and calories, and governments set biofuel targets.

Meeting this demand will be challenging. Gains in yield are likely to be much harder to achieve than those during the green revolution of the 1960s, which was driven by large volumes of fertiliser and water. Higher yields will not be enough; large amounts of new agricultural land will also be required. Estimates of the extra land needed by 2050 relative to 2000 range from 6 to 17 million square kilometres. The higher figure equates to an area larger than Russia.

But land, water and fertilisers are already in short supply in many areas, and expansion of agricultural land will put further pressure on biodiversity, increase greenhouse gas emissions, and perhaps bring us closer to ecological tipping points that could strain the global life-support systems upon which agriculture itself depends.

New approaches are clearly needed if we are to address the needs of the billion people who go to bed hungry each night. Integrated action by conservation and agriculture is long overdue.

First and foremost we need a "new agriculture". The United Nations Environment Programme (UNEP), of which I am executive director, contends that for agriculture to meet our future needs sustainably, ecosystem services such as water provision, pollination and maintenance of soil fertility must be enhanced. At present, the value of these services is not built into the cost of food production. The result is that farmers are not rewarded for stewarding their land for future generations, and food production and distribution are often environmentally damaging.

We need to find ways to put a value on the full range of ecosystem services and implement monitoring and payment systems to reward those managing land sustainably - for example, by offering incentives for carbon sequestration or water catchment services. The environmental costs of production need to be factored into the price of goods and services.

It is not only agriculture that needs to change. A "new conservation" is also required that acknowledges the importance of agriculture.

Although agriculture sometimes leads to an increase in species richness, all too often it does the opposite. That is one reason why conservationists remain focused on establishing nature reserves and other protected areas. While these can be important, recent analyses have shown that they are not large or representative enough to encompass all threatened species. Moreover, protected areas are sometimes established at a cost to local people, which makes them socially and economically contentious.

Conservationists need to broaden their outlook and work with farmers, agricultural scientists and agribusiness to support the integration of biodiversity with agriculture. Together, conservationists and agriculturalists can move forwards.

There are signs of progress. In December 2010, the UN General Assembly created a body to do for biodiversity and ecosystem services what the IPCC does for the global climate. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) will be a forum to integrate agriculture and conservation knowledge, and translate it into policy.

On top of that, a huge international research project called The Economics of Ecosystems and Biodiversity is drawing attention to the economic benefits of ecosystem services and calculating the costs of biodiversity loss and ecosystem degradation. Thanks to TEEB, the multitrillion-dollar value of the world's nature-based assets is rapidly being made clear.

If we are to have any chance of handing on a healthy, productive planet upon which more than 8 billion of us can survive and thrive, agriculturalists and conservationists must reconcile their differences.

Achim Steiner *is an under-secretary-general of the United Nations and executive director of the United Nations Environment Programme, based in Nairobi, Kenya*

http://www.newscientist.com/article/mg21028085.100-conservation-and-farming-must-learn-to-live-together.html

The secret superpower of the cockroach

- Updated 16:45 21 April 2011 by **Wendy Zukerman**
- Magazine issue 2808

Just about everywhere people live, cockroaches do too (Image: Colin Milkins/OSF/Getty)

You don't need to be tough to conquer the world's kitchens, but you do need one extraordinary ability

ON A midnight foray into my kitchen, I flicked on the light and was confronted with a devil's playground. Cockroaches were fornicating on my pots and dancing on the cooker. They were grinding on my floor and scuttling around my fridge.

Disgusted, I reached for the light switch again. The snack I had hoped for was no longer enticing. But then I saw one critter climbing up the wall. I leaned over to take a look. "How have you come to live in my home?" I wondered briefly - before squishing it with an empty milk carton and going back to bed.

When I moved from Melbourne to Sydney to work for *New Scientist*, I was told only about the fabulous weather and the views over the harbour. No one mentioned the rampant roaches.

But my midnight encounter was just the first of many, and my question would not go away. So I decided to find out more about my unwanted guests and why they have been so successful in colonising our dwellings. What I have discovered has taken me by surprise. Contrary to popular myth, these critters are not especially tough or radiation resistant. Indeed, they are pretty average as insects go. But in the past year, it has been shown that cockroaches do have one special power after all.

I began my search by heading to the vast collections of the Australian Museum in Sydney. The variety of cockroaches on display there is astonishing - big ones, small ones, green ones, striped ones, winged ones and wingless ones - but I soon noticed that they all conformed to the same basic pattern. While some of their cousins have branched out and evolved specialised features - such as the mantids, with their spiky legs for grabbing prey - roaches themselves have retained a rather plain body plan with no stings, pincers or other special traits.

It is estimated that only around 40 per cent of cockroach species can fly, for instance, and most are rather inept at it. They cannot fly very far. As for the notion that cockroaches would survive a nuclear apocalypse, think again: they are not especially tough.

A dose as low as 64 grays kills 93 per cent of immature German cockroaches. Sure, that is 10 times as much as humans can take, but cockroaches do not look so tough compared with the humble fruit fly, which can survive exposure to more than 640 grays, or the parasitoid wasp, *Habrobracon*, which needs a colossal 1800 grays to kill it.

Continuing my search, I discover that cockroaches thrived long before there were kitchens. They are one of only a handful of insect orders whose fossil record goes back more than 300 million years. Their heyday was during the Carboniferous period, when around 40 per cent of all insects were roach-like, prompting some

palaeontologists to describe this period as the Age of the Cockroach. Before turning to beetles, it seems that evolution once had an inordinate fondness for cockroaches.
These ancient "roachoids" were not that different from modern roaches. Females had a long ovipositor for laying eggs that disappeared around 140 million years ago, but otherwise they all look pretty similar to my kitchen guests.
Nowadays there are nearly 5000 species of cockroach and they live on every continent except Antarctica, finding homes in caves, woodlands and rainforests. Only a handful of species have adapted to living with humans, but it is these that have spread all around the world (see "Rogues' gallery"). "They give the rest a bad name," says entomologist Nathan Lo at the University of Sydney. "While I am repulsed by the pests, not all cockroaches are nasty, some are quite beautiful." Really?
Two of the most infamous pests are the large American cockroach and the smaller German cockroach. Their names are misleading, as it is not clear where they originated, nor when they spread around the world. It is the German variety, I learn, that infests my kitchen.
Which brings me back to my question: why have these critters been so successful? Martyn Robinson, an entomologist at the Australian Museum, thinks it is partly to do with their lack of specialised features. "Cockroaches have specialised in not specialising," he says. In particular, most roaches are not fussy eaters. "Roaches are masters of cannibalism," Lo says. "They'll eat everything and they'll eat each other."
Sometimes they even eat us. There are many accounts of people sleeping in heavily infested buildings or ships being bitten by cockroaches. The varmints seem to have a special liking for calluses and nails, perhaps because they can nibble them without waking their victims. Sailors on some ships reportedly wore gloves while sleeping to protect their fingernails.
There is, however, something else special about cockroaches besides not specialising. When a cockroach is opened up - or even just squished - you can see a white mass that fills much of its abdomen. Known as the fat body, this consists of two types of cells: adipocytes, which are filled with fat globules, and mycetocytes, packed with bacteria.
Around a fifth of insects harbour mutualistic bacteria and some have mycetocytes similar to those of cockroaches. But the relationship between a cockroach and its resident endosymbiont, called *Blattabacterium*, is especially close. Kill the bacteria with antibiotics, and the roaches struggle to survive and often die. Kill the cockroaches and *Blattabacterium* definitely dies. While some insects acquire mutualistic bacteria from the environment, every cockroach hatches with *Blattabacterium* already inside it. When the eggs are developing, a few bacteria somehow move from the fat body to the ovaries, where they are taken up by every egg.
Last year, Zakee Sabree of the University of Arizona in Tucson compared the genomes of bacterial strains living inside the American and German cockroach. He showed that the two strains diverged at least 140 million years ago - around the time the fossil record showed that the two cockroach lineages themselves split (*Applied Environmental Microbiology*, vol 76, p 4076). Since they went their separate ways, neither bacterial lineage has changed much.
Lo thinks the relation between the ancestors of cockroaches and of *Blattabacterium* was so successful there has been no need for the bacterium to change. "Once they developed a relationship, bam! They were able to dominate," says Lo.
Even before Sabree's study, *Blattabacterium* had come to be seen as a defining feature of cockroaches. When it was found inside the Australian termite *Mastotermes darwiniensis*, it made people wonder whether termites were related to cockroaches. Sure enough, a genetic analysis by Lo in 2000 confirmed that termites are the descendants of a wood-eating cockroach (*Current Biology*, vol 10, p 801). "At the time it was a little controversial, but now we know the termite is definitely a type of cockroach," says Lo.
But what does *Blattabacterium* do? Most mutualistic bacteria in insects provide them with nutrients that they do not get in their diet and cannot make for themselves. The location of the bacteria provides another clue. Nitrogen is a key component of amino acids, the building blocks of proteins, but animals usually excrete any excess nitrogen in the form of ammonia, urea or uric acid. By contrast, when cockroaches consume more nitrogen than they need, they store the excess in the fat cells of fat bodies, in the form of uric acid crystals. "Even when fed really high nitrogen diets, they still don't void the excess nitrogen," Lo says.
So it has long been suspected that *Blattabacterium* might help cockroaches recycle nitrogen. No one was able to prove it, though, because the bacterium will not grow outside roach cells. But nowadays there is a new way to find out what bacteria do: sequence their genome.

Even that is easier said than done. Just getting a pure sample of *Blattabacterium* DNA is tough. The cells containing the bacteria are sandwiched between fat cells, making it impossible to manually extract them. Plus, once the cells are collected, the bacteria have to be separated from the organelles inside the cell. Lo and his colleagues finally managed to isolate the bacterial DNA in 2008. Finally, it was time to sequence the genome. But Sabree beat him to the punch. In 2009, his team published *Blattabacterium*'s genome (*Proceedings of the National Academy of Sciences*, vol 106, p 19521). The genomic analysis confirmed the bacteria have all the enzymes needed to convert urea and ammonia into all 10 essential amino acids. They can also produce several vitamins.

So the fat bodies not only provide a store of fat that enables many cockroach species to go for more than a month without food, they also allow it to survive on very poor, low-protein diets. "It has its own chef and refrigerator on its back," says Sabree.

The partnership between the cockroaches and their mutualistic bacteria may well have been the key to their success over the past few hundred million years. Despite their dietary superpower, though, only a few cockroach species had all it takes to conquer human habitations. Entomologist David Rentz has counted no fewer than 84 species of cockroaches around his home in the rainforests of northern Queensland. Yet only the German and American roaches actually live and breed in the house.

The species that have switched to living in human homes are not only able to eat just about anything, they are also able to go for long periods with little water. "Some other cockroaches come in at night when the lights are off," Rentz says, "but usually you find them dead on the floor, because they get dehydrated [in the house]," he says.

The bad news is that the invasion of our homes is not over - there might be roach reinforcements on the way. One cockroach native to Australia, *Methana marginalis*, has started turning up in houses around the country in the last few years. It's unclear whether it has evolved the ability to breed inside houses yet. Having never found nymphs around his house, Rentz suspects not.

Recently, though, I have started spotting more and more of these native critters - with their light brown stripes - around my place. Lo thinks they are beautiful and wouldn't mind them walking up and down his arm "unlike those filthy Americans".

I have to agree, they are daintier than the American or German pests. But, if I ever catch them fornicating in my kitchen, it's the old milk-carton treatment for them too.

When this article was first posted, the lethal radiation doses mentioned for different species were out by several orders of magnitude because of a conversion error during the editing process.

Rogues' gallery

German cockroach

Blattella germanica (below) is a cosmopolitan pest that thrives among humans worldwide. Its dark brown body grows up to 16 millimetres long, and has two distinct black bands running along its back. It eats just about anything, and can spoil food with its faeces and defensive secretions.

Brown-banded cockroach

Probably native to Africa, *Supella longipalpa* has spread throughout the tropics, the US and Europe including the UK. It grows to 14 millimetres and is almost completely black. Its antennae are almost as long as its body.

American cockroach

Periplaneta americana is found in sewerage systems, cafes and kitchens throughout the world. It has a reddish brown body and grows to a huge 40 millimetres. By shedding its skin and defecating on food it can trigger allergic reactions and asthma in some people.

Oriental cockroach

Blatta orientalis is found on every continent, except Antarctica. Its black body grows to 27 millimetres. Males have wings covering three-quarters of their body, but females have very short wings and cannot fly.

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http://www.newscientist.com/article/mg21028081.400-the-secret-superpower-of-the-cockroach.html

Acidic ocean robs coral of vital building material

- 15 April 2011 by **Wendy Zukerman**, Cairns
- Magazine issue 2808

On a knife-edge (Image: Frans Lanting/NGS)

CARBON dioxide has pillaged the Great Barrier Reef of a compound that corals and many sea creatures need to grow. The finding, from the first survey of ocean acidification around one of the world's greatest natural landmarks, supports fears that the ecosystem is on its last legs.

Bizarrely, the reef doesn't appear to be suffering from the effects of ocean acidification just yet. But that may be because it is balanced on a knife-edge between health and decay.

Oceans become acidic when they absorb CO_2 from the atmosphere. Once dissolved, the gas reacts with carbonate to form bicarbonate, stripping seawater of the compound that many marine organisms including coral, shrimp and crabs need to build their shells or skeletons.

Bronte Tilbrook at CSIRO in Hobart, Tasmania, Australia, measured the concentration of aragonite - a form of calcium carbonate used by some creatures to build shells - at over 200 locations on the reef.

Corals grow well when the amount of aragonite in the water has a saturation level of 4.5. Below that, coral growth declines. Models suggest that if seawater becomes too low in aragonite, organisms with aragonite shells will dissolve. Studies in the Red Sea have found that some species of coral start to dissolve at a saturation of 2.8.

"Almost every bit of water we sampled was below 3.5," says Tilbrook, who presented his findings at Greenhouse 2011 in Cairns this week. Close to the shore, to the south of the reef, the saturation was 3.

Despite suboptimal conditions Tilbrook found little evidence that coral in the reef had reached their critical point. "They are still growing," he says. This could either mean that corals are more resilient than we thought, or they are on a knife-edge.

Will Howard of the Antarctic Climate and Ecosystems Cooperative Research Centre in Hobart has shown that some species of coral have a similar sensitivity to acidification as foraminifera in parts of the Southern Ocean, which are struggling to build their shells.

Howard and Tilbrook say this suggests the critical point for the corals of the Great Barrier Reef may be imminent. It is difficult to draw definite conclusions, however, because some 350 coral species are thought to inhabit the reef - with only a handful being tested under lab conditions.

http://www.newscientist.com/article/mg21028083.600-acidic-ocean-robs-coral-of-vital-building-material.html?full=true&print=true

How Japan will survive psychological fallout of crisis

- 12:21 15 April 2011 by **Ferris Jabr**

Stoicism helps (Image: KeystoneUSA-ZUMA/Rex)

Eventually the debris will be cleared, the radiation will fade and the nearly 200,000 people in temporary shelters will find new homes. But memory of the most powerful earthquake to strike Japan in recorded history, the devastating tsunami that followed and the worst nuclear emergency since Chernobyl will persist. The most enduring consequence of the ongoing crisis in Japan will not be medical, financial or environmental: it will be psychological.

Barbara Lopes-Cardozo remembers the screaming. One of the founding members of Doctors Without Borders, she was in Colombia in 1985 just after the Nevado del Ruiz volcano erupted, killing more than 23,000 people. She administered anaesthesia to those who survived, some of whom shrieked and howled from the terror of flashbacks.

The experience helped convinced her to focus her career on mental healthcare in emergencies and disasters. "I think it has been a mistake in the past not to focus on mental health," she says.

K. A. S. Wickrama of Iowa State University in Ames, who studied survivors of the 2004 Indian Ocean earthquake and tsunami, agrees. "Recovery of physical infrastructure is one thing – but recovery should also focus on psychological processes, on the social infrastructure."

Types of trauma

In the past three decades, psychologists and psychiatrists have published numerous studies on how disasters influence mental health. A 2004 review suggests that in the year following a technological disaster – such as a plane crash – between 25 and 75 per cent of survivors develop post-traumatic stress disorder (PTSD) – the symptoms of which may include flashbacks to the trauma, as witnessed in Colombia by Lopes-Cardozo. Following a natural disaster, PTSD seems somewhat less prevalent; but that may be because it is often easier to identify the direct victims of a technological disaster than, for example, the victims of an earthquake that affects a large area (*Epidemiologic Reviews*, DOI: 10.1093/epirev/mxi003).

The crisis in Japan is both natural and technological, which suggests that some PTSD can be expected. The problem will probably be compounded by "radiation anxiety" – the stress caused by the dread of radioactive contamination. Some researchers have suggested that, for most people, the widespread fear of radiation is more harmful than the radiation itself.

The workers who have risked their lives at the damaged Fukushima Daiichi nuclear plant may be particularly at risk. A study published in 2008 compared the mental health of 295 men who helped clean up the Chernobyl plant in Ukraine after the 1986 disaster and 397 people who lived in the same areas as the clean-up workers but did not work on-site: it found that the former group suffered higher levels of depression and anxiety, and contemplated suicide more frequently (*Psychological Medicine*, DOI: 10.1017/s0033291707002371).

But a study by Wickrama published last year offers reasons for optimism. He investigated the role of community participation in the mental health of mothers from 325 families in southern Sri Lanka who were

affected by the 2004 tsunami. In many developing nations, mothers are the primary caregivers of their families – a role that leaves them more vulnerable to mental health problems.
Wickrama found that mothers who believed they were part of a supportive community were at lower risk of PTSD and depression. What's more, those who formed grass-roots groups to distribute emergency relief and construct housing and roads benefitted psychologically as well as materially (*International Journal of Social Psychiatry*, DOI: 10.1177/0020764010374426).

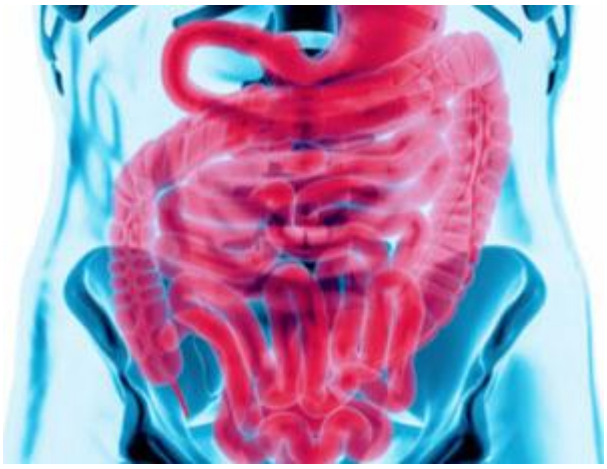
Cultural strength

Japanese culture encourages familial intimacy, which will be an "important social resource", Wickrama says. News reports of the behaviour of the Japanese evacuees confirm they possess what psychologists and sociologists call a collectivist orientation: a belief that the welfare of the community overrides that of the individual.
But Japan has not always embraced psychological counselling and mental healthcare, points out Joshua Breslau of the University of California, Davis. He was in Japan in 1995 when the Kobe earthquake struck. "The idea of responding to mental health problems was new – some people embraced it, some people didn't." He remembers people using a Japanese phrase (*kokoro no kea*) that translates as "care for the heart" as a way of promoting mental health awareness.
Today, Japan has organisations like the Hyogo Institute for Traumatic Stress, which opened in 2004 and is currently sending mental health experts into the Sendai region to counsel evacuees who have lost their homes. But Wickrama points out that many developing nations lack such resources, and depend on counsellors supplied by foreign organisations, who typically disappear after a few months.
Lopes-Cardoso has recognised this failing as well: "We need to train primary health professionals to give basic psychological care," she says. What concerns Lopes-Cardoso even more, however, is the need for psychiatric therapy based on rigorous scientific studies for the aftermath of disaster.
"We are doing major mental health surveys, but we still don't have nearly enough research," she says. "In all disaster situations we find that mental illness increases – what we need to do now is develop proper psychological first aid based on research."
Journal references: *Epidemiologic Reviews*, DOI: 10.1093/epirev/mxi003; *Psychological Medicine*, DOI: 10.1017/s0033291707002371; *International Journal of Social Psychiatry*, DOI: 10.1177/0020764010374426.

http://www.newscientist.com/article/dn20385-how-japan-will-survive-psychological-fallout-of-crisis.html?full=true&print=true

Each human has one of only three gut ecosystems

- 18:04 20 April 2011 by **Andy Coghlan**



Your inner ecosystem (Image: Artpartner-Images/Getty)

You're probably the member of a club you didn't even know existed. According to research published this week, we all have one of three ecosystems of bugs in our guts. *New Scientist* explores what this surprising discovery means, and how our internal fauna might affect our everyday lives.

Why might the types of bugs we carry be important?

We think of our bodies as our own, but actually only a tenth of our cells are human. The rest are all hitch-hikers, mainly harmless bacteria that have evolved with us.

There are 100,000 billion of these bacteria in our guts, where they play a crucial role in our health by helping to break down food and convert it into energy, and by excluding bacteria that are harmful to us. Some are even said to make us happier. In exchange, we provide shelter and a share of our food.

The types of bugs that call us home could explain differences in our ability to digest food and resist disease, and how we react to drugs.

Isn't it surprising that all humans share only three predominant gut-bug ecosystems, given our diverse diets, lifestyles and gene-profiles?

Yes, and even the researchers who made the discovery are mystified. "At the moment, it's purely an observation, but the signal is there, and it's strong and it's real," says Jeroen Raes of the Flanders Institute of Biology in Brussels, Belgium, a co-leader of the team in question. "We're still guessing the implications."

How did they find out?

Raes and his colleagues analysed DNA in faeces from 33 individuals from Japan, Denmark, the US, France and Spain. By comparing the DNA sequences with publicly available reference sequences for 1500 bacterial and other species, they excluded all human DNA and identified as many bacteria as they could.

What did they find?

To their amazement, they found that broadly, people's gut bugs segregated into three distinct "enterotypes", or ecosystems, not unlike the way that all humans share only a handful of blood types.

Isn't this a big conclusion for such a small sample?

Maybe, but they have gone on to confirm that the pattern is repeated in larger groups of people, including a study of 154 people from the US and 85 from Denmark.

Surely the type of ecosystem you have depends on what you eat?

Wrong, it seems. The other surprise was that the ecosystem you have doesn't seem to depend on how old you are, where you live in the world or your genetic make-up either. "We found that people from Japan and France, for example, might have ecosystems more similar to one another than to those of their compatriots, even though they have very different diets," says Raes.

So what are these three ecosystems?

The researchers have named them "bacteriode", "prevotella" and "ruminococcus", to reflect the species that

dominate in each. People with a bacteriode ecosystem have a bias towards bacteria that get most of their energy from carbohydrates and proteins. Prevotellas specialise in digesting sugar-covered proteins in mucin, the mixture of viscous proteins in the gut – an ability shared by people with a ruminococcus ecosystem.

Does it matter which one you've got?

The only difference identified was in the vitamins produced. Bacteriodes had a higher proportion of bacteria that make high amounts of vitamins C, B2, B5 and H, and prevotellan guts had more bacteria that make vitamin B1 and folic acid. The implications for health are not yet clear, however.

Could this explain why some people may be more prone to obesity?

The researchers did find a correlation between obesity and the abundance of bacteria that extract energy rapidly from food for their own use. Raes is currently looking into this in greater detail in a study of 100 people, to see if any strong links emerge.

Why might there be only three ecosystems?

Raes admits he has no answer yet, but says one possibility is that our gut environment is governed by our immune system, by blood type or the "major histocompatibility complex", which dictates which blood type you are.

A second possibility is the length of time it takes for food to pass through our digestive system. If it goes slowly, it gives opportunities for a more diverse range of species to grow and thrive.

What about links between our health and gut bacteria – might the identification of the three ecosystems shed light on disease?

It has been suggested that eating sushi might help us to get energy from food, and taking probiotics could help babies who suffer from eczema. It has even been suggested that gut bacteria has a role in Crohn's disease and autism.

Raes says that there are plenty of studies in mice showing that diet can alter gut bacteria. The hope is that future research will reveal more about the possibility of links between our enterotype and conditions such as obesity and diabetes.

Journal reference: *Nature*, DOI: 10.1038/nature09944

http://www.newscientist.com/article/dn20401-each-human-has-one-of-only-three-gut-ecosystems.html

New clues to preventing miscarriage or pre-term births

- 20 April 2011 by **Hayley Crawford** and **Helen Thomson**
- Magazine issue 2809

A happy outcome (Image: Susan Kirch/Plainpicture)

MISCARRIAGE and pre-term birth are the two things all parents-to-be worry about. Two studies published this week could help establish why some pregnancies go wrong, and offer hope for new treatments to prevent pregnancies ending this way.

One in five pregnancies end in miscarriage, and the risk increases with the age of the mother. Patricia Hunt and colleagues at Washington State University in Pullman have now identified a surprising contributing factor: a lack of quality control during egg-making.

Hunt's team found that not all of the immature egg cells, or oocytes, produced by mice contain the correct number of chromosomes. Egg or sperm cells divide through a process called meiosis, rather than the mitosis that is typical of cell division elsewhere in the body. There are several checks in place to make sure that meiosis occurs correctly, but Hunt's team found that this process isn't as strictly controlled in eggs as it is in sperm.

Specifically, when the pairs of chromosomes line up at what is called the meiotic spindle at the centre of the parent cell, they should await a chemical signal called the spindle assembly checkpoint (SAC) before dividing into daughter cells. However, the team found that eggs bend this rule. When they observed eggs dividing in ovaries removed from mice, they noticed that the SAC trigger for cell division waits for most - but not all - of the chromosomes to be lined up correctly. The consequence is either too many or too few chromosomes in the resulting egg cells, which can lead to birth defects or miscarriage (*Current Biology*, DOI: 10.1016/j.cub.2011.03.003).

The cell division process "is highly conserved between mice and humans", says Hunt, suggesting that the same lack of quality control also applies to us. She reckons that we may be evolutionarily programmed to allow defective cells to divide because eggs are precious. "It is better to try and fail than to simply give up on an egg before it is even fertilised," she says.

As the absence of a control mechanism can only increase the risk of chromosomal abnormality, So Iha Nagaoka, co-author of the study, says that IVF could be adapted to include screening that sorts the bad eggs from the good in a way that the body does not, helping to reduce the risk of miscarriage.

Premature birth is also a distressing experience for parents, and it is this aspect of pregnancy that Justin Fay at Washington University School of Medicine in St Louis, Missouri, concentrates on. Some 12 per cent of babies are premature, and caring for them costs the UK £1 billion ($1.64 billion) a year.

Fay and colleagues think they have identified a contributing factor. "Humans have a shorter gestation period relative to their brain and body size than you would expect looking at other primate lineages," he says. This is a result of our large brains and the narrow female pelvis, which mean that in order to maximise the chance of both mother and baby surviving, our gestation period has had to shorten.

The researchers think that this shortening is encoded in the genes involved in birth timing, some of which must have evolved rapidly since we diverged from other apes, to keep up with the growth of our brains.
To find out, the team compared numerous genomes from humans and other primates and pinpointed around 150 likely candidates for genes involved in accelerated birth timing. When the researchers looked for these genes in 328 mothers in Finland they found that variations in a gene called *FSHR* were more frequent in mothers who gave birth before 37 weeks of gestation. The team says the gene could be a new target for therapeutic measures to prevent pre-term births (*PLoS Genetics*, DOI: 10.1371/journal.pgen.1001365).
"It was surprising to find that *FSHR* was involved," says Fay. The hormone it controls- follicle stimulating hormone (FSH)- has a well-known function in the establishment of pregnancy rather than the initiation of labour. "It suggests that we should start looking at risk factors for pre-term births much earlier than 25 to 35 weeks into gestation," he says.
David Haig at Harvard University says that it may be significant that the neighbouring gene to *FSHR* - called *LHCGR* - is responsible for producing a hormone that helps to maintain a thick uterus during pregnancy. Any variations to *FSHR* might have a knock-on effect on nearby genes, he suggests.

Chimp births are surprisingly like our own

The process of human birth is unique among primates because the infant emerges with its head facing in the opposite direction from its mother, or so the argument goes. Now, the first close-up videos of three chimpanzee births suggest that theory is wrong. In all three cases, the newborn emerged with its head facing away from the mother (*Biology Letters*, DOI: 10.1098/rsbl.2011.0214).
It has also been suggested that the orientation of human newborns accounts for another uniquely human aspect of birth- the need for a midwife. Indeed, midwives contacted by *New Scientist* say that the differences in birth-related mortality rates between countries with good and poor levels of medical care shows the difference their assistance makes.
But this idea may also now be up for revision. Satoshi Hirata at the Great Ape Research Institute of Hayashibara Biochemical Laboratories in Okayama, Japan, who led the study, says that chimps make nests so that they have a safe place to give birth, which could allow this style of birth to occur without assistance.

http://www.newscientist.com/article/mg21028093.700-new-clues-to-preventing-miscarriage-or-preterm-births.html?full=true&print=true

One in 10 kids found with a taste disorder

- 11:18 22 April 2011 by **Wendy Zukerman**

Taste different? (Image: John Carleton/Getty)

Imagine a child without a taste for candy. Turns out this may be remarkably common: almost one in 10 children in a recent study were unable to taste their food properly. Taste disorders such as this are known to lead to diet changes and could play a role in obesity.

David Laing at the University of New South Wales in Sydney, Australia, and colleagues tested the taste buds of 432 children aged 8 to 12. Each was asked to drink a series of water-based drinks containing either sugar, salt, citric acid or bitter quinine hydrochloride. After each drink the children were asked to point to one of three photographs that they thought best described the taste. One photograph showed a food object with the correct taste and one showed food with the incorrect taste. The third photograph always showed a glass of water in case the children found the drink tasteless.

The experiment was repeated for five different concentrations of each flavoured drink, making a total of 40 drinks. These were given to the children in a random order. Between drinks they rinsed their mouth with water.

A child is considered to have a taste disorder if they cannot point to the photograph that correctly relates to the taste in at least three of the five different concentrations of that particular flavour.

Surprisingly, 41 children – 9.5 per cent – met this criterion, with almost two-thirds of those children unable to identify a sweet taste.

Taste disorders can be caused by a variety of diseases including Bell's palsy, renal failure and diabetes. But Laing suspects that chronic middle-ear infections may be responsible for the children's disorders.

From ear to brain

Last month, Seung Geun Yeo at the Kyung Hee University in Seoul, South Korea, found a strong association in 42 children between chronic middle-ear infections and difficulty identifying sweet and salty tastes.

A major nerve involved in tasting, called the chorda tympani, passes through the middle ear en route to the brainstem. Inflammatory proteins, viruses and bacteria from the infection can "chew up the nerve" and deteriorate taste sensations, says Laing.

In his study, Indigenous Australian children, who are particularly susceptible to ear infections, were also more likely to have taste disorders than non-Indigenous kids.

"Given the age of the children, it is likely that for many their taste loss is permanent," says Laing.

No taste for exercise

The disorder may partly explain the rise of childhood obesity. The South Korean study found that children with taste disorders were heavier than those without. According to Laing, losing a taste sensation would "dramatically" change the taste of many foods, possibly leading to dietary switches. For example, children who could not appreciate a sweet taste may move to a high-salt diet.

The loss of taste sensations and childhood obesity is "a reasonable link", says Beverly Mühlhäusler at the University of Adelaide, South Australia. While high-fat diets and low activity levels are the main cause of obesity, taste disorders could explain why some people are more likely to make those poor lifestyle choices, she says.

But it is also possible that obese children are predisposed to getting ear infections and the ensuing taste disorders. According to Yeo, obese people have a thicker fat pad around their ear and more inflammatory proteins than normal individuals – two factors that increase the likelihood of ear infection.

Journal references: Laing: *Acta Paediatrica*, DOI: 10.1111/j.1651-2227.2011.02292.x; Yeo: *Archives of Otolaryngology Head and Neck Surgery*, DOI: 10.1001/archoto.2011.23

http://www.newscientist.com/article/dn20408-one-in-10-kids-found-with-a-taste-disorder.html

How to be happy: The digital frontier

- 22 April 2011 by **Kat Austen**
- Magazine issue 2808

Digital bliss? (Image: Jonathan Hordle/Rex Features)

Can we tell how happy people are from their online activity – and can living digitally actually make you happier?

HAPPINESS is hard enough to pin down in the real world, but in the digital realm, the stumbling blocks are more fundamental.

Data is mostly created by a self-selecting group of bloggers, tweeters or social network fiends - and people may alter the extent of their online interactions depending on mood. "Are they more likely to distance themselves from Facebook when they are unhappy?" wondered Julie Kane Ahkter and Steven Soria of Stanford University, California, who analysed mood in Facebook status updates. Equally tricky is the desire for online popularity, which can lead people to fake happiness online to keep friends.

But the most basic problem is correlating online sentiment with real-world emotions. Sentiment has begun to be correlated with real-world opinion - but not yet emotions. For example, Bernardo Huberman's group at HP Labs in Palo Alto, California, predicted a film's box-office success by analysing the volume of responses and their sentiments on Twitter.

Similarly, work by Noah Smith at Carnegie Mellon University in Pittsburgh, Pennsylvania, shows an 80 per cent correlation between Twitter sentiment on politics and old-style opinion polls.

But can living digitally actually increase happiness? Maybe. Feng-Yang Kuo of the National Sun Yat-Sen University, Taiwan, found that bloggers have an improved sense of "subjective well-being" (a proxy for happiness?) from the self-disclosure afforded by blogs.

New life-logging technologies, which document the minutiae of daily life, can improve memory in dementia sufferers. And Anind K. Dey, also at Carnegie Mellon, has reported early findings that life-logging data provides useful clues for improving our quality of life. Who wouldn't be happy with that? Kat Austen

http://www.newscientist.com/article/mg21028085.900-how-to-be-happy-the-digital-frontier.html?full=true&print=true

Digital legacy: Archaeology of the future

- 11:00 20 April 2011 by **Sumit Paul-Choudhury**

The historians of 2061 will want to study the birth of the world wide web. How on earth will they know where to start?
Today, historians have to piece together the details of their subjects' lives from tiny scraps of evidence. Their successors are more likely to be overwhelmed: the problem will be making sense of our vast digital legacies. What techniques will they use to make sense of this deluge?
Many of us now generate more data than we can manage – think of all those holiday pictures you'll never get round to organising into an album. The contents of our hard drives are jumbled messes; the web's lack of structure, coupled with anonymity and the use of aliases, will make the online world an equally formidable challenge for future historians.
All the HTML, MP3 and JPEG files that make up today's web are likely to remain readable for a very long time. But unpicking their original provenance and authenticity will be no mean feat, because data is often duplicated, edited, annotated and modified.
To safeguard our files, we tend to back them up, email documents to ourselves or post pictures online. Files also get passed between people. These actions often change the file, yet most of these changes are minor and usually invisible to a human being.
This is a mixed blessing for internet archaeologists. On one hand, the variations provide valuable insight into how information has spread. On the other, it makes it difficult to establish where it first came from, as anyone who's ever tried to track down the origins of an internet meme will appreciate.

Fuzzy filter

A brute-force way of sifting through all these files for provenance is "hashing": a mathematical technique that summarises a large piece of data as a much smaller number – or "hash value" – making it easy to compare files. But because even a tiny change to the original data will result in a completely different hash value, it can be hard to see the relation between copies.
Breaking each file up into segments and creating a separate hash for each segment can reveal when two files are mostly composed of identical segments and are thus likely to be related.
Such "fuzzy hashes" can be used to find near-identical copies, or to identify incomplete or early drafts – information that a biographer might find helpful.
The technique is not perfect, though: its ability to spot similarities is, well, fuzzy, and it works better for some file types than others. Compressing a picture slightly, for example, doesn't affect its appearance very much, but can change its hash values dramatically.

Write stuff

What about text? The internet is full of anonymous comments, status updates and blog posts. Historians may want to unmask the authors.
One way to do that is look for their characteristic "writeprints": their vocabulary, the length of the sentences they use, words and punctuation patterns they're particularly fond of, and even habitual grammatical mistakes. Normally this requires a substantial chunk of text to work on, but researchers at the National Institute for Computing and Automation Research in Grenoble, France, have designed a system that can link different aliases used by one person, using only the characters that make up their usernames.
You can try a simple version of this approach on the website I Write Like, which tells you which famous writer's output your own deathless prose most resembles. But I Write Like also illustrates some of the difficulties of this approach, notoriously failing to identify some of the writers it actually uses as references. More sophisticated approaches would undoubtedly do better, but changes in our writeprints over time again make it hard to be definitive about the author of a work. (Then again, such changes can be illuminating for literary sleuths: analysis of Agatha Christie's later works have been used to support suspicions that she suffered from dementia.)

Finding meaning

Writeprints confine themselves to the structure of text, but semantic analysis tools go further – trying to identify relevant information in the meaning of the text. That could help future researchers work out what you were like without having to trawl through every one of your status updates.

Defuse, a system under development by Aaron Zinman at the Massachusetts Institute of Technology, represents individual commenters on a website as coloured blocks, based on the kind of language they use and how closely they conform to community norms. It's an attempt to create a kind of "digital body", he says – a pixel portrait that mimics our ability to size someone up at a glance in the physical world.

But Zinman cautions against interpreting the output of such systems too literally. "It's important to understand how complex humans are," he says. "A biography of someone important may be hundreds of pages long, but it's still a condensed account of their life, written through a particular lens and with a particular objective. There are a million ways you can slice the data about a person, and they will look different in each one."

That's a point made more explicitly by Zinman's earlier project, Personas, which purports to reveal how the web sees you by searching for "meaningful" statements.

Real messiness

When I tried Personas myself, it came up with "management, education, news", which I'd say is more like a blurry telephoto picture of me than a finely detailed portrait. That's the point: Zinman intended it to illustrate how poorly today's machine learning captures the messiness of real people.

Viktor Mayer-Schönberger of the Oxford Internet Institute in the UK also strikes a cautionary note. "Digital memory only captures digital artefacts," he says. "The more we depend on it, the more tempted we are to attribute qualities to it that it doesn't actually have, like authenticity and comprehensiveness."

So even if the tools of the trade improve immeasurably over the next half-century, they'll still be limited by the records we leave behind us. While those records are becoming ever richer, with our locations and even our heartbeats now being recorded, the historians of 2061 may still get only a glimpse of what we were really like – or at least, who we considered ourselves to be.

Sumit Paul-Choudhury *is the editor of newscientist.com*

http://www.newscientist.com/article/dn20395-digital-legacy-archaeology-of-the-future.html

Bear DNA is clue to age of Chauvet cave art

- 19 April 2011 by **Michael Marshall**
- Magazine issue 2809

Too sophisticated for their time? (Image: Raphael Gaillarde/Gamma-Rapho/Getty)

EXPLORING a gorge in south-east France in 1994 for prehistoric artefacts, Jean-Marie Chauvet hit the jackpot. After squeezing through a narrow passage, he found himself in a hidden cavern, the walls of which were covered with paintings of animals.

But dating the beautiful images - which featured in Werner Herzog's recent documentary film *Cave of Forgotten Dreams* - has led to an ugly spat between archaeologists. Could the bones of cave bears settle the debate?

Within a year of Chauvet's discovery, radiocarbon dating suggested the images were between 30,000 and 32,000 years old, making them almost twice the age of the famous Lascaux cave art in south-west France (see map). The result "polarised the archaeological world", says Andrew Lawson, a freelance archaeologist based in Salisbury, UK.

Lawson accepts the radiocarbon findings. "Nowhere else in western Europe do we know of sophisticated art this early," he says. But Paul Pettitt of the University of Sheffield, UK, is adamant that the paintings cannot be that old. The dating study doesn't stand up, he claims, insisting that the paintings' advanced style is enough to mark them as recent. To suggest otherwise, he says, would be like claiming to have found "a Renaissance painting in a Roman villa".

Despite a comprehensive radiocarbon study published in 2001 that seemed to confirm that the paintings were indeed 30,000 years old (*Nature*, DOI: 10.1038/35097160), Pettitt and his colleagues were unconvinced. Two years later they argued that the cave walls were still chemically active, so the radiocarbon dating could have been thrown out by changes over the millennia to the pigments used to create the paintings (*Antiquity*, vol 77, p 134).

To try to settle the controversy, Jean-Marc Elalouf of the Institute of Biology and Technology in Saclay, France, and his team have turned to the remains of cave bears. Along with mammoths and other huge mammals, cave bears (*Ursus spelaeus*) dominated the European landscape until the end of the last ice age.

The Chauvet cave contains several depictions of cave bears, and Elalouf argues that these must have been painted while the bears still thrived in the area. To pin down when the bears disappeared, his team collected 38 samples of cave bear remains in the Chauvet cave and analysed their mitochondrial DNA.
They found that almost all the samples were genetically similar, suggesting the cave bear population was small, isolated and therefore vulnerable. Radiocarbon dating showed the samples were all between 37,000 and 29,000 years old, hinting that by the end of that period they were extinct, at least locally. Samples from a nearby cave, Deux-Ouvertures, gave similar results (*Journal of Archaeological Science*, DOI: 10.1016/j.jas.2011.03.033).
Given the age of the cave bear remains, "it is clear that the paintings are very ancient", says Elalouf. Michael Knapp of the University of Otago in Dunedin, New Zealand, who also studies cave bears, says he has no doubts about the DNA analysis.
While we do not know exactly when cave bears became extinct, all reliably dated remains in Europe are at least 24,000 years old, says Martina Pacher of the Commission of Quaternary Research in Vienna, Austria. "So the results at Chauvet are not surprising, and I agree with their conclusions," she says.
"We now have an independent line of evidence that the bears [in Chauvet] date to before 29,000 years ago," Lawson says. "That bolsters the case for an early date."
Pettitt remains unconvinced, calling the new research "sloppy". He says that the team is trying to extrapolate the regional spread of the bears over time by relying on evidence from just two caves.
Pettitt also questions whether the paintings show cave bears at all: brown bears lived in the area long after the cave bears were gone. But Elalouf says the two species can be distinguished by skull shape, and that the paintings definitely show cave bears.

http://www.newscientist.com/article/mg21028093.900-bear-dna-is-clue-to-age-of-chauvet-cave-art.html

Reinventing the wheel: designing an 'impossible' bike

- Updated 15:55 19 April 2011 by **Jeff Hecht**
- Magazine issue 2809

This weird contraption is called a two-mass-skate bike (Image: Sam Rentmeester/FMAX)

If the usual ideas of how bicycles balance themselves are right, this weird contraption ought to quickly topple over. In fact it stays upright, an observation that might lead to a rethink of bicycle dynamics – and perhaps to better bike designs.

Push a riderless bike fast enough, and it stays upright for a surprising distance. When it starts tipping to the right or left, the front wheel steers into the fall, correcting the tilt.

Earlier studies attributed this in part to the gyroscopic effect of the spinning wheels. But this model, built by Andy Ruina of Cornell University in Ithaca, New York, and colleagues, nullifies the gyroscopic effect with discs that spin in the opposite direction to the wheels. Also, its front wheel is mounted forward from the usual place – a change expected to make the bike topple.

The key to its stability seems to be that the centre of gravity of the handlebars is lower than the frame's and forward of the steering axis. So when the handlebars start to fall, they do so faster than the frame. This twists the hinge to the front wheel, steering it into a fall.

Journal reference: *Science*, DOI: 10.1126/science.1201959

http://www.newscientist.com/article/dn20383-reinventing-the-wheel-designing-an-impossible-bike.html?full=true&print=true

Brown Recluse Spider: Range Could Expand in N. America With Changing Climate

Brown recluse spider. (Credit: iStockphoto/William Howe)

ScienceDaily (Apr. 23, 2011) — One of the most feared spiders in North America is the subject a new study that aims to predict its distribution and how that distribution may be affected by climate changes.

When provoked, the spider, commonly known as the brown recluse (*Loxosceles reclusa*), injects powerful venom that can kill the tissues at the site of the bite. This can lead to a painful deep sore and occasional scarring.

But the wounds are not always easy to diagnose. Medical practitioners can confuse the bite with other serious conditions, including Lyme disease and various cancers. The distribution of the spider is poorly understood as well, and medical professionals routinely diagnose brown recluse bites outside of the areas where it is known to exist.

By better characterizing its distribution, and by examining potential new areas of distribution with future climate change scenarios, the medical community and the public can be more informed about this species, said study author Erin Saupe. Saupe is a graduate student in Geology and a Biodiversity Institute student.

To address the issue of brown recluse distribution, Saupe and other researchers used a predictive mapping technique called ecological niche modeling. They applied future climate change scenarios to the spider's known distribution in the Midwest and southern United States. The researchers concluded that the range may expand northward, potentially invading previously unaffected regions. Newly influenced areas may include parts of Nebraska, Minnesota, Wisconsin, Michigan, South Dakota, Ohio, and Pennsylvania.

"These results illustrate a potential negative consequence of climate change on humans and will aid medical professionals in proper bite identification and treatment, potentially reducing bite misdiagnoses," Saupe said.

The paper is published in the March 25 edition of the journal *PLoS ONE*. The research team included Saupe; Monica Papes, a Biodiversity Institute and Ecology and Evolutionary Biology alumna; Paul Selden, Director of the Paleontological Institute and Gulf-Hedberg Distinguished Professor of Invertebrate Paleontology, Department of Geology; and Richard S. Vetter, University of California-Riverside.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Kansas Biodiversity Institute**.

Journal Reference:

1. Erin E. Saupe, Monica Papes, Paul A. Selden, Richard S. Vetter. **Tracking a Medically Important Spider: Climate Change, Ecological Niche Modeling, and the Brown Recluse (Loxosceles reclusa)**. *PLoS ONE*, 2011; 6 (3): e17731 DOI: 10.1371/journal.pone.0017731

http://www.sciencedaily.com/releases/2011/04/110421212230.htm

Lawn of Native Grasses Beats Traditional Lawn for Lushness, Weed Resistance

The lawn research plots at the Lady Bird Johnson Wildflower Center where the characteristics of common Bermudagrass were compared to Buffalograss and a mixture of up to seven native grass species. Each octagonal bed includes all the grass combinations, with the nine octagons allowing mowing and other treatments to be replicated. (Credit: The Lady Bird Johnson Wildflower Center at The University of Texas at Austin)

ScienceDaily (Apr. 22, 2011) — A lawn of regionally native grasses would take less resources to maintain while providing as lush a carpet as a common turfgrass used in the South, according to a study by ecologists at The University of Texas at Austin's Lady Bird Johnson Wildflower Center.

"We created a lawn that needs less mowing and keeps weeds out better than a common American lawn option," said Dr. Mark Simmons, director of the center's Ecosystem Design Group, noting that this new approach could have a huge impact on pocketbooks and the environment.

Simmons led the study comparing common Bermudagrass to seven native grasses that will be published online this week in the journal *Ecological Engineering.*

Commercial and residential lawns cover about 40 million acres -- more American landscape than any traditional agricultural crop. But keeping that turfgrass looking good takes more time, effort and money than it could and carries an environmental price tag.

U.S. lawn maintenance annually consumes about 800 million gallons of gasoline, $5.2 billion of fossil-fuel derived fertilizers and $700 million in pesticides. Up to two thirds of the drinking water consumed in municipalities goes to watering lawns.

"Most lawns use a single grass species, which requires inputs to maintain," Simmons said. "The goal was to develop a more ecologically stable, natural alternative for lawns that are so important to many Europeans and Americans."

Simmons knew that the species co-existing in natural grasslands can thrive without human intervention from living and studying in southern England near where Jane Austen once lived, and in the grasslands of South Africa. To test whether a mixture of grasses provides a good lawn, Simmons and colleagues Michelle Bertelsen, Dr. Steve Windhager and Holly Zafian used funding from Walmart to establish multiple plots of grasses in an open field at the center.

Co-author Bertelsen is an ecologist at the Wildflower Center. Windhager previously directed landscape restoration research at the center and is now chief executive officer of the Santa Barbara Botanic Garden. Zafian was a center research assistant and is now a graduate student at Texas State University -- San Marcos.

For the study, plots of non-native Bermudagrass were established from commercially available seeds alongside plots of Buffalograss in various combinations with other native, short grass species. In 2009, the researchers applied different mowing and other regimes to the two-year-old turf plots.

The traditional turfgrass and the native grasses responded the same to mowing once or twice a month, to two watering regimens and to the equivalent of foot traffic. However, the turf of seven native grasses produced a carpet that was 30 percent thicker in early spring than the Bermuda turf. As temperatures climbed into mid-summer and all the lawns thinned, the mixed native turfgrass still stayed 20 percent thicker than Bermuda.

"If we had mowed more frequently, the Bermudagrass might have become denser because of the way it grows," Simmons said, "but the point was to find something that took less work to maintain than Bermuda and other traditional turfgrasses."

Although Buffalograss also retained its lushness into summer, the mixed native turfgrass beat both single species (monoculture) turfgrasses in weed resistance. When dandelion seeds were added by hand, those plots grew half as many dandelions as the Buffalograss or Bermudagrass plots.

To see if the mixed native turfgrass would also outperform the others under conditions such as very light watering, he and his colleagues will conduct the next research phase later this year. The answer under some conditions will likely be a yes because the multiple species in natural grasslands are thought to allow them to respond better to different conditions over time.

How soon American lawns benefit from the findings depends partly on whether native grasses become more commercially available. The native grass combination that will likely work best will also vary with location, Simmons noted.

"This is just the first step to showing that having multiple grass species, basically creating a stable ecosystem that is a lawn, may have advantages for some turfgrass applications," Simmons said. "But we need to apply the findings to different settings to move away from solely having lawns that rely on us for life support."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Texas at Austin**.

http://www.sciencedaily.com/releases/2011/04/110421104512.htm

'Time Machine' Made to Visually Explore Space and Time in Videos: Time-Lapse GigaPans Provide New Way to Access Big Data

The early universe. This is an image from one of a number of videos available on the Gigapan website. Gigapan enables viewers to explore gigapixel-scale, high-resolution videos and image sequences by panning or zooming in and out of the images while simultaneously moving back and forth through time. (Credit: Image courtesy of Carnegie Mellon University, NASA, Gigapan, Google)

ScienceDaily (Apr. 22, 2011) — Researchers at Carnegie Mellon University's Robotics Institute have leveraged the latest browser technology to create GigaPan Time Machine, a system that enables viewers to explore gigapixel-scale, high-resolution videos and image sequences by panning or zooming in and out of the images while simultaneously moving back and forth through time.

Viewers, for instance, can use the system to focus in on the details of a booth within a panorama of a carnival midway, but also reverse time to see how the booth was constructed. Or they can watch a group of plants sprout, grow and flower, shifting perspective to watch some plants move wildly as they grow while others get eaten by caterpillars. Or, they can view a computer simulation of the early universe, watching as gravity works across 600 million light-years to condense matter into filaments and finally into stars that can be seen by zooming in for a close up.

"With GigaPan Time Machine, you can simultaneously explore space and time at extremely high resolutions," said Illah Nourbakhsh, associate professor of robotics and head of the CREATE Lab. "Science has always been about narrowing your point of view -- selecting a particular experiment or observation that you think might provide insight. But this system enables what we call exhaustive science, capturing huge amounts of data that can then be explored in amazing ways."

The system is an extension of the GigaPan technology developed by the CREATE Lab and NASA, which can capture a mosaic of hundreds or thousands of digital pictures and stitch those frames into a panorama that be interactively explored via computer. To extend GigaPan into the time dimension, image mosaics are repeatedly captured at set intervals, and then stitched across both space and time to create a video in which each frame can be hundreds of millions, or even billions of pixels.

An enabling technology for time-lapse GigaPans is a feature of the HTML5 language that has been incorporated into such browsers as Google's Chrome and Apple's Safari. HTML5, the latest revision of the HyperText Markup Language (HTML) standard that is at the core of the Internet, makes browsers capable of presenting video content without use of plug-ins such as Adobe Flash or Quicktime.

Using HTML5, CREATE Lab computer scientists Randy Sargent, Chris Bartley and Paul Dille developed algorithms and software architecture that make it possible to shift seamlessly from one video portion to another as viewers zoom in and out of Time Machine imagery. To keep bandwidth manageable, the GigaPan site streams only those video fragments that pertain to the segment and/or time frame being viewed.

"We were crashing the browsers early on," Sargent recalled. "We're really pushing the browser technology to the limits."

Guidelines on how individuals can capture time-lapse images using GigaPan cameras are included on the site created for hosting the new imagery's large data files, http://timemachine.gigapan.org. Sargent explained the CREATE Lab is eager to work with people who want to capture Time Machine imagery with GigaPan, or use the visualization technology for other applications.

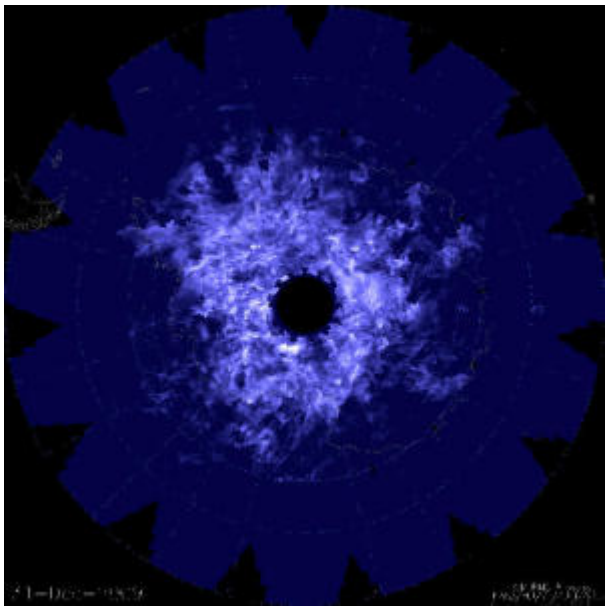
Once a Time Machine GigaPan has been created, viewers can annotate and save their explorations of it in the form of video "Time Warps."

Though the time-lapse mode is an extension of the original GigaPan concept, scientists already are applying the visualization techniques to other types of Big Data. Carnegie Mellon's Bruce and Astrid McWilliams Center for Cosmology, for instance, has used it to visualize a simulation of the early universe performed at the Pittsburgh Supercomputing Center by Tiziana Di Matteo, associate professor of physics.
"Simulations are a huge bunch of numbers, ugly numbers," Di Matteo said. "Visualizing even a portion of a simulation requires a huge amount of computing itself." Visualization of these large data sets is crucial to the science, however. "Discoveries often come from just looking at it," she explained.
Rupert Croft, associate professor of physics, said cosmological simulations are so massive that only a segment can be visualized at a time using usual techniques. Yet whatever is happening within that segment is being affected by forces elsewhere in the simulation that cannot be readily accessed. By converting the entire simulation into a time-lapse GigaPan, however, Croft and his Ph.D. student, Yu Feng, were able to create an image that provided both the big picture of what was happening in the early universe and the ability to look in detail at any region of interest.
Using a conventional GigaPan camera, Janet Steven, an assistant professor of biology at Sweet Briar College in Virginia, has created time-lapse imagery of rapid-growing brassicas, known as Wisconsin Fast Plants. "This is such an incredible tool for plant biology," she said. "It gives you the advantage of observing individual plants, groups of plants and parts of plants, all at once."
Steven, who has received GigaPan training through the Fine Outreach for Science program, said time-lapse photography has long been used in biology, but the GigaPan technology makes it possible to observe a number of plants in detail without having separate cameras for each plant. Even as one plant is studied in detail, it's possible to also see what neighboring plants are doing and how that might affect the subject plant, she added.
Steven said creating time-lapse GigaPans of entire landscapes could be a powerful tool for studying seasonal change in plants and ecosystems, an area of increasing interest for understanding climate change. Time-lapse GigaPan imagery of biological experiments also could be an educational tool, allowing students to make independent observations and develop their own hypotheses.
Google Inc. supported development of GigaPan Time Machine.

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

http://www.sciencedaily.com/releases/2011/04/110421151916.htm

Clouds, Clouds, Burning Bright



Looking down from above, AIM captured this composite image of the noctilucent cloud cover above the Southern Pole on December 31, 2009. The 2009 cloud season began a month earlier than the 2010 season did. (Credit: NASA/HU/VT/CU LASP)

ScienceDaily (Apr. 22, 2011) — High up in the sky near the poles some 50 miles above the ground, silvery blue clouds sometimes appear, shining brightly in the night. First noticed in 1885, these clouds are known as noctilucent, or "night shining," clouds. Their discovery spawned over a century of research into what conditions causes them to form and vary -- questions that still tantalize scientists to this day. Since 2007, a NASA mission called Aeronomy of Ice in the Mesosphere (AIM) has shown that the cloud formation is changing year to year, a process they believe is intimately tied to the weather and climate of the whole globe.

"The formation of the clouds requires both water and incredibly low temperatures," says Charles Jackman, an atmospheric scientist at NASA's Goddard Space Flight Center in Greenbelt, Md., who is NASA's project scientist for AIM. "The temperatures turn out to be one of the prime driving factors for when the clouds appear."

So the appearance of the noctilucent clouds, also known as polar mesospheric clouds or PMCs since they occur in a layer of the atmosphere called the mesosphere, can provide information about the temperature and other characteristics of the atmosphere. This in turn, helps researchers understand more about Earth's low altitude weather systems, and they've discovered that events in one hemisphere can have a sizable effect in another.

Since these mysterious clouds were first spotted, researchers have learned much about them. They light up because they're so high that they reflect sunlight from over the horizon. They are formed of ice water crystals most likely created on meteoric dust. And they are exclusively a summertime phenomenon.

"The question people usually ask is why do clouds which require such cold temperatures form in the summer?" says James Russell, an atmospheric scientist at Hampton University in Hampton, Va., who is the Principal Investigator for AIM. "It's because of the dynamics of the atmosphere. You actually get the coldest temperatures of the year near the poles in summer at that height in the mesosphere."

As summer warmth heats up air near the ground, the air rises. As it rises, it also expands since atmospheric pressure decreases with height. Scientists have long known that such expansion cools things down -- just think of how the spray out of an aerosol can feels cold -- and this, coupled with dynamics in the atmosphere that drives the cold air even higher, brings temperatures in the mesosphere down past a freezing -210º F (-134 ºC).

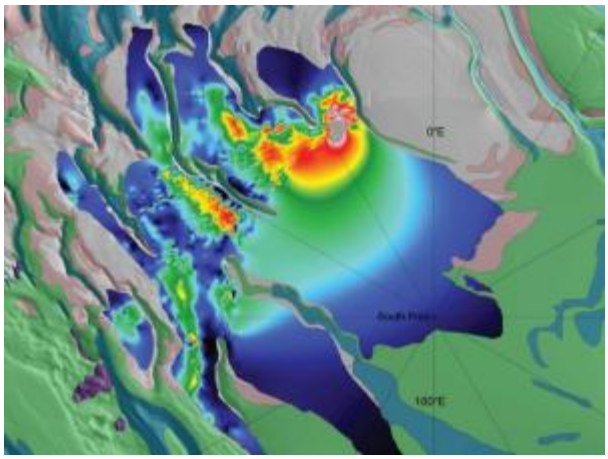
In the Northern hemisphere, the mesosphere reaches these temperatures consistently by the middle of May. Since AIM has been collecting data, the onset of the Northern season has never varied by more than a week or

so. But the southern hemisphere turns out to be highly variable. Indeed, the 2010 season started nearly a month later than the 2009 season.
Atmospheric scientist Bodil Karlsson, a member of the AIM team, has been analyzing why the start of the southern noctilucent cloud season can vary so dramatically. Karlsson is a researcher at Stockholm University in Sweden, though until recently she worked as a post-doctoral researcher at the University of Colorado. A change in when some pretty clouds show up may not seem like much all by itself, but it's a tool for mapping the goings-on in the atmosphere, says Karlsson.
"Since the clouds are so sensitive to the atmospheric temperatures," says Karlsson. "They can act as a proxy for information about the wind circulation that causes these temperatures. They can tell us that the circulation exists first of all, and tell us something about the strength of the circulation."
She says the onset of the clouds is timed to something called the southern stratospheric vortex -- a winter wind pattern that circles above the pole. In 2010, that vortex lingered well into the southern summer season, keeping the lower air cold and interfering with cloud formation. This part of the equation is fairly straightforward and Karlsson has recently submitted a paper on the subject to the Journal of Geophysical Research. But this is not yet the complete answer to what drives the appearance of these brightly lit clouds.
AIM researchers also believe there is a connection between seemingly disparate atmospheric patterns in the north and south. The upwelling of polar air each summer that contributes to noctilucent cloud formation is part of a larger circulation loop that travels between the two poles. So wind activity some 13,000 miles (20,920 km) away in the northern hemisphere appears to be influencing the southern circulation.
The first hints that wind in the north and south poles were coupled came in 2002 and 2003 when researchers noticed that despite a very calm lower weather system near the southern poles in the summer, the higher altitudes showed variability. Something else must be driving that change.
Now, AIM's detailed images of the clouds have enabled researchers to look at even day-to-day variability. They've spotted a 3 to10 day time lag between low-lying weather events in the north -- an area that, since it is fairly mountainous, is prone to more complex wind patterns -- and weather events in the mesosphere in the south. On the flip side, the lower atmosphere at the southern poles has little variability, and so the upper atmosphere where the clouds form at the northern poles stays fairly constant. Thus, there's a consistent start to the cloud season each year.
"The real importance of all of that," says Hampton's Russell, "is not only that events down where we live can affect the clouds 50 miles (80 km) above, but that the total atmosphere from one pole to the next is rather tightly connected."
Hammering out the exact mechanisms of that connection will, of course, take more analysis. The noctilucent cloud season will also surely be affected by the change in heat output from the sun during the upcoming solar maximum. Researchers hope to use the clouds to understand how the sun's cycle affects Earth's atmosphere and the interaction between natural- and humankind-caused changes.
"These are the highest clouds in Earth's atmosphere, formed in the coldest place in Earth's atmosphere," says Goddard's Jackman. "Although the clouds occur only in the polar summer, they help us to understand more about the whole globe."
AIM is a NASA-funded Small Explorers (SMEX) mission. NASA Goddard manages the program for the agency's Science Mission Directorate at NASA headquarters in Washington. The mission is led by the Principal Investigator from the Center for Atmospheric Sciences at Hampton University in Virginia. The Laboratory for Atmospheric and Space Physics (LASP), University of Colorado, Boulder, and the Space Dynamics Laboratory, Utah State University, built the instruments. LASP also manages the mission and controls the satellite.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NASA/Goddard Space Flight Center**.

http://www.sciencedaily.com/releases/2011/04/110419091153.htm

Huge Dry Ice Deposit on Mars: NASA Orbiter Reveals Big Changes in Red Planet's Atmosphere



A newly found, buried deposit of frozen carbon dioxide -- dry ice -- near the south pole of Mars contains about 30 times more carbon dioxide than previously estimated to be frozen near the pole. (Credit: NASA/JPL-Caltech/Sapienza University of Rome/Southwest Research Institute)

ScienceDaily (Apr. 22, 2011) — NASA's Mars Reconnaissance Orbiter has discovered the total amount of atmosphere on Mars changes dramatically as the tilt of the planet's axis varies. This process can affect the stability of liquid water, if it exists on the Martian surface, and increase the frequency and severity of Martian dust storms.

Researchers using the orbiter's ground-penetrating radar identified a large, buried deposit of frozen carbon dioxide, or dry ice, at the Red Planet's south pole. The scientists suspect that much of this carbon dioxide enters the planet's atmosphere and swells the atmosphere's mass when Mars' tilt increases. The findings are published in the journal *Science*.

The newly found deposit has a volume similar to Lake Superior's nearly 3,000 cubic miles (about 12,000 cubic kilometers). The deposit holds up to 80 percent as much carbon dioxide as today's Martian atmosphere. Collapse pits caused by dry ice sublimation and other clues suggest the deposit is in a dissipating phase, adding gas to the atmosphere each year. Mars' atmosphere is about 95 percent carbon dioxide, in contrast to Earth's much thicker atmosphere, which is less than .04 percent carbon dioxide.

"We already knew there is a small perennial cap of carbon-dioxide ice on top of the water ice there, but this buried deposit has about 30 times more dry ice than previously estimated," said Roger Phillips of Southwest Research Institute in Boulder, Colo. Phillips is deputy team leader for the Mars Reconnaissance Orbiter's Shallow Radar instrument and lead author of the report.

"We identified the deposit as dry ice by determining the radar signature fit the radio-wave transmission characteristics of frozen carbon dioxide far better than the characteristics of frozen water," said Roberto Seu of Sapienza University of Rome, team leader for the Shallow Radar and a co-author of the new report. Additional evidence came from correlating the deposit to visible sublimation features typical of dry ice.

"When you include this buried deposit, Martian carbon dioxide right now is roughly half frozen and half in the atmosphere, but at other times it can be nearly all frozen or nearly all in the atmosphere," Phillips said.

An occasional increase in the atmosphere would strengthen winds, lofting more dust and leading to more frequent and more intense dust storms. Another result is an expanded area on the planet's surface where liquid water could persist without boiling. Modeling based on known variation in the tilt of Mars' axis suggests several-fold changes in the total mass of the planet's atmosphere can happen on time frames of 100,000 years or less.

The changes in atmospheric density caused by the carbon-dioxide increase also would amplify some effects of the changes caused by the tilt. Researchers plugged the mass of the buried carbon-dioxide deposit into climate models for the period when Mars' tilt and orbital properties maximize the amount of summer sunshine hitting

the south pole. They found at such times, global, year-round average air pressure is approximately 75 percent greater than the current level.
"A tilted Mars with a thicker carbon-dioxide atmosphere causes a greenhouse effect that tries to warm the Martian surface, while thicker and longer-lived polar ice caps try to cool it," said co-author Robert Haberle, a planetary scientist at NASA's Ames Research Center in Moffett Field, Calif. "Our simulations show the polar caps cool more than the greenhouse warms. Unlike Earth, which has a thick, moist atmosphere that produces a strong greenhouse effect, Mars' atmosphere is too thin and dry to produce as strong a greenhouse effect as Earth's, even when you double its carbon-dioxide content."
The Shallow Radar, one of the Mars Reconnaissance Orbiter's six instruments, was provided by the Italian Space Agency, and its operations are led by the Department of Information Engineering, Electronics and Telecommunications at Sapienza University of Rome. NASA's Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the Mars Reconnaissance Orbiter project for NASA's Science Mission Directorate at the agency's headquarters in Washington. Lockheed Martin Space Systems in Denver built the spacecraft.
For more information about the Mars Reconnaissance Orbiter mission, visit http://www.nasa.gov/mro .

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/04/110421190450.htm

Critical Role of Placenta in Brain Development Demonstrated

ScienceDaily (Apr. 22, 2011) — Research at the Keck School of Medicine of the University of Southern California's (USC) Zilkha Neurogenetic Institute shows for the first time that the human placenta plays an active role in synthesizing serotonin, paving the way to new treatment strategies that could mitigate health impacts such as cardiovascular disease and mental illness.

The groundbreaking findings, conducted with researchers from Vanderbilt University as part of a Silvio Conte Center of Excellence grant from the National Institute of Mental Health, offer conclusive evidence that the placenta provides serotonin to the fetal forebrain, not through the mother's blood supply, as theorized for the past 60 years. The research, "A transient placental source of serotonin for the fetal forebrain," will be published in the journal *Nature* on April 21, 2011.

"Our research indicates that the placenta actually synthesizes serotonin, and the serotonin is released from the placenta into the fetal bloodstream where it can reach the fetal brain," said lead author Alexandre Bonnin, Ph.D. "The placenta was seen as a passive organ, but we now know that it has significant synthetic capabilities and has a much more critical role in developmental programming of the fetus than previously thought."

Bonnin's work with Pat Levitt, Ph.D., director of the Zilkha Neurogenetic Institute and corresponding author on the paper, included the invention of a unique technology known as a "placentometer" that monitors substances that pass through the mouse placenta from mother to fetus. This technology can incorporate genetic models of human disease, and could lead to targeted therapies that treat the mother without affecting the fetus, or vice versa.

"The findings by Dr. Bonnin and his collaborators open the door for future studies examining the potential role for targeted interventions in high-risk pregnancies where a perturbed intrauterine environment might negatively impact fetal brain development," said Istvan Seri, professor of pediatrics, Keck School, and director, Center for Fetal and Neonatal Medicine at Children's Hospital Los Angeles. "However, it will take many more basic, translational and clinical trials and many years until we can provide evidence that approaches like this one work."

Serotonin, a neurotransmitter known to affect wellbeing in humans, also has been implicated in brain, cardiac and pancreas development.

In the early stages of development, neurons that synthesize serotonin develop in the fetal hindbrain, where heart, respiration and other critical functions reside, eventually building their way up to the forebrain, the home of higher cognition and emotional regulation. The study shows that during this gap between hindbrain and forebrain serotonin development, the placenta is an important source of serotonin to the forebrain -- a process that could be affected by the mother's nutrition, since her diet is the only source for the essential amino acid tryptophan.

"An altered capacity of the placenta to make and release serotonin could affect the levels of serotonin in the human forebrain as it does in the mouse," said Levitt. "Developmental programming of the fetal brain can set the stage for adult-onset health impacts including heart disease, diabetes and mental illness."
The research relates to a growing body of evidence that subtle, deleterious effects on the fetus as it develops could lead to a lifetime of chronic mental health problems, including anxiety disorders, learning and emotional disabilities and depression.

"Bonnin's research may be of particular importance for early onset brain disorders, such as autism, Asperger's syndrome and pediatric obsessive-compulsive disorder, where investigators are considering a role for serotonin based on human genetic studies," said Randy Blakely, Ph.D., director of the Vanderbilt Conte Center and a collaborator on the paper.

Alexandre Bonnin, Nick Goeden, Kevin Chen, Melissa L. Wilson, Jennifer King, Jean C. Shih, Randy D. Blakely, Evan S. Deneris, Pat Levitt. "A transient placental source of serotonin for the fetal forebrain." *Nature*, April 2011.

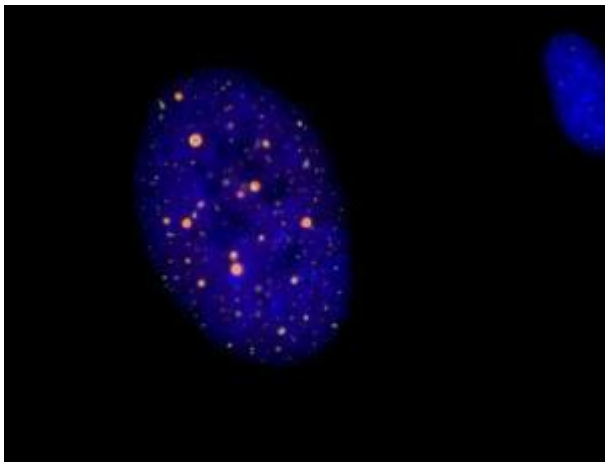
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Southern California**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Alexandre Bonnin, Nick Goeden, Kevin Chen, Melissa L. Wilson, Jennifer King, Jean C. Shih, Randy D. Blakely, Evan S. Deneris, Pat Levitt. **A transient placental source of serotonin for the fetal forebrain**. *Nature*, 2011; 472 (7343): 347 DOI: 10.1038/nature09972

http://www.sciencedaily.com/releases/2011/04/110421104516.htm

Cancer Cell Proliferation: A New Ending to an Old 'Tail'



About 10 percent of tumor cells use a mechanism called ALT, short for alternative lengthening of telomeres, to keep their chromosomes ends intact. PML bodies that contain telomeric DNA and associated telomere-binding proteins (shown in orange) are highly characteristic of ALT tumor cells. (Credit: Courtesy of Dr. Liana Oganesian, Salk Institute for Biological Studies)

ScienceDaily (Apr. 22, 2011) — In stark contrast to normal cells, which only divide a finite number of times before they enter into a permanent state of growth arrest or simply die, cancer cells never cease to proliferate. Now, scientists at the Salk Institute for Biological Studies have uncovered an important clue to one of the mechanisms underlying cancer cell immortality.

Their findings, published in the April 22, 2011 issue of *Molecular Cell*, reveal an unanticipated structure at chromosome ends, which could be a key ingredient in the biological "elixir of life," potentially making it an attractive chemotherapeutic target to cut short the life of a cancer cell.

"How tumor cells evade cell death is still baffling to us, but we think we may have solved a small piece of this puzzle," says Jan Karlseder, Ph.D., a professor in the Molecular and Cell Biology Laboratory, who led the Salk team.

A lynchpin to the immortality of malignant cells is the ability to maintain telomeres, the specialized ends of chromosomes. Like slow-burning fuses, telomeres become shorter each time a cell divides, acting as a kind of cellular clock ticking down a cell's age. Eventually they are depleted, and the cell enters a permanently arrested state called senescence. To escape this inevitable demise, about 90 percent of human tumors rely on a huge boost in the levels of an enzyme called telomerase, which adds DNA to telomeres, thus turning the clock backwards.

The remaining 10 percent use a mechanism known as ALT, short for alternative lengthening of telomeres. "Although it is a rare phenomenon, understanding ALT is essential since tumors can evade anti-cancer therapies aimed at inhibiting the activity of telomerase through the activation of ALT," explains postdoctoral researcher and first author Liana Oganesian, Ph.D. "This is why we clearly need a two-pronged approached to successfully tackle cancer."

Unlike telomerase, which tacks on telomeric DNA, ALT replenishes chromosome ends through a process called homologous recombination. In normal cells homologous recombination is used to mend broken DNA, whereby the intact neighboring DNA of an identical sequence is used as a template to restore the sequence of the broken DNA piece. Uniquely, human ALT tumors make use of the same recombination machinery to illicitly restore lost telomeric DNA, but not much is known about this process.

Trying to learn more about the biological tools that ALT tumors use to sustain their immortal status, Karlseder and his team uncovered a new structural beacon, called the C-tail -- a string of DNA rich in the base cytosine (C) that hangs over the very tip of telomeres. The finding came as a big surprise since conventional wisdom had it that mammalian cells normally terminate both ends of every chromosome with a single-stranded stretch of DNA rich in the base guanine (G).

When Ogenesian carefully looked at chromosome ends, however, she discovered that about half of all telomeres in ALT tumors bore a C-tail, while the presence of such a tail in normal human cells was several hundred fold less prevalent. "This piece of DNA is conspicuously absent in tumors that use telomerase, suggesting that C-tails are a unique feature of ALT tumors," she says.
Curiously, there is precedent for chromosomal C-tails in an evolutionarily distant relative, the roundworm. In 2008 the Karlseder team discovered that G-tails and C-tails happily coexisted in worm cells and went on to show that they team up with two distinct proteins. When the C-tail specific protein was removed from cells, strikingly the worm began to exhibit some of the characteristics normally attributed to human ALT tumors.
"It was really exciting to discover that worms can teach us a thing or two about the mechanisms of human cancer," says Karlseder and adds that "the challenge now is to determine the precise role of C-tails in tumor cells and to unveil the mechanisms responsible for creating them."
The work was funded in part by the National Institutes of Health and a Merieux Research Grant by the Institut Merieux.

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/04/110421122327.htm

New Technique Improves Sensitivity of PCR Pathogen Detection

A more sensitive test called "Bio-PCR" should prove useful for early detection of many bacteria, including the one that causes Pierce's disease on grapes. Shown is an ARS-developed seedless variety, Autumn Royal. (Credit: Bob Nichols)

ScienceDaily (Apr. 22, 2011) — A new procedure devised by U.S. Department of Agriculture (USDA) scientists and colleagues can improve polymerase chain reaction (PCR)-based methods of detecting plant disease organisms.

PCR-based tests are prized tools for diagnosing plant diseases that can cause yield losses and diminished markets among other economic harm. But the test's ability to obtain a "genetic fingerprint" conclusively identifying a culprit pathogen hinges on there being a minimum number of its cells. Otherwise, the pathogen's genetic material can't be probed and multiplied in amounts necessary for detection, explains plant pathologist Norm Schaad, formerly with USDA's Agricultural Research Service (ARS). ARS is USDA's principal intramural scientific research agency.

Such diagnostic shortcomings can be especially costly when asymptomatic seed or plants intended for sale are certified as pathogen-free when, in fact, they are not, adds Schaad. He worked at the ARS Foreign Disease-Weed Science Research Unit in Frederick, Md., prior to retiring last year.

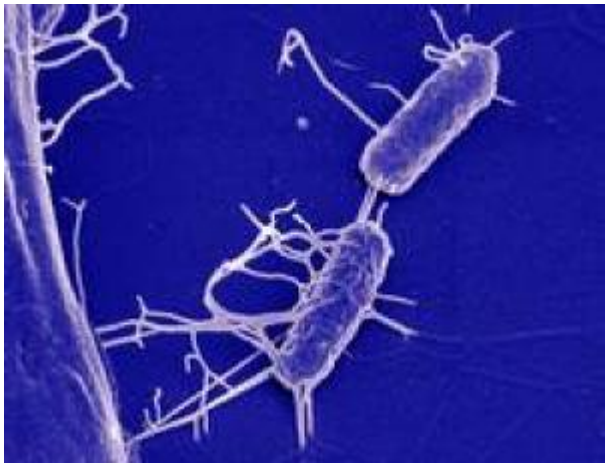
To tackle the problem, Schaad and colleagues Nikolas Panopoulos and Efstathios Hatziloukas devised a preliminary step called Bio-PCR. It uses growth-promoting agar or liquid media to increase the number of a target organism's cells in a sample prior to amplification of genetic material. In four to 72 hours, depending on the pathogen, the cells make thousands of new copies, enabling detection by direct PCR, according to Schaad. Besides increasing sensitivity by 100- to 1,000-fold over conventional PCR methods, the enrichment technique stops substances called inhibitors from interfering with the action of a key enzyme, Taq polymerase.

Bio-PCR works best with fast-growing bacteria such as *Ralstonia solanacearum*, which causes bacterial wilt of potato and tomato, and *Acidovorax avenae*, which causes bacterial fruit blotch of watermelon. However, Bio-PCR also improves detection of slow-growing pathogens such as *Xylella fastidiosa*, responsible for Pierce's disease of grapes and leaf scorch of shade trees.
In studies with *X. fastidiosa*, Bio-PCR detected the bacterium in 90 percent of infected grape samples compared to 13 percent with conventional PCR methods.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **USDA/Agricultural Research Service**. The original article was written by Jan Suszkiw.

http://www.sciencedaily.com/releases/2011/04/110421104508.htm

Salmonella Utilize Multiple Modes of Infection: New Mechanism That Helps With Invading Host Cells Discovered



Salmonella typhimurium. (Credit: Copyright Manfred Rohde / HZI)

ScienceDaily (Apr. 22, 2011) — Scientists from the Helmholtz Centre for Infection Research (HZI) in Braunschweig, Germany have discovered a new, hitherto unknown mechanism of *Salmonella* invasion into gut cells: In this entry mode, the bacteria exploit the muscle power of cells to be pulled into the host cell cytoplasm. Thus, the strategies *Salmonella* use to infect cells are more complex than previously thought. According to the World Health Organization, the number of *Salmonella* infections is continuously rising, and the severity of infections is increasing. One of the reasons for this may be the sophisticated infection strategies the bacteria have evolved. The striking diversity of invasion strategies may allow *Salmonella* to infect multiple cell types and different hosts.

"*Salmonella* do not infect their hosts according to textbook model," says Theresia Stradal, group leader at the Helmholtz Centre in Braunschweig, who has recently accepted a call to the University of Münster. "Only a single infection mechanism has seriously been discussed in the field up till now -without understanding all the details," adds Klemens Rottner, now Professor at the University of Bonn.

All entry mechanisms employed by *Salmonella* target the so-called actin cytoskeleton of the host cell. Actin can polymerise into fine and dynamic fibrils, also called filaments, which associate into networks or fibres. These structures stabilise the cell and enable it to move, as they are constantly built up and taken down. One of the most important core elements is the Arp2/3 complex that nucleates the assembly of actin monomers into filaments.

Extensions of the cell membrane are filled with actin filaments. In the commonly accepted infection mechanism, *Salmonella* abuses the Arp2/3 complex to enter the host cell: the bacteria activate the complex and thus initiate the formation actin filaments and development of prominent membrane extensions, so-called ruffles. These ruffles surround and enclose the bacteria so that they end up in the cell interior. Last year, the research groups headed by Theresia Stradal and Klemens Rottner discovered that *Salmonella* can also reach the cell interior without initiating membrane ruffles. With this, the researchers disproved a long-standing dogma.

In their recent study, the experts from Braunschweig now describe a completely unknown infection mechanism. The results have just appeared in the latest issue of the journal *Cell Host & Microbe*. In this new infection mechanism, *Salmonella* also manipulate the actin cytoskeleton of the host cell. This time, however, they do not induce the generation of new filaments, but activate the motor protein myosin II. The interplay of actin and myosin II in muscle cells is well known: in a contracting muscle, myosin and actin filaments slide along each other and this way shorten the muscle; it contracts.

In epithelial cells, the contractile structures are less organised but work similarly. Here, actin and myosin II form so-called stress fibres that tightly connect to the membrane. During an infection, stress fibres at the entry site can contract and pull the bacteria into the cell. "This way of infection operates independently from the

Arp2/3 complex, the central component of the 'classic' infection mechanism," says Jan Hänisch, who worked on this project as postdoctoral researcher.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Helmholtz Association of German Research Centres**.

Journal Reference:

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http://www.sciencedaily.com/releases/2011/04/110421122333.htm

Earth Recovered from Prehistoric Global Warming Faster Than Previously Thought

Earth may be able to recover from rising carbon dioxide emissions faster than previously thought, according to evidence from a prehistoric event. When faced with high levels of atmospheric carbon dioxide and rising temperatures 56 million years ago, Earth increased its ability to pull carbon from the air. (Credit: © Argus / Fotolia)

ScienceDaily (Apr. 21, 2011) — Earth may be able to recover from rising carbon dioxide emissions faster than previously thought, according to evidence from a prehistoric event analyzed by a Purdue University-led team.

When faced with high levels of atmospheric carbon dioxide and rising temperatures 56 million years ago, Earth increased its ability to pull carbon from the air. This led to a recovery that was quicker than anticipated by many models of the carbon cycle -- though still on the order of tens of thousands of years, said Gabriel Bowen, the associate professor of earth and atmospheric sciences who led the study.

"We found that more than half of the added carbon dioxide was pulled from the atmosphere within 30,000 to 40,000 years, which is one-third of the time span previously thought," said Bowen, who also is a member of the Purdue Climate Change Research Center. "We still don't know exactly where this carbon went, but the evidence suggests it was a much more dynamic response than traditional models represent."

Bowen worked with James Zachos, a professor of earth and planetary sciences at the University of California, Santa Cruz, to study the end of the Palaeocene-Eocene Thermal Maximum, an approximately 170,000-year-long period of global warming that has many features in common with the world's current situation, he said.

"During this prehistoric event billions of tons of carbon was released into the ocean, atmosphere and biosphere, causing warming of about 5 degrees Celsius," Bowen said. "This is a good analog for the carbon being released from fossil fuels today."

Scientists have known of this prehistoric event for 20 years, but how the system recovered and returned to normal atmospheric levels has remained a mystery.

Bowen and Zachos examined samples of marine and terrestrial sediments deposited throughout the event. The team measured the levels of two different types of carbon atoms, the isotopes carbon-12 and carbon-13. The ratio of these isotopes changes as carbon dioxide is drawn from or added to the atmosphere during the growth or decay of organic matter.

Plants prefer carbon-12 during photosynthesis, and when they accelerate their uptake of carbon dioxide it shifts the carbon isotope ratio in the atmosphere. This shift is then reflected in the carbon isotopes present in rock minerals formed by reactions involving atmospheric carbon dioxide, Bowen said.

"The rate of the carbon isotope change in rock minerals tells us how rapidly the carbon dioxide was pulled from the atmosphere," he said. "We can see the fluxes of carbon dioxide in to and out of the atmosphere. At the beginning of the event we see a shift indicating that a lot of organic-derived carbon dioxide had been added to the atmosphere, and at the end of the event we see a shift indicating that a lot of carbon dioxide was taken up as organic carbon and thus removed from the atmosphere."

A paper detailing the team's National Science Foundation-funded work was published in *Nature Geoscience.*

It had been thought that a slow and fairly constant recovery began soon after excess carbon entered the atmosphere and that the weathering of rocks, called silicate weathering, dictated the timing of the response. Atmospheric carbon dioxide that reacts with silicon-based minerals in rocks is pulled from the air and captured in the end product of the reaction. This mechanism has a fairly direct correlation with the amount of carbon dioxide in the atmosphere and occurs relatively slowly, Bowen said.

The changes Bowen and Zachos found during the Palaeocene-Eocene Thermal Maximum went beyond the effects expected from silicate weathering, he said.

"It seems there was actually a long period of higher levels of atmospheric carbon dioxide followed by a short and rapid recovery to normal levels," he said. "During the recovery, the rate at which carbon was pulled from the atmosphere was an order of magnitude greater than the slow drawdown of carbon expected from silicate weathering alone."

A rapid growth of the biosphere, with a spread of forests, plants and carbon-rich soils to take in the excess carbon dioxide, could explain the quick recovery, Bowen said.

"Expansion of the biosphere is one plausible mechanism for the rapid recovery, but in order to take up this much carbon in forests and soils there must have first been a massive depletion of these carbon stocks," he said. "We don't currently know where all the carbon that caused this event came from, and our results suggest the troubling possibility that widespread decay or burning of large parts of the continental biosphere may have been involved."

Release from a different source, such as volcanoes or sea floor sediments, may have started the event, he said.

"The release of carbon from the biosphere may have occurred as a positive feedback to the warming," Bowen said. "The forests may have dried out, which can lead to die off and forest fires. If we take the Earth's future climate to a place where that feedback starts to happen we could see accelerated rates of climate change."

The team continues to work on new models of the carbon cycle and is also investigating changes in the water cycle during the Palaeocene-Eocene Thermal Maximum.

"We need to figure out where the carbon went all those years ago to know where it could go in the future," he said. "These findings show that the Earth's response is much more dynamic than we thought and highlight the importance of feedback loops in the carbon cycle."

Story Source:

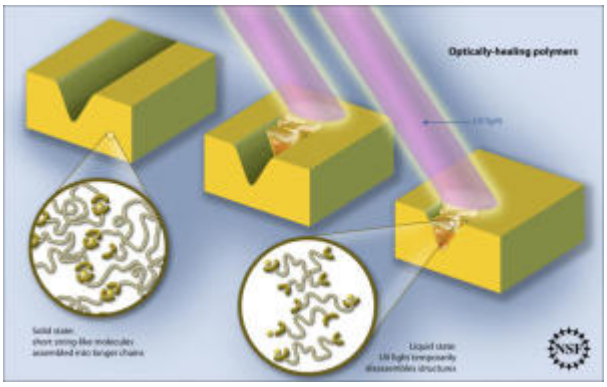
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Purdue University**.

Journal Reference:

1. Gabriel J. Bowen, James C. Zachos. **Rapid carbon sequestration at the termination of the Palaeocene–Eocene Thermal Maximum**. *Nature Geoscience*, 2010; 3 (12): 866 DOI: 10.1038/ngeo1014

http://www.sciencedaily.com/releases/2011/04/110421151919.htm

Material That If Scratched, You Can Quickly and Easily Fix Yourself, With Light Not Heat



Schematic of optically healing polymers. The specially designed polymer molecules that make up the solid item can be disassembled by the UV light so that they flow and fill in the cracks. When the light is turned off, the molecules reassemble themselves and the filled cracks become rigid again. (Credit: Zina Deretsky, National Science Foundation, after Burnworth et al., Nature, April 21, 2011)

ScienceDaily (Apr. 21, 2011) — Imagine you're driving your own new car--or a rental car--and you need to park in a commercial garage. Maybe you're going to work, visiting a mall or attending an event at a sports stadium, and you're in a rush. Limited and small available spots and concrete pillars make parking a challenge. And it happens that day: you slightly misjudge a corner and you can hear the squeal as you scratch the side of your car--small scratches, but large anticipated repair costs.

Now imagine that that you can repair these unsightly scratches yourself--quickly, easily and inexpensively. . . . or that you can go through a car wash that can detect these and other more minor scratches and fix them as the car goes through the washing garage. Fantasy? Not exactly. Not anymore. Not according to a new discovery detailed in the April 21 issue of the journal *Nature,* and depicted in a short video interview and simulation: http://www.youtube.com/watch?v=h-fka0wfY8w

A team of researchers in the United States and Switzerland have developed a polymer-based material that can heal itself with the help of a widely used type of lighting. Called "metallo-supramolecular polymers," the material is capable of becoming a supple liquid that fills crevasses and gaps left by scrapes and scuffs when placed under ultraviolet light for less than a minute and then resolidifying.

"This is ingenious and transformative materials research," said Andrew Lovinger, polymers program director in NSF's Division of Materials Research. "It demonstrates the versatility and power of novel polymeric materials to address technological issues and serve society while creating broadly applicable scientific concepts."

The team involves researchers at Case Western Reserve University in Cleveland, Ohio, led by Stuart J. Rowan; the Adolphe Merkle Institute of the University of Fribourg in Switzerland, led by Christoph Weder; and the Army Research Laboratory at Aberdeen Proving Ground in Maryland, led by Rick Beyer.

The scientists envision widespread uses in the not-so-distant future for re-healable materials like theirs, primarily as coatings for consumer goods such as automobiles, floors and furniture. While their polymers are not yet ready for commercial use, they acknowledge, they now have proved that the concept works. And with that, what happens next is up to the market place. Necessity, the mother of invention, will expand the possibilities for commercial applications.

"These polymers have a Napoleon Complex," explains lead author Stuart Rowan, a professor of macromolecular engineering and science and director of the Institute for Advanced Materials at Case Western Reserve University. "In reality they're pretty small but are designed to behave like they're big by taking advantage of specific weak molecular interactions."

"Our study is really a fundamental research study," said Christoph Weder, a professor of polymer chemistry and materials and the director of the Adolphe Merkle Institute. "We tried to create materials that have a unique property matrix, that have unique functionality and that in principle could be very useful."

Specifically, the new materials were created by a mechanism known as supramolecular assembly. Unlike conventional polymers, which consist of long, chain-like molecules with thousands of atoms, these materials

are composed of smaller molecules, which were assembled into longer, polymer-like chains using metal ions as "molecular glue" to create the metallo-supramolecular polymers.
While these metallo-supramolecular polymers behave in many ways like normal polymers, when irradiated with intense ultraviolet light the assembled structures become temporarily unglued. This transforms the originally solid material into a liquid that flows easily. When the light is switched off, the material re-assembles and solidifies again; its original properties are restored.
Using lamps such as those dentists use to cure fillings, the researchers repaired scratches in their polymers. Wherever they waved the light beam, the scratches filled up and disappeared, much like a cut that heals and leaves no trace on skin. While skin's healing process can be represented by time-lapse photography that spans several days or weeks, self-healing polymers heal in just seconds.
In addition, unlike the human body, durability of the material does not seem to be compromised by repeated injuries. Tests showed the researchers could repeatedly scratch and heal their materials in the same location.
Further, while heat has provided a means to heal materials for a long time, the use of light provides distinct advantages, says Mark Burnworth, a graduate student at Case Western Reserve University. "By using light, we have more control as it allows us to target only the defect and leave the rest of the material untouched."
The researchers systematically investigated several new polymers to find an optimal combination of mechanical properties and healing ability. They found that metal ions that drive the assembly process via weaker chemical interactions serve best as the light-switchable molecular glue.
They also found the materials that assembled in the most orderly microstructures had the best mechanical properties. But, healing efficiency improved as structural order decreased.
"Understanding these relationships is critical for allowing us improve the lifetime of coatings tailored to specific applications, like windows in abrasive environments" Beyer said.
And what's next? According to Rowan, "One of our next steps is to use the concepts we have shown here to design a coating that would be more applicable in an industrial setting."
Film director and art curator Aaron Rose was at least partially right when he said, "In the right light, at the right time, everything is extraordinary." Self-healing polymers certainly are extraordinary.
The research was funded by the Army Research Office of the U.S. Army Research Laboratory, the U.S. National Science Foundation, and the Adolphe Merkle Foundation.

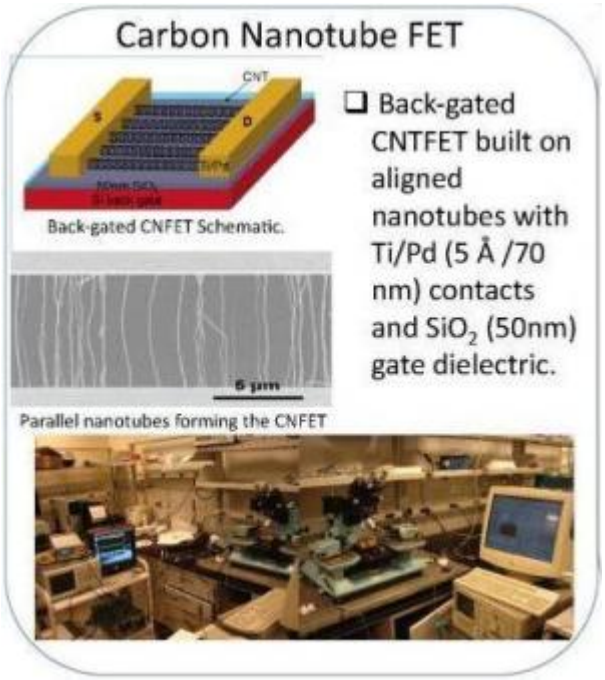
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Science Foundation**.

Journal Reference:

1. Mark Burnworth, Liming Tang, Justin R. Kumpfer, Andrew J. Duncan, Frederick L. Beyer, Gina L. Fiore, Stuart J. Rowan, Christoph Weder. **Optically healable supramolecular polymers**. *Nature*, 2011; 472 (7343): 334 DOI: 10.1038/nature09963

http://www.sciencedaily.com/releases/2011/04/110420143618.htm

Functioning Synapse Created Using Carbon Nanotubes: Devices Might Be Used in Brain Prostheses or Synthetic Brains



This image shows nanotubes used in synthetic synapse and apparatus used to create them. (Credit: USC Viterbi School of Engineering)

ScienceDaily (Apr. 22, 2011) — Engineering researchers the University of Southern California have made a significant breakthrough in the use of nanotechnologies for the construction of a synthetic brain. They have built a carbon nanotube synapse circuit whose behavior in tests reproduces the function of a neuron, the building block of the brain.

The team, which was led by Professor Alice Parker and Professor Chongwu Zhou in the USC Viterbi School of Engineering Ming Hsieh Department of Electrical Engineering, used an interdisciplinary approach combining circuit design with nanotechnology to address the complex problem of capturing brain function.

In a paper published in the proceedings of the IEEE/NIH 2011 Life Science Systems and Applications Workshop in April 2011, the Viterbi team detailed how they were able to use carbon nanotubes to create a synapse.

Carbon nanotubes are molecular carbon structures that are extremely small, with a diameter a million times smaller than a pencil point. These nanotubes can be used in electronic circuits, acting as metallic conductors or semiconductors.

"This is a necessary first step in the process," said Parker, who began the looking at the possibility of developing a synthetic brain in 2006. "We wanted to answer the question: Can you build a circuit that would act like a neuron? The next step is even more complex. How can we build structures out of these circuits that mimic the function of the brain, which has 100 billion neurons and 10,000 synapses per neuron?"

Parker emphasized that the actual development of a synthetic brain, or even a functional brain area is decades away, and she said the next hurdle for the research centers on reproducing brain plasticity in the circuits.

The human brain continually produces new neurons, makes new connections and adapts throughout life, and creating this process through analog circuits will be a monumental task, according to Parker.

She believes the ongoing research of understanding the process of human intelligence could have long-term implications for everything from developing prosthetic nanotechnology that would heal traumatic brain injuries to developing intelligent, safe cars that would protect drivers in bold new ways.

For Jonathan Joshi, a USC Viterbi Ph.D. student who is a co-author of the paper, the interdisciplinary approach to the problem was key to the initial progress. Joshi said that working with Zhou and his group of nanotechnology researchers provided the ideal dynamic of circuit technology and nanotechnology.

"The interdisciplinary approach is the only approach that will lead to a solution. We need more than one type of engineer working on this solution," said Joshi. "We should constantly be in search of new technologies to solve this problem."

Story Source:

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

http://www.sciencedaily.com/releases/2011/04/110421151921.htm

Jurassic Spider from China Is Largest Fossil Specimen Discovered

In the image above, the figure on the left is of a fossil female golden orb-weaver spider (Nephila jurassica) from the Middle Jurassic of China. The body length about 1 inch, front legs about 2.5 inches (= leg span more than 5 inches). Next to it is an image of a living female golden orb-weaver spider (Nephila pilipes), in Queensland, Australia, on her golden orb web. It is about the same size as the fossil specimen. (Credit: Image courtesy of University of Kansas Biodiversity Institute)

ScienceDaily (Apr. 22, 2011) — With a leg span of more than five inches, a recently named Jurassic period spider from China is the largest fossil specimen discovered, and one that has modern relatives in tropical climates today.

A research team of KU and Capital Normal University (Beijing) researchers said the spider belongs to the living genus *Nephila*, or golden orb-weavers. An extremely long range for any animal genus, the nephilids are example of living fossils. Nephilids are the largest web-weaving spiders alive today (body length up to 5 cm, leg span 15 cm) and are common to the tropical and subtropical regions today. This suggests that the paleoclimate of Daohugou, China, where the specimen was found, was probably similarly warm and humid during the Jurassic.

Nephila females weave some of the largest orb webs known (up to 1.5 m in diameter) with distinctive gold-colored silk to catch a wide variety of medium-sized to large insects, but occasionally bats and birds as by-catch. Typically, an orb-weaver spider first weaves a non-sticky spiral with space for sticky spirals in between. Unlike most other orb-weaving spiders, *Nephila* do not remove the non-sticky spirals after weaving the sticky spirals. This results in a 'manuscript paper' effect when the orb is seen in the sunlight, because the sticky spirals reflect the light while the non-sticky spirals do not, thus resembling musical staves.

This fossil finding provides evidence that golden orb-webs were being woven and capturing medium to large insects in Jurassic times, and predation by these spiders would have played an important role in the natural selection of contemporaneous insects.

The research was published in the online edition of *Biology Letters*. Paul A. Selden, Gulf-Hedberg Distinguished Professor at KU and director of the Paleontological Institute, as well as ChungKun Shih and Dong Ren, professors from Capital Normal University, Beijing, China, authored the research.

Story Source:

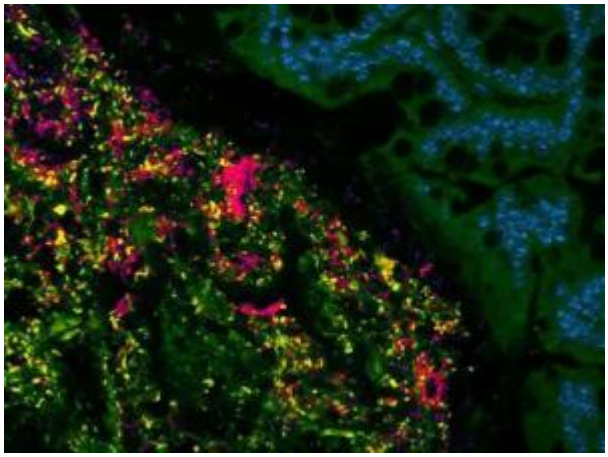
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Kansas Biodiversity Institute**.

Journal Reference:

1. P. A. Selden, C. Shih, D. Ren. **A golden orb-weaver spider (Araneae: Nephilidae: Nephila) from the Middle Jurassic of China**. *Biology Letters*, 2011; DOI: 10.1098/rsbl.2011.0228
2.

http://www.sciencedaily.com/releases/2011/04/110421210754.htm

Learning to Tolerate Our Microbial Self: Bacteria Co-Opt Human Immune Cells for Mutual Benefit



The image depicts symbiotic microbes in the process of colonizing the mucosal surface of the mouse colon. Yellow cells are Escherichia coli; red cells are Bacteroides fragilis. Intestinal tissues are labeled in green with blue nuclei. (Credit: S. Melanie Lee/Caltech)

ScienceDaily (Apr. 22, 2011) — The human gut is filled with 100 trillion symbiotic bacteria -- ten times more microbial cells than our own cells -- representing close to one thousand different species. "And yet, if you were to eat a piece of chicken with just a few *Salmonella*, your immune system would mount a potent inflammatory response," says Sarkis K. Mazmanian, assistant professor of biology at the California Institute of Technology (Caltech).

Salmonella and its pathogenic bacterial kin don't look that much different from the legion of bacteria in our gut that we blissfully ignore, which raises the question: What decides whether we react or don't? Researchers have pondered this paradox for decades.

In the case of a common "friendly" gut bacterium, *Bacteroides fragilis*, Mazmanian and his colleagues have figured out the surprising answer: "The decision is not made by us," he says. "It's made by the bacteria. Since we are their home, they hold the key to our immune system."

What's more, the bacteria enforce their "decision" by hijacking cells of the immune system, say Mazmanian and his colleagues, who have figured out the mechanism by which the bacteria accomplish this feat -- and revealed an explanation for how the immune system distinguishes between beneficial and pathogenic organisms.

In addition, the work, described in the April 21 issue of *Science* Express, "suggests that it's time to reconsider how we define self versus non-self," Mazmanian says.

Like other commensal gut bacteria -- those that provide nutrients and other benefits to their hosts, without causing harm -- *B. fragilis* was thought to live within the interior of the gut (the lumen), and thus far away from the immune system. "The dogma is that the immune system doesn't respond to symbiotic bacteria because of immunological ignorance," Mazmanian explains. "If we can't see them, we won't react to them."

But using a technique called whole-mount confocal microscopy to study the intestines of mice, he and his colleagues found that the bacteria actually live in a unique ecological niche, deep within the crypts of the colon, "and thus in intimate contact with the gut mucosal immune system," he says.

"The closeness of this association highlights that an active communication is occurring between the bacteria and their host," says Caltech postdoctoral scholar June L. Round.

From that vantage point, the bacteria are able to orchestrate control over the immune system -- and, specifically, over the behavior of immune cells known as regulatory T cells, or Treg cells. The normal function of Treg cells is to prevent the immune system from reacting against our own tissues, by shutting down certain immune responses; they therefore prevent autoimmune reactions (which, when uncontrolled, can lead to diseases such as multiple sclerosis, type 1 diabetes, lupus, psoriasis, and Crohn's disease).

Bacteroides fragilis has evolved to produce a molecule that tricks the immune system into activating Treg cells in the gut, but in this case, Mazmanian says, "the purpose is to keep the cells from attacking the bugs. Beautiful, right?"

In their *Science* paper, Mazmanian and colleagues describe the entire molecular pathway that produces this effect. It starts with the bacteria producing a complex sugar molecule called polysaccharide A (PSA). PSA is sensed by particular receptors, known as Toll-like receptors, on the surfaces of Treg cells, thus activating those cells specifically. In response, Treg cells suppress yet another type of cell, the T helper 17 (Th17) cells. Normally, Th17 cells induce pro-inflammatory responses -- those that would result, for example, in the elimination of foreign bacteria or other pathogens from the body. By shutting those cells down, *B. fragilis* gets a free pass to colonize the gut. "Up until now, we have thought that triggering of Toll-like receptors resulted solely in the induction of pathways that eliminate bacteria," says Round. "However, our studies suggest that multiple yet undiscovered host pathways allow us to coexist with our microbial partners."

When Mazmanian and his colleagues blocked this mechanism -- by removing the PSA molecule, by removing the Toll-like receptor for PSA, or by eliminating the Treg cells themselves -- the bacteria were attacked by the immune system and expelled. "They can no longer co-opt the immune system into inducing an anti-inflammatory response, so the formerly benign bacterium now looks like a pathogen," he says, "although the bug itself is exactly the same."

"Our immune system arose in the face of commensal colonization and thus likely evolved specialized molecules to recognize good bacteria," says Round. Mazmanian suspects that genetic mutations in these pathways could be responsible for certain types of immune disorders, including inflammatory bowel disease: "The question is, do patients get sick because they are rejecting bacteria they shouldn't reject?"

On a more philosophical level, Mazmanian says, the findings suggest that our concept of "self" should be broadened to include our many trillions of microbial residents. "These bacteria live inside us for our entire lives, and they've evolved to look and act like us, as part of us," he says. "As far as our immune system is concerned, the molecules made by gut bacteria should be tolerated similarly to our own molecules. Except in this case, the bacteria 'teaches' us to tolerate them, for both our benefit and theirs."

The work was supported by the National Institutes of Health, the Damon Runyon Cancer Research Foundation, and the Crohn's and Colitis Foundation of America.

Story Source:

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

Journal Reference:

1. June L. Round, S. Melanie Lee, Jennifer Li, Gloria Tran, Bana Jabri, Talal A. Chatila, and Sarkis K. Mazmanian. **The Toll-Like Receptor 2 Pathway Establishes Colonization by a Commensal of the Human Microbiota**. *Science*, 21 April 2011 DOI: 10.1126/science.1206095

http://www.sciencedaily.com/releases/2011/04/110421141632.htm

Prenatal Pesticide Exposure Tied to Lower IQ in Children, Study Finds

Organophosphate pesticides are approved for use in agriculture. Increasing evidence suggests that prenatal exposure to pesticides may have health impacts in later years. (Credit: iStockphoto)

ScienceDaily (Apr. 22, 2011) — In a new study suggesting pesticides may be associated with the health and development of children, researchers at the University of California, Berkeley's School of Public Health have found that prenatal exposure to organophosphate pesticides -- widely used on food crops -- is related to lower intelligence scores at age 7.

The researchers found that every tenfold increase in measures of organophosphates detected during a mother's pregnancy corresponded to a 5.5 point drop in overall IQ scores in the 7-year-olds. Children in the study with the highest levels of prenatal pesticide exposure scored seven points lower on a standardized measure of intelligence compared with children who had the lowest levels of exposure.

"These associations are substantial, especially when viewing this at a population-wide level," said study principal investigator Brenda Eskenazi, UC Berkeley professor of epidemiology and of maternal and child health. "That difference could mean, on average, more kids being shifted into the lower end of the spectrum of learning, and more kids needing special services in school."

The UC Berkeley study is among a trio of papers showing an association between pesticide exposure and childhood IQ to be published online April 21 in the journal *Environmental Health Perspectives*. Notably, the other two studies -- one at Mt. Sinai Medical Center, the other at Columbia University -- examined urban populations in New York City, while the UC Berkeley study focused on children living in Salinas, an agricultural center in Monterey County, California.

The studies in New York also examined prenatal exposure to pesticides and IQ in children at age 7. Like the UC Berkeley researchers, scientists at Mt. Sinai sampled pesticide metabolites in maternal urine, while researchers at Columbia looked at umbilical cord blood levels of a specific pesticide, chlorpyrifos.

"It is very unusual to see this much consistency across populations in studies, so that speaks to the significance of the findings," said lead author Maryse Bouchard, who was working as a UC Berkeley post-doctoral researcher with Eskenazi while this study was underway. "The children are now at a stage where they are going to school, so it's easier to get good, valid assessments of cognitive function."

Organophosphates (OP) are a class of pesticides that are well-known neurotoxicants. Indoor use of chlorpyrifos and diazinon, two common OP pesticides, has been phased out over the past decade, primarily because of health risks to children.

The 329 children in the UC Berkeley study had been followed from before birth as part of the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS), an ongoing longitudinal study led by Eskenazi. The new findings on IQ come less than a year after another study from the CHAMACOS cohort found an association between prenatal pesticide exposure and attention problems in children at age 5.
Researchers began enrolling pregnant women in the study in 1999. During pregnancy and after the children were born, study participants came to regular visits where CHAMACOS staff administered questionnaires and measured the health and development of the children.
During the visits, samples of urine were taken from the participants and tested for dialkyl phosphate (DAP) metabolites, the breakdown product of about 75 percent of the organophosphorus insecticides in use in the United States. Samples were taken twice during pregnancy, with the two results averaged, and after birth from the children at regular intervals between ages 6 months and 5 years.
The Wechsler Intelligence Scale for Children -- Fourth Edition (WISC-IV) was used to assess the cognitive abilities of the children at age 7. The test includes subcategories for verbal comprehension, perceptual reasoning, working memory and processing speed.
In addition to the association with overall IQ scores, each of the four cognitive development subcategories saw significant decreases in scores associated with higher levels of DAPs when the mothers were pregnant. The findings held even after researchers considered such factors as maternal education, family income and exposure to other environmental contaminants, including DDT, lead and flame retardants.
"There are limitations to every study; we used metabolites to assess exposure, so we cannot isolate the exposure to a specific pesticide chemical, for instance," added Eskenazi. "But the way this and the New York studies were designed -- starting with pregnant women and then following their children -- is one of the strongest methods available to study how environmental factors affect children's health."
While markers of prenatal OP pesticide exposure were significantly correlated with childhood IQ, exposure to pesticides after birth was not. This suggests that exposure during fetal brain development was more critical than childhood exposure.
Levels of maternal DAPs among the women in the UC Berkeley study were somewhat higher than average compared with the U.S. population, but they were not out of the range of measurements found among women in a national study.
"These findings are likely applicable to the general population," said Bouchard, who is currently a researcher at the University of Montreal's Department of Environmental and Occupational Health. "In addition, the other two studies being published were done in New York City, so the connection between pesticide exposure and IQ is not limited to people living in an agricultural community."
The prenatal exposures measured in this paper occurred in 1999-2000. Overall, OP pesticide use in the United States has been trending downward, declining more than 50 percent between 2001 and 2009, and about 45 percent since 2001 in California. At the same time, the use of OP pesticides in Monterey County remained steady between 2001 and 2008, but declined 18 percent from 2008 to 2009. Several studies suggest that exposure to OP pesticides has gone down with declining use.
According to the Centers for Disease Control, people are exposed to OP pesticides through eating foods from crops treated with these chemicals. Farm workers, gardeners, florists, pesticide applicators and manufacturers of these insecticides may have greater exposure than the general population.
"Many people are also exposed when pesticides are used around homes, schools or other buildings," said study co-author Asa Bradman, associate director of the Center for Environmental Research in Children's Health (CERCH) at UC Berkeley.
The researchers recommended that consumers reduce their home use of pesticides, noting that most home and garden pests can be controlled without those chemicals. If pesticides are needed, they said bait stations should be used instead of sprays.
They also said that consumers should thoroughly wash fruits and vegetables; go beyond a quick rinse and use a soft brush, if practical. Consumers could also consider buying organic produce when possible as a way to reduce pesticide exposure from food, they said.
"I'm concerned about people not eating right based on the results of this study," said Eskenazi. "Most people already are not getting enough fruits and vegetables in their diet, which is linked to serious health problems in the United States. People, especially those who are pregnant, need to eat a diet rich in fruits and vegetables."

Other co-authors of the study are Jonathan Chevrier, Kim Harley, Katherine Kogut, Michelle Vedar, Celina Trujillo and Caroline Johnson at UC Berkeley's CERCH; Dana Boyd Barr at Emory University's Rollins School of Public Health; and Norma Morga at the Clinica de Salud del Valle de Salinas.

The National Institute of Environmental Health Sciences, the Environmental Protection Agency and the National Institute for Occupational Health and Safety helped fund this research.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Berkeley**. The original article was written by Sarah Yang.

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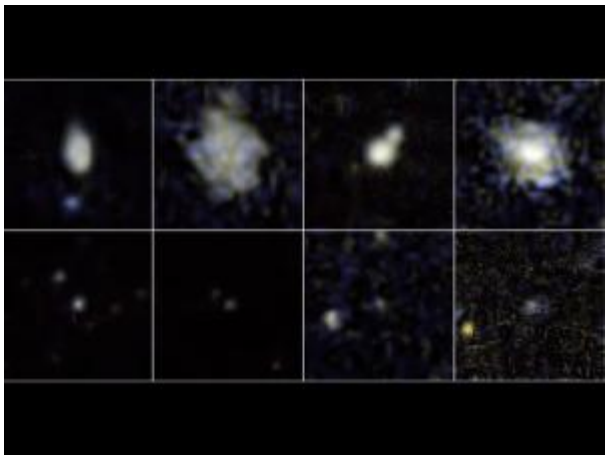
3. Virginia Rauh, Srikesh Arunajadai, Megan Horton, Frederica Perera, Lori Hoepner, Dana B. Barr, Robin Whyatt. **7-Year Neurodevelopmental Scores and Prenatal Exposure to Chlorpyrifos, a Common Agricultural Pesticide**. *Environmental Health Perspectives*, 2011; DOI: 10.1289/ehp.1003160

http://www.sciencedaily.com/releases/2011/04/110421082519.htm

Why Biggest Stellar Explosions Often Happen in Tiniest Galaxies: Ultraviolet Probe Sheds Light on Mystery



NASA's Galaxy Evolution Explorer is helping to solve a mystery -- why do the littlest of galaxies produce the biggest of star explosions, or supernovae? (Credit: NASA/JPL-Caltech)

ScienceDaily (Apr. 21, 2011) — Astronomers using NASA's Galaxy Evolution Explorer may be closer to knowing why some of the most massive stellar explosions ever observed occur in the tiniest of galaxies.

"It's like finding a sumo wrestler in a little 'Smart Car,'" said Don Neill, a member of NASA's Galaxy Evolution Explorer team at the California Institute of Technology in Pasadena, and lead author of a new study published in the *Astrophysical Journal*.

"The most powerful explosions of massive stars are happening in extremely low-mass galaxies. New data are revealing that the stars that start out massive in these little galaxies stay massive until they explode, while in larger galaxies they are whittled away as they age, and are less massive when they explode," said Neill.

Over the past few years, astronomers using data from the Palomar Transient Factory, a sky survey based at the ground-based Palomar Observatory near San Diego, have discovered a surprising number of exceptionally bright stellar explosions in so-called dwarf galaxies up to 1,000 times smaller than our Milky Way galaxy. Stellar explosions, called supernovae, occur when massive stars -- some up to 100 times the mass of our sun -- end their lives.

The Palomar observations may explain a mystery first pointed out by Neil deGrasse Tyson and John Scalo when they were at the University of Austin Texas (Tyson is now the director of the Hayden Planetarium in New York, N.Y.). They noted that supernovae were occurring where there seemed to be no galaxies at all, and they even proposed that dwarf galaxies were the culprits, as the Palomar data now indicate.

Now, astronomers are using ultraviolet data from the Galaxy Evolution Explorer to further examine the dwarf galaxies. Newly formed stars tend to radiate copious amounts of ultraviolet light, so the Galaxy Evolution Explorer, which has scanned much of the sky in ultraviolet light, is the ideal tool for measuring the rate of star birth in galaxies.

The results show that the little galaxies are low in mass, as suspected, and have low rates of star formation. In other words, the petite galaxies are not producing that many huge stars.

"Even in these little galaxies where the explosions are happening, the big guys are rare," said co-author Michael Rich of UCLA, who is a member of the mission team.

In addition, the new study helps explain why massive stars in little galaxies undergo even more powerful explosions than stars of a similar heft in larger galaxies like our Milky Way. The reason is that low-mass galaxies tend to have fewer heavy atoms, such as carbon and oxygen, than their larger counterparts. These small galaxies are younger, and thus their stars have had less time to enrich the environment with heavy atoms.

According to Neill and his collaborators, the lack of heavy atoms in the atmosphere around a massive star causes it to shed less material as it ages. In essence, the massive stars in little galaxies are fatter in their old age than the massive stars in larger galaxies. And the fatter the star, the bigger the blast that will occur when it

finally goes supernova. This, according to the astronomers, may explain why super supernovae are occurring in the not-so-super galaxies.
"These stars are like heavyweight champions, breaking all the records," said Neill.
Added Rich, "These dwarf galaxies are especially interesting to astronomers, because they are quite similar to the kinds of galaxies that may have been present in our young universe, shortly after the Big Bang. The Galaxy Evolution Explorer has given us a powerful tool for learning what galaxies were like when the universe was just a child."
Caltech leads the Galaxy Evolution Explorer mission and is responsible for science operations and data analysis. NASA's Jet Propulsion Laboratory in Pasadena manages the mission and built the science instrument. Caltech manages JPL for NASA. The mission was developed under NASA's Explorers Program managed by the Goddard Space Flight Center, Greenbelt, Md. Researchers sponsored by Yonsei University in South Korea and the Centre National d'Etudes Spatiales (CNES) in France collaborated on this mission.
Graphics and additional information about the Galaxy Evolution Explorer are online at http://www.nasa.gov/galex/ and http://www.galex.caltech.edu .

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

Journal Reference:

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Melting Ice on Arctic Islands a Major Player in Sea Level Rise

This ice channel, or supraglacial melt channel, was formed by meltwater flowing along the surface of the Belcher Glacier on Devon Island in Nunavut, Canada. It was photographed in August 2009. (Credit: Angus Duncan)

ScienceDaily (Apr. 21, 2011) — Melting glaciers and ice caps on Canadian Arctic islands play a much greater role in sea level rise than scientists previously thought, according to a new study led by a University of Michigan researcher.

The 550,000-square-mile Canadian Arctic Archipelago contains some 30,000 islands. Between 2004 and 2009, the region lost the equivalent of three-quarters of the water in Lake Erie, the study found. Warmer-than-usual temperatures in those years caused a rapid increase in the melting of glacier ice and snow, said Alex Gardner, a research fellow in the Department of Atmospheric, Oceanic and Space Sciences who led the project. The study is published online in *Nature* on April 20.

"This is a region that we previously didn't think was contributing much to sea level rise," Gardner said. "Now we realize that outside of Antarctica and Greenland, it was the largest contributor for the years 2007 through 2009. This area is highly sensitive and if temperatures continue to increase, we will see much more melting."

Ninety-nine percent of all the world's land ice is trapped in the massive ice sheets of Antarctica and Greenland. Despite their size, they currently only account for about half of the land-ice being lost to oceans. This is partly because they are cold enough that ice only melts at their edges.

The other half of the ice melt adding to sea-level rise comes from smaller mountain glaciers and ice caps such as those in the Canadian Arctic, Alaska, and Patagonia. This study underscores the importance of these many smaller, often overlooked regions, Gardner said.

During the first three years of this study, from 2004 through 2006, the region lost an average of 7 cubic miles of water per year. That increased dramatically to 22 cubic miles of water -- roughly 24 trillion gallons -- per year during the latter part of the study. Over the entire six years, this added a total of 1 millimeter to the height of the world's oceans. While that might not sound like much, Gardner says that small amounts can make big differences.

In this study, a one-degree increase in average air temperature resulted in 15 cubic miles of additional melting.

Because the study took place over just six years, however, the results don't signify a trend.

"This is a big response to a small change in climate," Gardner said. "If the warming continues and we start to see similar responses in other glaciated regions, I would say it's worrisome, but right now we just don't know if it will continue."

The United Nations projects that the oceans will rise by a full meter by the end of century. This could have ramifications for tens of millions of people who live in coastal cities and low-lying areas across the globe. Future tsunamis and storm surges, for example, would more easily overtop ocean barriers.

To conduct the study, researchers from an international array of institutions performed numerical simulations and then used two different satellite-based techniques to independently validate their model results. Through laser altimetry, they measured changes in the region's elevation over time. And through a technique called

"gravimetry," they measured changes in Earth's gravitational field, which signified a redistribution of mass -- a loss of mass for glaciers and ice caps.
The research was funded by the Natural Sciences and Engineering Research Council of Canada, the Alberta Ingeneuity Fund, the European Union 7th Framework Program, and the Canadian Foundation for Climate and Atmospheric Sciences.
Other collaborators are with the University of Alberta, Scripps Institution of Oceanography, the University of Oslo, the Royal Netherlands Meteorological Institute, the Alaska Department of Natural Resources, the Geological Survey of Canada, Trent University, Westfield State University and the Campbell Scientific Canada Corp.

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

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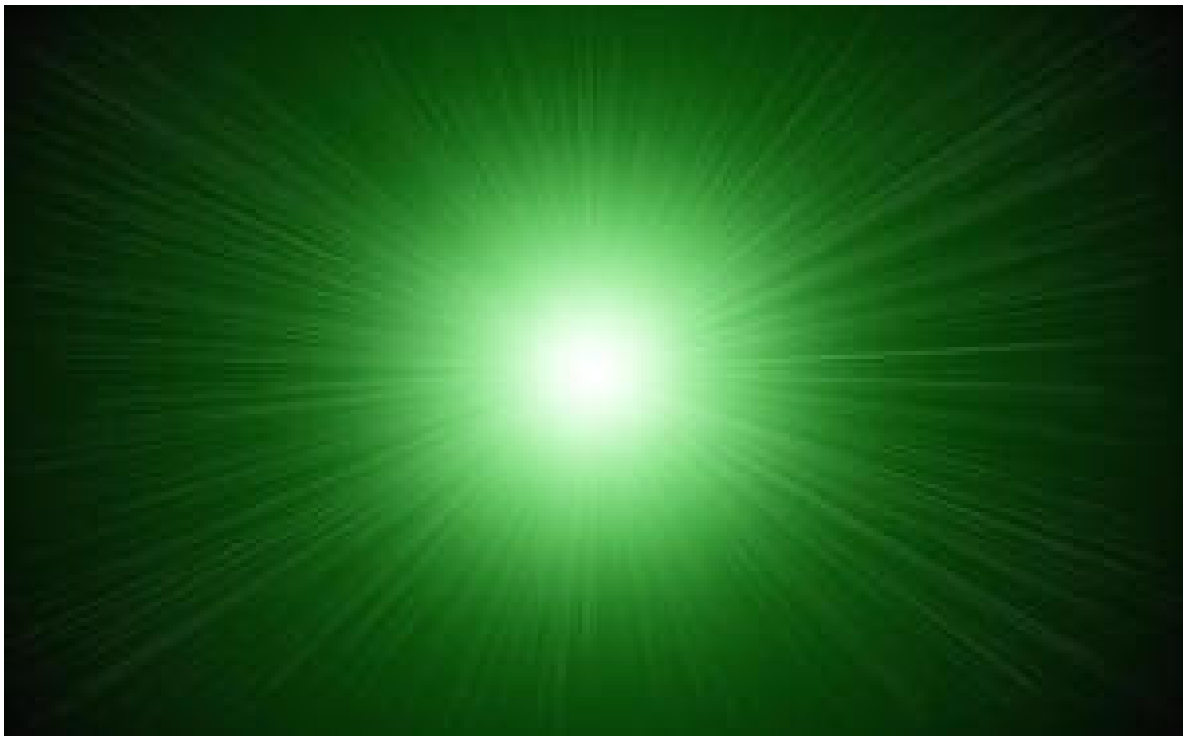
Laser Sparks Revolution in Internal Combustion Engines



Automakers are now one step closer to being able to replace this long-standing technology with laser igniters, which will enable cleaner, more efficient, and more economical vehicles. (Credit: © Tilio & Paolo / Fotolia)

ScienceDaily (Apr. 21, 2011) — For more than 150 years, spark plugs have powered internal combustion engines. Automakers are now one step closer to being able to replace this long-standing technology with laser igniters, which will enable cleaner, more efficient, and more economical vehicles.

In the past, lasers strong enough to ignite an engine's air-fuel mixtures were too large to fit under an automobile's hood. At this year's Conference on Lasers and Electro Optics (CLEO: 2011), to be held in Baltimore May 1-6, researchers from Japan will describe the first multibeam laser system small enough to screw into an engine's cylinder head.

Equally significant, the new laser system is made from ceramics, and could be produced inexpensively in large volumes, according to one of the presentation's authors, Takunori Taira of Japan's National Institutes of Natural Sciences.

According to Taira, conventional spark plugs pose a barrier to improving fuel economy and reducing emissions of nitrogen oxides (NO_x), a key component of smog.

Spark plugs work by sending small, high-voltage electrical sparks across a gap between two metal electrodes. The spark ignites the air-fuel mixture in the engine's cylinder -- producing a controlled explosion that forces the piston down to the bottom of the cylinder, generating the horsepower needed to move the vehicle.

Engines make NO_x as a byproduct of combustion. If engines ran leaner -- burnt more air and less fuel -- they would produce significantly smaller NO_x emissions.

Spark plugs can ignite leaner fuel mixtures, but only by increasing spark energy. Unfortunately, these high voltages erode spark plug electrodes so fast, the solution is not economical. By contrast, lasers, which ignite the air-fuel mixture with concentrated optical energy, have no electrodes and are not affected.

Lasers also improve efficiency. Conventional spark plugs sit on top of the cylinder and only ignite the air-fuel mixture close to them. The relatively cold metal of nearby electrodes and cylinder walls absorbs heat from the explosion, quenching the flame front just as it starts to expand.

Lasers, Taira explains, can focus their beams directly into the center of the mixture. Without quenching, the flame front expands more symmetrically and up to three times faster than those produced by spark plugs.

Equally important, he says, lasers inject their energy within nanoseconds, compared with milliseconds for spark plugs. "Timing -- quick combustion -- is very important. The more precise the timing, the more efficient the combustion and the better the fuel economy," he says.

Lasers promise less pollution and greater fuel efficiency, but making small, powerful lasers has, until now, proven hard. To ignite combustion, a laser must focus light to approximately 100 gigawatts per square centimeter with short pulses of more than 10 millijoules each.

"In the past, lasers that could meet those requirements were limited to basic research because they were big, inefficient, and unstable," Taira says. Nor could they be located away from the engine, because their powerful beams would destroy any optical fibers that delivered light to the cylinders.

Taira's research team overcame this problem by making composite lasers from ceramic powders. The team heats the powders to fuse them into optically transparent solids and embeds metal ions in them to tune their properties.

Ceramics are easier to tune optically than conventional crystals. They are also much stronger, more durable, and thermally conductive, so they can dissipate the heat from an engine without breaking down.

Taira's team built its laser from two yttrium-aluminum-gallium (YAG) segments, one doped with neodymium, the other with chromium. They bonded the two sections together to form a powerful laser only 9 millimeters in diameter and 11 millimeters long (a bit less than half an inch).

The composite generates two laser beams that can ignite fuel in two separate locations at the same time. This would produce a flame wall that grows faster and more uniformly than one lit by a single laser.

The laser is not strong enough to light the leanest fuel mixtures with a single pulse. By using several 800-picosecond-long pulses, however, they can inject enough energy to ignite the mixture completely.

A commercial automotive engine will require 60 Hz (or pulse trains per second), Taira says. He has already tested the new dual-beam laser at 100 Hz. The team is also at work on a three-beam laser that will enable even faster and more uniform combustion.

The laser-ignition system, although highly promising, is not yet being installed into actual automobiles made in a factory. Taira's team is, however, working with a large spark-plug company and with DENSO Corporation, a member of the Toyota Group.

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A Mega-Dam Dilemma in the Amazon

A huge dam on Peru's Inambari River will bring much-needed development to the region. But at what cost?

- By Clay Risen
- Photographs by Ivan Kashinsky
- *Smithsonian* magazine, March 2011

The town of Puerto Maldonado lies about 600 miles east of Lima, Peru, but locals call it the Wild West. Gold-buying offices line its main avenues. Bars fill the side streets, offering beer and cheap *lomo saltado*—stir-fried meat and vegetables served with rice and French fries. Miners and farmers motorbike into the sprawling central market to stock up on T-shirts and dried alpaca meat. Garbage and stray dogs fill the alleyways. There's a pioneer cemetery on the edge of town, where its first residents are buried.

And Puerto Maldonado is booming. Officially, it has a population of 25,000, but no one can keep up with the new arrivals—hundreds each month, mostly from the Andean highlands. Residents say the town has doubled in size over the past decade. There are only a few paved roads, but asphalt crews are laying down new ones every day. Two- and three-story buildings are going up on every block.

Puerto Maldonado is the capital of Peru's Madre de Dios region (similar to an American state), which abuts Bolivia and Brazil. The area is almost all rain forest and until recent decades was one of South America's least populated and most inaccessible areas. But today it is a critical part of Latin America's economic revolution. Poverty rates are dropping, consumer demand is rising and infrastructure development is on a tear. One of the biggest projects, the $2 billion Inter-oceanic Highway, is nearly complete—and runs straight through Puerto Maldonado. Once open, the highway is expected to see 400 trucks a day carrying goods from Brazil to Peruvian ports.

Later this year a consortium of Brazilian construction and energy companies plans to start building a $4 billion hydroelectric dam on the Inambari River, which starts in the Andes and empties into the Madre de Dios River near Puerto Maldonado. When the dam is completed, in four to five years, its 2,000 megawatts of installed capacity—a touch below that of the Hoover Dam—will make it the largest hydroelectric facility in Peru and the fifth-largest in all of South America.

The Inambari dam, pending environmental impact studies, will be built under an agreement signed last summer in Manaus, Brazil, by Peruvian President Alan García and Brazil's then-president, Luiz Inácio Lula da Silva. In a joint statement released afterward, the pair praised the deal as "an instrument of great strategic interest to both countries." At first, most of the dam's electricity will go to Brazil, which desperately needs

power to feed its economic expansion—a projected 7.6 percent in 2011, the fastest in nearly two decades. Over 30 years, the bulk of the electricity will gradually go to Peru to meet its own growing power demands. "The reality is, every year we need more and more energy," says Antonio Brack Egg, Peru's environmental minister. "We need hydropower."

But the dam will also change the Inambari's ecosystem, already damaged by decades of logging and mining. The river level will drop, and whatever water is released will lack the nutrient-rich sediment on which the lowland wildlife—and, by extension, the Madre de Dios region—depends. Meanwhile, the 155-square-mile reservoir created behind the dam will displace about 4,000 people in at least 60 villages. And this dam is just one of dozens being planned or built in what has been called a "blue gold rush," an infrastructure spree that is transforming the South American interior.

Development of the Amazon basin, managed correctly, could be a boon for the continent, lifting millions out of poverty and eventually bringing stability to a part of the world that has known too little of it. But in the short term it is creating new social and political tensions. How Peru balances its priorities—economic growth versus social harmony and environmental protection—will determine whether it joins the ranks of middle-class countries or is left with entrenched poverty and denuded landscapes.

Madre de Dios claims to be the biodiversity capital of the world. Fittingly, Puerto Maldonado boasts a Monument to Biodiversity. It is a tower that looms over the middle of a wide traffic circle near the center of town, with a base ringed with broad concrete buttresses, mimicking a rain forest tree. Between the buttresses are bas-relief sculptures of the region's main activities, past and present: subsistence agriculture; rubber, timber and Brazil-nut harvesting; and gold mining—oddly human pursuits to detail on a monument to wildlife.

I was in Puerto Maldonado to meet up with an old friend, Nathan Lujan, who was leading a team of researchers along the Inambari River. After getting his PhD in biology from Auburn University in Alabama, Nathan, 34, landed at Texas A&M as a postdoctoral researcher. But he spends months at a time on rivers like the Inambari. For the better part of the past decade he's been looking for catfish—specifically, the suckermouthed armored catfish, or *Loricariidae*, the largest family of catfish on the planet. Despite their numbers, many *Loricariidae* species are threatened by development, and on this trip, Nathan was planning to catalog as many as possible before the Inambari dam is built.

The river Nathan showed me was hardly pristine. It serves many purposes—transportation, waste removal, a source of food and water. Garbage dots its banks, and raw sewage pours in from riverfront villages. Much of Puerto Maldonado's growth (and, though officials are loath to admit it, a decent share of Peru's as well) has come from the unchecked, often illegal exploitation of natural resources.

Antonio Rodriguez, who came to the area from the mountain city of Cuzco in the mid-1990s in search of work as a lumberjack, summed up the prevailing attitude: "We are colonists," he told me when I met him in the relatively new village of Sarayacu, which overlooks the Inambari. Thousands of men like Rodriguez made quick work of the surrounding forests. Mahogany trees that once lined the river are gone, and all we could see for miles was scrub brush and secondary growth. Thanks to the resulting erosion, the river is a waxy brown and gray. "These days only a few people are still interested in lumber," he said. The rest have moved on to the next bonanza: gold. "Now it's all mining."

Indeed, with world prices up by some 300 percent over the past decade, gold is a particularly lucrative export. Peru is the world's sixth-largest gold producer, and while much of it comes from Andean mines, a growing portion—by some estimates, 16 to 20 of the 182 tons that Peru exports annually—comes from illegal or quasi-legal mining along the banks of Madre de Dios' rivers. Small-scale, so-called artisanal mining is a big business in the region; during our five-day boat trip along the river, we were rarely out of sight of a front-end loader digging into the bank in search of deposits of alluvial gold.

Less visible were the tons of mercury that miners use to separate out the gold and that eventually end up in the rivers. Waterborne microorganisms metabolize the element into methylmercury, which is highly toxic and easily enters the food chain. In perhaps the most notorious instance of methylmercury poisoning, more than 2,000 people near Minamata, Japan, developed neurological disorders in the mid- 1950s and '60s after eating fish contaminated by runoff from a local chemical plant. In that case, 27 tons of mercury compounds had been released over 35 years. The Peruvian government estimates that 30 to 40 tons are dumped into the country's Amazonian rivers *each year*.

A 2009 study by Luis Fernandez of the Carnegie Institution for Science and Victor Gonzalez of Ecuador's Universidad Técnica de Machala found that three of the most widely consumed fish in the region's rivers contained more mercury than the World Health Organization deems acceptable—and that one species of catfish had more than double that. There are no reliable studies on mercury levels in the local residents, but their diet relies heavily on fish, and the human body absorbs about 95 percent of fish-borne mercury. Given the amounts of mercury in the rivers, Madre de Dios could be facing a public health disaster.

But Peru is eager to move beyond artisanal gold mining and its hazards. Over the past few decades the country has adopted a number of strict mining laws, including an embargo on issuing new artisanal-mining permits. And in May 2008 President García named Brack, a respected biologist, to be Peru's first minister of the environment.

At 70, Brack has the white hair and the carefully trimmed beard of an academic, though he has spent most of his career working in Peru's Agriculture Ministry. He speaks rapid, near-perfect English and checks his BlackBerry often. When I caught up with him last fall in New York City, where he attended a meeting at the United Nations, I told him I had recently returned from the Inambari. "Did you try any fish?" he asked. "It's good to have a little mercury in your blood."

Under Brack, the ministry has rewritten sections of the Peruvian penal code to make it easier to prosecute polluters, and it has won significant budget increases. Brack has placed more than 200,000 square miles of rain forest under protection, and he has set a goal of zero deforestation by 2021. Thanks in part to him, Peru is the only Latin American country to sign the Extractive Industries Transparency Initiative, an effort led by former British Prime Minister Tony Blair to make the mining industry more accountable to public and government scrutiny.

Brack has also taken over enforcement of artisanal-mining laws from the Ministry of Energy and Mining. "There are now 20 people in jail" for breaking Peru's environmental laws, he said. A few days before our meeting, police had raided a series of mines in Madre de Dios and made 21 arrests. He told me he wants to deploy the army to protect the country's nature preserves.

But Brack acknowledged that it is difficult to enforce laws created in Lima, by coastal politicians, in a remote part of the country suffering from gold fever. Last April thousands of members of the National Federation of Independent Miners blocked the Pan-American Highway to protest a plan to tighten regulations on artisanal miners; the demonstration turned violent and five people were killed. Brack said several police officers involved in anti-mining raids had received death threats, and the Independent Miners has demanded that he be sacked. "I have a lot of enemies in Madre de Dios," he said.

Unlike the leftist governments of Ecuador and Venezuela, Peru and Brazil have been led, of late, by pragmatic centrists who see good fiscal management and rapid internal development as the key to long-term prosperity. By aggressively exploiting its resources, Brazil has created a relatively stable society anchored by a strong and growing middle class. Dilma Rousseff, Lula's handpicked successor as president, says she will continue her mentor's policies.

Lula reduced Brazil's poverty rate from 26.7 percent in 2002, when he entered office, to 15.3 percent in 2009—accounting for some 20 million people. Peru has done almost as well: it has reduced its poverty rate from 50 percent to 35 percent, a difference of about four million people. But farming and resource extraction require lots of land and energy, which is why Brazil is expected to need 50 percent more electricity in the next decade, and Peru at least 40 percent more. In the short term, both countries will have to keep pushing deeper into the Amazon to generate electricity.

Meanwhile, they are under pressure from trading partners and finance organizations such as the World Bank to manage their growth with less environmental damage. Brazil has a bad reputation for its decades of rain forest destruction; it has little interest in becoming known as a polluter, too. With the world's focus on limiting fossil-fuel consumption, hydropower has become the easy answer.

Until recently, Brazil had focused its hydropower construction within its own borders. But a hydropower facility works best near a drop in elevation; gravity pushes water through its turbines more quickly, generating more electricity—and Brazil is almost completely flat. Which is why, over the past decade, Brazil has underwritten mega-dams in Bolivia, Paraguay and Peru.

In 2006, Brazil and Peru began negotiating an agreement to construct at least five dams throughout Peru, most of which would sell power to Brazil to feed the growth in its southwestern states. Those negotiations produced the deal that García and Lula signed last summer.

Although Peru relies primarily on fossil fuels for its energy, Peruvian engineers have been talking about a dam along the Inambari since the 1970s. The momentum of the rivers coming down from the Andes pushes an enormous volume of water through a narrow ravine—the perfect place to build a hydropower plant. The problem was simply a lack of demand. The region's recent growth took care of that.

But there are risks. By flooding 155 square miles of land, the proposed dam will wipe out a big chunk of carbon-dioxide-absorbing forest. And unless that forest is thoroughly cleared beforehand, the decay of the submerged tree roots will result in massive releases of methane and CO2. Scientists are still divided over how to quantify these side effects, but most acknowledge that hydropower is not as eco-friendly as it might appear. "It's not by definition cleaner," says Foster Brown, an environmental geochemist and expert on the southwestern Amazon at the Federal University of Acre, in Brazil. "You cannot just say it's therefore a better resource."

What's more, the dam may kill much of the aquatic life below it. On my trip along the river with Nathan, he explained that freshwater fish are particularly sensitive to variations in water and sediment flow; they do most of their eating and reproducing during the dry season, but they need the high water levels of the rainy season to have room to grow. The dam, he said, will upset that rhythm, releasing water whenever it runs high, which could mean every day, every week or not for years. "Shifting the river's flow regime from annual to daily ebbs and flows will likely eliminate all but the most tolerant and weedy of aquatic species," Nathan said.

And the released water may even be toxic for fish. Most dams release water from the bottom of the reservoir, where, under intense pressure, nitrogen has dissolved into it. Once the water heads downriver, however, the nitrogen starts to slowly bubble out. If fish breathe it in the meantime, the trapped gases can be deadly. "It's the same as getting the bends," said Dean Jacobsen, an ecologist on Nathan's team.

Others point out that if the fish are full of mercury, the local people may be better off avoiding them. In the long run, a stronger economy will provide new jobs and more money, with which locals can buy food trucked in from elsewhere. But such changes come slowly. In the meantime, the people may face massive economic and social displacement. "Locally, it means that people won't have enough to eat," said Don Taphorn, a biologist on the team. As he spoke, some fishermen were unloading dozens of enormous fish, some weighing 60 pounds or more. "If this guy didn't find fish, he can't sell them, and he's out of a job."

Brack, however, says the benefits of the dam—more electricity, more jobs and more trade with Brazil—will outweigh the costs and in any case will reduce the burning of fossil fuels. "All the environmentalists are crying out that we need to substitute fossil-fuel energy with renewable energy," he said, "but when we construct hydroelectric facilities, they say no."

A demonstration against Brazil's proposed Belo Monte dam in March 2010 brought worldwide attention thanks to the film director James Cameron, who went to Brazil to dramatize comparisons between the Amazon and the world depicted in his blockbuster *Avatar*. In Peru, Inambari dam critics are now accusing the government of selling out the country's resources and violating indigenous people's rights. Last March in Puno province, where most of the reservoir created by the dam will sit, 600 people turned out near the dam site, blocking roads and shutting down businesses.

Nevertheless, development of the interior has become a sort of state religion, and political candidates compete to see who can promise the most public works and new jobs. Billboards along the Interoceanic Highway, which will soon link Brazil's Atlantic coast to Peru's Pacific coast, some 3,400 miles, display side-by-side photographs of the road pre- and post-asphalt and bear captions like "Before: Uncertainty; After: The Future."

President García has spoken forcefully against indigenous and environmental groups that oppose projects like the Inambari dam. "There are many unused resources that cannot be traded, that do not receive investment and do not create jobs," he wrote in a controversial 2007 op-ed in *El Comercio*, a Lima newspaper. "And all this because of the taboo of past ideologies, idleness, laziness or the law of the dog in the manger that says, 'If I do not do it, then let no one do it' "—a reference to a Greek fable about a hound that refuses to let an ox eat a bale of hay, even though the dog can't eat it himself.

Last June, García vetoed a bill that would have given local tribes a say in oil and gas projects on their territory. He told reporters he would not give local people veto power over national resources. Peru, he said, "is for all Peruvians."

Even in the Peruvian Amazon, the dam enjoys wide support. A poll of local business leaders in the Puno region found that 61 percent were in favor of it.

On my fourth day on the Inambari, I met Albino Mosquipa Sales, the manager of a hotel in the town of Mazuco, just downriver from the dam site. “On the whole it is a good thing,” he said of the dam. “It will bring economic benefits like jobs and commerce,” plus a new hospital promised by the state electrical company. Mosquipa’s caveats were mostly procedural: Lima should have consulted with local populations more, he said, and the regional government should have pushed harder for concessions from the dam builders. It was a line of complaint I heard often. People questioned whether the electricity should go to Brazil, but not whether the dam should be built.

Eventually I made it to Puente Inambari, a postage-stamp-size village of perhaps 50 buildings that will be destroyed when the dam is built. I had expected to find anger. What I found was enthusiasm.

Graciela Uscamaita, a young woman in a yellow long-sleeved shirt, was sitting in a doorstep by the side of the road. Her four young boys played beside her. Like virtually everyone I had met on the trip, she had the dark skin and prominent cheekbones of an Andean highlander. And, like the other local residents I talked to, she was happy about the hospital and the new houses the government has offered to build them farther uphill. In the meantime, there was the possibility of getting a job on a construction crew. “It will be better for us,” she said. “It will bring work.”

Clay Risen wrote about President Lyndon Johnson for the April 2008 issue of *Smithsonian*. **Ivan Kashinsky** photographed the Colombian flower industry for the February 2011 issue.

Find this article at:
http://www.smithsonianmag.com/people-places/A-Mega-Dam-Dilemma-in-the-Amazon.html

The Secrets Behind Your Flowers

Chances are the bouquet you're about to buy came from Colombia. What's behind the blooms?

- By John McQuaid
- Photographs by Ivan Kashinsky
- *Smithsonian* magazine, February 2011

In 1967 david cheever, a graduate student in horticulture at Colorado State University, wrote a term paper titled “Bogotá, Colombia as a Cut-Flower Exporter for World Markets.” The paper suggested that the savanna near Colombia’s capital was an ideal place to grow flowers to sell in the United States. The savanna is a high plain fanning out from the Andean foothills, about 8,700 feet above sea level and 320 miles north of the Equator, and close to both the Pacific Ocean and the Caribbean Sea. Those circumstances, Cheever wrote, create a pleasant climate with little temperature variation and consistent light, about 12 hours per day year-round—ideal for a crop that must always be available. A former lakebed, the savanna also has dense, clay-rich soil and networks of wetlands, tributaries and waterfalls left after the lake receded 100,000 years ago. And, Cheever noted, Bogotá was just a three-hour flight from Miami—closer to East Coast customers than California, the center of the U.S. flower industry.

After graduating, Cheever put his theories into practice. He and three partners invested $25,000 apiece to start a business in Colombia called Floramérica, which applied assembly-line practices and modern shipping techniques at greenhouses close to Bogotá’s El Dorado International Airport. The company started with carnations. “We did our first planting in October of 1969, for Mother’s Day 1970, and we hit it right on the money,” says Cheever, 72, who is retired and lives in Medellín, Colombia, and New Hampshire.

It’s not often that a global industry springs from a school assignment, but Cheever’s paper and business efforts started an economic revolution in Colombia. A few other growers had exported flowers to the United States, but Floramérica turned it into a big business. Within five years of Floramérica’s debut at least ten more flower-growing companies were operating on the savanna, exporting some $16 million in cut flowers to the United States. By 1991, the World Bank reported, the industry was “a textbook story of how a market economy works.” Today, the country is the world’s second-largest exporter of cut flowers, after the Netherlands, shipping more than $1 billion in blooms. Colombia now commands about 70 percent of the U.S. market; if you buy a bouquet in a supermarket, big-box store or airport kiosk, it probably came from the Bogotá savanna.

This growth took place in a country ravaged by political violence for most of the 20th century and by the cocaine trade since the 1980s, and it came with significant help from the United States. To limit coca farming and expand job opportunities in Colombia, the U.S. government in 1991 suspended import duties on Colombian flowers. The results were dramatic, though disastrous for U.S. growers. In 1971, the United States produced 1.2 billion blooms of the major flowers (roses, carnations and chrysanthemums) and imported only 100 million. By 2003, the trade balance had reversed; the United States imported two billion major blooms and grew only 200 million.

In the 40 years since Cheever had his brainstorm, Colombian flowers have become another global industrial product, like food or electronics. That became apparent to me a few years ago as I stood in front of the flower display at my local supermarket before Mother's Day (the second-biggest fresh flower-buying occasion in the United States, after Valentine's Day). My market, in suburban Maryland, had an impressive display of hundreds of preassembled bouquets, as well as fresh, unbunched roses, gerbera daisies and alstroemeria lilies in five-gallon buckets. One $14.99 bouquet caught my eye: about 25 yellow and white gerbera daisies and a sprig of baby's breath arranged around a single purplish rose. A sticker on the wrapping indicated it had come from Colombia, some 2,400 miles away.

How could something so delicate and perishable (and once so exotic) have come so far and still be such a bargain? It's no secret that the inexpensive imported products Americans buy often exact a toll on the people who make them and on the environments where they are made. What was I buying into with my Mother's Day bouquet? My search for answers took me to a barrio about 25 miles northwest of Bogotá.

In cartagenita, the buses rumble over ruts and potholes, moving slowly up and down steep hillsides lined with cinder block houses. "*Turismo*" is painted in flowing aquamarine script on the buses, but they are no longer used for tours. They carry workers to the flower farms.

Cartagenita is a neighborhood in Facatativá, a city of about 120,000 people and one of Colombia's largest flower hubs. Only a few of Cartagenita's streets are paved, and the homes are connected like town houses but without any plan, so one sometimes stands taller or shorter than the next. The barrio ends abruptly after a few blocks at open pasture. Aidé Silva, a flower worker and union leader, moved there 20 years ago. "I've got a house here. My husband built it," she told me. "He worked at Floramérica, and in the afternoons and when Sunday came everybody worked building that little house." In the years since, she said, thousands more flower workers have bought cheap land and done the same. Cartagenita has the vitality of a working-class neighborhood. There's a buzz in the evenings as workers come home, some heading for their houses and apartments, some to hang out in the bars and open-air convenience stores.

More than 100,000 people—many displaced by Colombia's guerrilla wars and rural poverty—labor in greenhouses spread across the savanna. Seen from an airplane, the greenhouses form geometric gray-and-white patterns reminiscent of an Escher drawing. Up close, they turn out to be bare-bones structures of plastic sheeting stapled to wooden frames. But the low-rent look is deceptive; the operations are highly sophisticated. At a farm called M.G. Consultores, I stood on a platform above a sprawling assembly line where about 320 workers (triple the usual number—this was the run-up to Mother's Day), most of them women, were arrayed along two long conveyor belts with 14 parallel rows of workstations on either side. The work was divided into many small, discrete tasks—measuring, cutting, bunching—before neat bundles appeared on the belt, which were then dunked in a foamy antifungal solution and boxed. Latin pop music reverberated off the corrugated metal walls. The workers were handling 300,000 rose blooms a day.

Most flowers grown in Colombia are bred in European labs, especially Dutch labs, which ship seedlings and cuttings to growers. A single gerbera plant, for instance, can last several years and produce hundreds of blooms, each one taking 8 to 12 weeks to mature. Growers change colors constantly, rotating new plants in depending on the season or consumer mood. "The tendency now is monochromatic, purple on purple," said Catalina Mojica, who works for M.G. Consultores on labor and environmental sustainability issues. "We are two years behind fashion—usually European fashion." Indeed, two years earlier, several top European clothing designers had featured purple in their lines.

Not so long ago, Americans got their flowers from neighborhood florists, who bought blooms grown on U.S. farms. Florists crafted bouquets and arrangements to order. They still do, of course, but this approach seems increasingly quaint. These days, the bouquets that many Americans buy, typically at supermarkets, are grown, assembled and packaged overseas. At the C.I. Agroindustria del Riofrío farm, adjacent to M.G. Consultores,

dozens of bouquet assemblers were nearly swallowed up by bulging piles of gerberas, alstroemeria and sprigs of baby's breath, all to be precisely arranged and bundled in zebra-striped plastic wrap.

Adjacent to the assembly line were spacious storerooms kept at about 34 degrees Fahrenheit. It's no understatement to say the entire flower industry depends on that number. Selling flowers is, at bottom, an attempt to outwit death, and near-freezing temperatures can delay the inevitable. Cut a flower, and its ability to photosynthesize food from light, carbon dioxide and water soon ceases. Stored food is depleted and the flower wilts. Putting flowers in water slows that process, but only cold temperatures can arrest it for weeks at a time. It took the development of "cold chains"—refrigerated warehouses and trucks every point along the way—to ensure that flowers remain in suspended animation from farm to store.

In the cold rooms, boxes containing flowers are attached to refrigeration units that infuse them with chilled air. Then they're stacked on pallets, which are wrapped in plastic and loaded onto trucks and driven to Miami-bound planes. (The Queen's Flowers Corporation, one of the top importers in Miami, receives 3,000 boxes of Colombian blooms, or five tractor-trailers' worth, on a typical day. And its shipments multiply three times during busy seasons.) It takes about 48 hours for flowers to get from a field in Colombia to a warehouse in the United States, and one or two more days to reach a retailer.

This industrial machine has been assembled at some cost. As the flower business grew, researchers for labor and environmental organizations documented the sorts of problems that typify developing economies. From the beginning, the majority of the tens of thousands of job-seekers who migrated to the savanna were women, and many of them were single mothers. Most workers made the minimum wage, which is now about $250 per month. Many of them reported sexual harassment by male bosses; working long hours without breaks; and repetitive stress injuries with no employer-provided treatment or time off. As recently as 1994, a Colombian sociologist found children as young as 9 working in greenhouses on Saturdays, and children 11 and up working 46-hour weeks in almost all areas of the farms.

A 1981 survey of almost 9,000 flower workers by scientists from Colombia, France and Britain found that the work had exposed people to as many as 127 different chemicals, mostly fungicides and pesticides. (One incentive to use pesticides: the U.S. Department of Agriculture checks imported flowers for insects, but not for chemical residues.) A 1990 study by Colombia's National Institute of Health (NIH) suggested that pregnant Colombian flower workers exposed to pesticides might have higher rates of miscarriages, premature births and babies with congenital defects.

Colombia's flower industry has also been profligate in its use of a vital natural resource: fresh water. Producing a single rose bloom requires as much as three gallons of water, according to a study of the Kenyan flower industry by scientists at the University of Twente in the Netherlands. The Bogotá area receives 33 inches of rainfall annually, but after flower farms and other users drilled more than 5,000 wells on the savanna, groundwater levels plunged. One engineering study reported that springs, streams and wetlands were disappearing. As Bogotá continues to expand, the city and the flower industry will be competing for the same dwindling supply.

In the 1990s, the Colombia flower industry's success in American and European markets drew attention to its practices; a stream of reports about harsh treatment of workers and depletion of natural resources followed. At the same time, consumers began to care more about how their goods were being produced, so Colombia's flower farms began to respond. "It's definitely improved over time, particularly as a result of the different organizations giving everybody adverse publicity," says Catherine Ziegler, author of the book *Favored Flowers*, about the global industry.

In 1996, Colombia began a series of initiatives, still underway, to eliminate child labor, and international labor groups report that it has been greatly reduced in the cut-flower business. Farms belonging to the flower exporters association, Asocolflores (about 75 percent of the total), have moved to replace the more hazardous classes of agricultural chemicals, says Marcela Varona, a scientist at the environmental health laboratory at Colombia's NIH. (But researchers note that flower workers who have used hazardous chemicals in the past may continue to be affected for years.)

In addition, the flower industry created Florverde, a voluntary certification program that requires participating farms to meet targets for sustainable water use and follow internationally recognized safety guidelines for chemical applications. At several farms I visited, the plastic sheeting on greenhouse roofs had been extended and reshaped to collect rainwater. Farms participating in Florverde have reduced their groundwater use by more than half by collecting and using rainwater, says Ximena Franco Villegas, the program's director.

At the same time, slightly fewer than half of Asocolflores farms participate in Florverde, and government oversight remains weak. “The industry is self-regulated, so it’s up to the owner and up to his ethics what he does,” says Greta Friedemann-Sanchez, a University of Minnesota anthropologist and author of the book *Assembling Flowers and Cultivating Homes: Labor and Gender in Colombia*. “There are facilities that have enough washrooms, bathrooms, lockers, cafeterias, a subsidized lunch workers can purchase, recycle all organic material, trying to do biological control of pests and fungus, and follow labor laws. And then there are firms that don’t do any of those things.”

Similarly, labor disagreements continue. At the Facatativá headquarters of Untraflores, the flower workers union Aidé Silva helped organize in the early 2000s, she told me that after 19 years in the industry, she lost her job in late 2009 in a corporate reorganization—an action she says her employer, Flores Benilda, took to break the union after workers shut down a farm to protest pay and benefit cuts. Moreover, Silva says Benilda drained an $840,000 employee support fund that workers had been contributing to for 20 years, leaving only about $8,000. Benilda did not respond to requests for comment.

The global economic crisis has had an impact, too. “The dollar has fallen, the peso has been revalued, the competition from other countries has grown, as has the focus on supermarkets,” said Untraflores’ political adviser, Alejandro Torres. “These changes in the global flower markets have generated costs, and those get put on the workers.” Thousands of workers have been laid off, and some flower farms have moved away from hiring employees in favor of contracting labor; Torres and Silva say the arrangement allows the farms to stop paying the employer share of government social security and medical benefits.

By contrast, Catalina Mojica says M.G. Consultores is actually working to retain employees. Mojica’s focus on collecting data about working conditions and her willingness to talk with local officials and reporters, for example, represents a change for the industry; farm owners have tended to be secretive about their business operations and rarely meet with outsiders. “They don’t get together and BS with people,” she says. “Some owners don’t know the local government officials, they don’t know the [labor and environmental groups]. We’re still very awkward. It’s not something people do.”

“What is expensive for us is people moving from the industry—so we have to keep people happy here,” says María Clara Sanín, a sustainability consultant who has worked with flower farms. At Flores de Bojacá, a farm west of Bogotá that employs about 400 people, there’s an elected employee council that can air complaints to management. The farm has a day care center, a nice cafeteria and machines that strip the thorns off roses—a task usually performed by hand, with special gloves, and a major cause of repetitive stress injuries.

Ultimately, many flower workers have improved their lot. Sanín’s firm, Enlaza, recently surveyed hundreds of women at M.G. Consultores and found that most had previously worked on subsistence farms or as maids, jobs that paid lower wages than the flower industry. Women with their own incomes have more autonomy than those dependent on husbands, says Friedemann-Sanchez, the anthropologist. She answered my original question—What was I buying into if I bought a Colombian bouquet?—with one of her own: “If you don’t buy flowers, what’s going to happen to all these women?”

As I tried to sort out these conflicting snapshots of the industry, I kept coming back to what a flower worker named Argenis Bernal had told me about her life. She began laboring on flower farms when she was 15. Because she was a good worker, she said, she was assigned to the harvest, wielding her clippers along pathways between long lines of flower beds, amassing stacks of roses, carnations, gerberas and other blooms. “You spend all your time hunched over, from the time they sow the seedling to the time the stems are cut,” she said. “That’s the work, all day long.”

After about a decade, she said, she had to stop harvesting. Now she’s 53, and “I’ve got these problems with my spinal column and with repetitive motion.” She still spends eight hours a day at a farm outside Facatativá owned by Flores Condor, fastening new carnation buds onto the stems of mother plants.

“I’ve stuck it out there because I have only a couple of years until I qualify for a pension,” she says. She and her husband, who have four children, are putting one of their sons through a business management program at a regional community college. Their teenage daughter is hoping to study there, too.

The global marketplace will always demand cheaper flowers, and Colombian farms must compete with growers in other nations, including neighboring Ecuador and rising flower power Kenya. Increasingly, though, there’s another factor flower growers must consider: independent flower certification programs, including Fair Trade flowers, VeriFlora and the Rainforest Alliance, which are working to certify farms in Colombia.

Such programs have been key to Colombia's business in Europe, where customers pay close attention to the source of their flowers. The U.S. trade in certified flowers is tiny by comparison—my Mother's Day bouquet bore no certification notice—but growing. "Sustainability is an attribute that consumers are seeking," says Linda Brown, creator of the certification standards for VeriFlora, which is based in Emeryville, California. "When you are looking 10 to 20 years out, sustainability will become the way that people do business."
As for David Cheever, he had an eventful ride through the revolution he started with his grad school paper. He says he and his colleagues differed and he was forced out of Floramérica in July 1971, not long after it started. "I went home and cried all afternoon," he says. But he went on to create his own success, starting carnation-propagation businesses. "I feel myself as more of a missionary than an entrepreneur," he says.
John McQuaid has written extensively on environmental issues. **Ivan Kashinsky** is a contributor to the book *Infinite Ecuador*.

Find this article at:
http://www.smithsonianmag.com/people-places/The-Secrets-Behind-Your-Flowers.html

Seeing Dubai Through a Cell Phone Camera

At a shopping mall in Dubai, Joel Sternfeld documents the peak of consumer culture with his iPhone

- By David Zax
- *Smithsonian* magazine, February 2011

For years Joel Sternfeld roamed the country with the sort of camera that rests on a tripod and usually requires the photographer to compose each shot carefully from beneath a black drape. Beginning in the late 1980s he became known for photographs that examined how Americans related to one another and to their environment—his best-known book, *American Prospects* (1987), highlighted incongruities between people and places, such as a woman sunbathing with warships in the far background, or a firefighter buying a pumpkin while a house burns. But for his most recent project, he went to Dubai and took pictures in shopping malls with an iPhone.

This new direction was, in fact, a logical extension of his work. Sternfeld, who was born in 1944 in New York City, traveled to Montreal in 2005 to photograph the 11th United Nations conference on climate change; his book *When It Changed* documented the looks on the delegates' faces as they absorbed data on the condition of the planet. He came away with the realization that solving climate change wasn't enough, because the underlying forces that have led to it, especially consumerism, would continue to deplete natural resources, though perhaps in a different way. He decided to make this basic human ravenousness his latest subject, which led him to Dubai.

The emirate is home not only to an archipelago of palm-shaped man-made islands, but also to the world's tallest building (the Burj Khalifa, 2,716 feet) and most expansive shopping-and-entertainment complex (the Dubai Mall, over 12 million square feet). A government Web site, dubaitourism.ae, touts the emirate as a

"shopper's paradise" whose "marble-walled malls and efficient air conditioning provide a cool welcome to customers." In Dubai, Sternfeld, says, "you have one megamall *right next* to another megamall."
Dubai, decided Sternfeld, was "a perfect symbolic site for a consuming world." Where his previous subjects were understated and earthy, Dubai was dazzling and outsize; similarly, where his previous photographic style was measured and careful, the Dubai project would require a style that was casual, even impulsive—like shopping itself. Art, Sternfeld believes, is at its best when there is a unity of form and content—"When you have unity, I think it squares the reach or power of the work," he says—so the idea of documenting consumerism with a consumer product was especially appealing. Thus the iPhone.
In his new book, *iDubai*, Sternfeld has published scores of these photographs: an opulent chrome sports car awaits its valet parker outside the Kempinski Hotel; a model of downtown Dubai features red "sold" flags poking from the skyscrapers. Others feature aisles of colorful packaged goods, shopping carts overflowing with toys, and tourists bent intently over their own smart phones, oblivious to the nearby stranger photographing them with his.
And yet Sternfeld says he came to feel a certain affinity. Some of the malls were "imaginative, interesting places" with a "dreamlike quality." More important, they served a vital social role as town centers, places for friends and family to gather. And he often noticed scenes of paternal love—men eating with children at the food court, or pushing a stroller into a glass elevator, or, as on the opposite page, contemplating the wonders of an indoor ski slope—an aspect of the Arabic male he felt was underrepresented in Western media.
The photographs in *iDubai* are deeply ambivalent. The perversity of modernity, from Sternfeld's point of view, is that even these moments of familial togetherness take place within a culture that is ultimately unsustainable and destructive. He has emphasized that *iDubai* is a criticism of globalized, and not Arab, consumerism; what he hopes for is a greater appreciation of what he sees as our shaky future.
David Zax, who lives in Brooklyn and covers technology for *Fast Company*, has written frequently for *Smithsonian*.

Find this article at:
http://www.smithsonianmag.com/people-places/Seeing-Dubai-Through-a-Cell-Phone-Camera.html

When Did Girls Start Wearing Pink?

Every generation brings a new definition of masculinity and femininity that manifests itself in children's dress

- By Jeanne Maglaty
- Smithsonian.com, April 08, 2011

Little Franklin Delano Roosevelt sits primly on a stool, his white skirt spread smoothly over his lap, his hands clasping a hat trimmed with a marabou feather. Shoulder-length hair and patent leather party shoes complete the ensemble.We find the look unsettling today, yet social convention of 1884, when FDR was photographed at age 2 1/2, dictated that boys wore dresses until age 6 or 7, also the time of their first haircut. Franklin's outfit was considered gender-neutral.

But nowadays people just *have to* know the sex of a baby or young child at first glance, says Jo B. Paoletti, a historian at the University of Maryland and author of *Pink and Blue: Telling the Girls From the Boys in America*, to be published later this year. Thus we see, for example, a pink headband encircling the bald head of an infant girl.

Why have young children's clothing styles changed so dramatically? How did we end up with two "teams"—boys in blue and girls in pink?

"It's really a story of what happened to neutral clothing," says Paoletti, who has explored the meaning of children's clothing for 30 years. For centuries, she says, children wore dainty white dresses up to age 6. "What was once a matter of practicality—you dress your baby in white dresses and diapers; white cotton can be bleached—became a matter of 'Oh my God, if I dress my baby in the wrong thing, they'll grow up perverted,' " Paoletti says.

The march toward gender-specific clothes was neither linear nor rapid. Pink and blue arrived, along with other pastels, as colors for babies in the mid-19th century, yet the two colors were not promoted as gender signifiers until just before World War I—and even then, it took time for popular culture to sort things out. For example, a *Ladies' Home Journal* article in June 1918 said, "The generally accepted rule is pink for the boys, and blue for the girls. The reason is that pink, being a more decided and stronger color, is more suitable for the boy, while blue, which is more delicate and dainty, is prettier for the girl." Other sources said blue was flattering for blonds, pink for brunettes; or blue was for blue-eyed babies, pink for brown-eyed babies, according to Paoletti.

In 1927, *Time* magazine printed a chart showing sex-appropriate colors for girls and boys according to leading U.S. stores. In Boston, Filene's told parents to dress boys in pink. So did Best & Co. in New York City, Halle's in Cleveland and Marshall Field in Chicago.

Today's color dictate wasn't established until the 1940s, as a result of Americans' preferences as interpreted by manufacturers and retailers. "It could have gone the other way," Paoletti says.

So the baby boomers were raised in gender-specific clothing. Boys dressed like their fathers, girls like their mothers. Girls had to wear dresses to school, though unadorned styles and tomboy play clothes were acceptable.

When the women's liberation movement arrived in the mid-1960s, with its anti-feminine, anti-fashion message, the unisex look became the rage—but completely reversed from the time of young Franklin Roosevelt. Now young girls were dressing in masculine—or at least unfeminine—styles, devoid of gender hints. Paoletti found that in the 1970s, the Sears, Roebuck catalog pictured no pink toddler clothing for two years.

"One of the ways [feminists] thought that girls were kind of lured into subservient roles as women is through clothing," says Paoletti. " 'If we dress our girls more like boys and less like frilly little girls . . . they are going to have more options and feel freer to be active.' "

John Money, a sexual identity researcher at Johns Hopkins Hospital in Baltimore, argued that gender was primarily learned through social and environmental cues. "This was one of the drivers back in the '70s of the argument that it's 'nurture not nature,' " Paoletti says.

Gender-neutral clothing remained popular until about 1985. Paoletti remembers that year distinctly because it was between the births of her children, a girl in '82 and a boy in '86. "All of a sudden it wasn't just a blue overall; it was a blue overall with a teddy bear holding a football," she says. Disposable diapers were manufactured in pink and blue.

Prenatal testing was a big reason for the change. Expectant parents learned the sex of their unborn baby and then went shopping for "girl" or "boy" merchandise. ("The more you individualize clothing, the more you can sell," Paoletti says.) The pink fad spread from sleepers and crib sheets to big-ticket items such as strollers, car seats and riding toys. Affluent parents could conceivably decorate for baby No. 1, a girl, and start all over when the next child was a boy.

Some young mothers who grew up in the 1980s deprived of pinks, lace, long hair and Barbies, Paoletti suggests, rejected the unisex look for their own daughters. "Even if they are still feminists, they are perceiving those things in a different light than the baby boomer feminists did," she says. "They think even if they want their girl to be a surgeon, there's nothing wrong if she is a very feminine surgeon."

Another important factor has been the rise of consumerism among children in recent decades. According to child development experts, children are just becoming conscious of their gender between ages 3 and 4, and they do not realize it's permanent until age 6 or 7. At the same time, however, they are the subjects of sophisticated and pervasive advertising that tends to reinforce social conventions. "So they think, for example, that what makes someone female is having long hair and a dress,'' says Paoletti. "They are so interested—and they are so adamant in their likes and dislikes."

In researching and writing her book, Paoletti says, she kept thinking about the parents of children who don't conform to gender roles: Should they dress their children to conform, or allow them to express themselves in their dress? "One thing I can say now is that I'm not real keen on the gender binary—the idea that you have very masculine and very feminine things. The loss of neutral clothing is something that people should think more about. And there is a growing demand for neutral clothing for babies and toddlers now, too."

"There is a whole community out there of parents and kids who are struggling with 'My son really doesn't want to wear boy clothes, prefers to wear girl clothes.' " She hopes one audience for her book will be people who study gender clinically. The fashion world may have divided children into pink and blue, but in the world of real individuals, not all is black and white.

Find this article at:
http://www.smithsonianmag.com/arts-culture/When-Did-Girls-Start-Wearing-Pink.html

Catching the Bamboo Train

Rural Cambodians cobbled old tank parts and scrap lumber into an ingenious way to get around

- By Russ Juskalian
- Photographs by Russ Juskalian
- *Smithsonian* magazine, January 2011

We were a few miles from the nearest village when we ran out of gas. The motor, a small thing perched on the back of a queen-size bamboo platform, spat out a few tubercular-sounding coughs and gave up. There were three of us riding this Frankenstein's pump trolley, known in Cambodia as a norry, including my interpreter and the conductor, a short, elderly man with sunbaked skin and the permanent squint of failing eyesight. The morning was wretchedly hot, and in addition to a long-sleeved shirt and pants to block the sun, I wore a hat on my head and a scarf around my face. One could stay dry when moving along, the oncoming air acting like a mighty fan. But as the norry rolled to a slow stop, sweat bloomed on the skin almost instantly.
I'd traveled across a broad stretch of Cambodia on the "bamboo train," as this form of transportation is known in English, and now I considered what getting stuck here would mean.
The old man pointed down the line and mumbled in his native Khmer. "His house is nearby," said Phichith Rithea, the 22-year-old interpreter. "He says it's about 500 meters." All I could see was heat-rippled air. Rithea pushed until he was ready to collapse, and the old man mumbled again. "He says we are nearly there," Rithea translated as I took my turn pushing. The old man told me to walk on one of the rails to avoid snakes sunning on the metal ties. I slowed down as we approached a lone wooden train car converted to a house near where the old man had pointed. "That's not it," said Rithea. My head spun with heat and exhaustion. When we reached the old man's house, we estimated that it was more than a mile from where we had broken down. The conductor filled our tank with a light-green liquid he kept in one-liter Coke bottles, and we were on our way, headed toward the capital, Phnom Penh.
If you have the time, money and inclination, you can travel almost 11,000 miles from London to Singapore exclusively by train—except in Cambodia. It wasn't always so. In the 1920s, the French started work on a railroad that would eventually run 400 miles across Cambodia in two major sections: the first from the Thai border, via Battambang, to Phnom Penh; the second from Phnom Penh to the coastal city of Sihanoukville to the south. The rail was a single line of meter-wide track, but it did the job, and people used it.
The years after French colonial rule, which ended in 1953, were characterized by instability and then civil war. In 1975, the Khmer Rouge regime evacuated Phnom Penh, reducing the city's population from more

than two million people to 10,000 in a single day. From then until the regime fell, in 1979, an estimated 1.4 million Cambodians, or about 20 percent of the total population, died from execution, starvation or overwork. A new psychology took root: say nothing unnecessary, think no original thoughts, do nothing to stand out. In other words, to demonstrate the very qualities that make us human was to consign oneself to a torture center like the notorious S-21 prison, and eventually a mass grave. The Khmer Rouge had a slogan:
To spare you is no profit, to destroy you is no loss.
From 1979 to the late 1990s, a guerrilla war burned through the country. Remnants of the Khmer Rouge mined the railroad extensively and frequently ambushed trains. An official from the Cambodian Ministry of Public Works and Transport told me that the ministry still wouldn't guarantee that the rails had been fully cleared of land mines.
I went to Cambodia last June to ride the norries, which I'd heard about on previous travels to Southeast Asia, and to get a glimpse of rural life along the way. Passenger trains hadn't run in over a year. And for quite some time before that, there had been only one train a week, taking about 16 hours to cover a route that took only five hours by bus; at speeds just faster than a jog, the train tended to break down or derail. At the train yard in Phnom Penh, I saw rows of derelict cars, some with interiors overgrown with plants, others whose floors had entirely rotted out. All that was left was the norry.
A norry is basically a breadbox-size motor on top of a bed-size bamboo platform on top of two independent sets of metal wheels—all held together by gravity. It's built from bamboo, old tank parts and motors ripped from broken motorbikes, rice harvesters and tractors. To accelerate, the driver slides the motor backward, using a stick as a lever, to create enough tension in the rubber belt to rotate the rear axle. Though no two norries are identical, a failing part can be swapped with a replacement in a few seconds. Norries are technically illegal but nonetheless vital and, if you know where to look, ubiquitous.
I started just outside Battambang, on a 170-mile-long stretch of what was once the Northern Line. The "norry station" was little more than a few teak and bamboo homes at the dusty confluence of a dirt road and a set of old rails. When Rithea and I arrived, there were chickens, dogs and children scampering about and two cops lounging in the shade, chatting with the locals. Bamboo platforms, disembodied engines and old tank wheels welded in pairs to heavy axles were stacked near the tracks.
A man sitting on the rails had a prosthetic left leg, a few gold teeth and a disarming smile. He gave his name as Sean Seurm and his age as 66. He said he was a norry driver but complained that the local travelers used his services less often these days, having been replaced by foreign tourists looking for a 20-minute jaunt into the countryside. "We have less business, and now we have to pay the police," said Seurm's wife, Phek Teorng. Shaking down a norry driver ferrying locals at 50 cents a ride had probably not been worth the trouble, but tourists pay ten times that.
Over the next hour, at least five small groups of Western backpackers arrived to ride the norry. None of the locals was forthcoming when Rithea asked about our chances of catching one to Phnum Thippadei, about 18 miles away. A man with a tattoo of Angkor Wat on his chest intimated that we had no choice but to wait for the local vegetable norry, which wouldn't leave until 4 a.m. When we came back to board it, the sky was dotted with glittering stars, the tiniest slice of crescent moon to the east, and the Milky Way's surprisingly visible Great Rift.
The vegetable norry carried us a few miles down the track to meet up with one headed to Phnum Thippadei. It was less sturdy than I had imagined, with gaps in the bamboo wide enough to jam a finger through, and the platform vibrated at just the right frequency to make my legs itch. Our driver, standing near the back, used a headlamp as a signaling device for road crossings and upcoming stations, turning the rails to silver streaks darting into the undergrowth. I was mesmerized—until a shrub smacked me in the face. When another took a small chunk out of my right sleeve, I felt like a tyro for riding too close to the edge.
As I scrambled onto the norry to Phnum Thippadei, I inhaled an almost sickly sweet scent of overripe fruit; in addition to a few Cambodian women, we were carrying cargo that included a pile of spiky jackfruit the size of watermelons. "They sell vegetables along the way," said Rithea as we rolled to a brief stop at a village. Most of the produce was dropped off, and before we pulled away, I saw nylon mats being unrolled and vegetables being set up by the rail—an impromptu market.
As the stars grew faint and the sky slowly faded to pink and yellow pastels ahead of a not-yet-risen sun, villagers lighted small gas lanterns at railside huts. At each stop, always where a dirt road intersected the rail, I heard voices droning in the distance. Rithea said they were monks chant-ing morning prayers or intoning the

mournful words of a funeral or singing Buddhist poetry. It made me think of the Muslim call to prayer, or of Joseph Conrad's Marlow awakening to a jungle incantation that "had a strange narcotic effect upon my half-awake senses."

The sun was low in the sky when we pulled into Phnum Thippadei. A few dozen people squatted by the track or sat in plastic chairs eating a breakfast of *ka tieu*, a noodle soup. After some searching, we found a norry driver named Yan Baem and his sidekick, La Vanda, who dressed like a Miami bon vivant in a patterned white shirt with a wide collar, white pants and flip-flops. They said they'd take us to Moung Roessei, about 15 miles down the line, where Rithea thought we could get a norry to Pursat.

Now that the sun was up, I could see why the going was so rough: the tracks were woefully misaligned. Most of the rail was warped into a comical squiggle, as if it had been made of plastic and then deformed by a massive hair dryer. In some places, there were breaches in the rail more than four inches wide. With nothing to distract me, I focused meditatively on the *click-CLANK-jolt, click-CLANK-jolt, click-CLANK-jolt* of the ride, barely reacting when the norry hit a particularly bad gap in the track and the platform jumped the front axle and slid down the rail with all of us still seated. After a quick inspection, Baem and Vanda reassembled the norry and pressed on, a bit slower than before.

In Moung Roessei, we met Baem's aunt, Keo Chendra, who was dressed in a floral magenta shirt and bright pink pajama pants. She insisted there were no norries going our way—but her husband, who owned a norry, would take us for a price. Rithea wanted to negotiate, but I had begun to suspect that "no norries running here" was just a way to get unsuspecting foreigners to overpay for a chartered ride and that Rithea was too polite to challenge such assertions. After all, we'd been told that no norries ran between Phnum Thippadei and Moung Roessei—and hadn't we seen a handful traveling that route?

We decided to cool off in the shade for a bit. Chendra had a food stand, so we ordered plates of *bai sach chrouk*, a marinated, grilled pork dish over broken rice. After eating, we walked to what was once a sizable train station, the old buildings now crumbling shells, pockmarked and empty. A scribbled chalkboard that once announced the comings and goings of trains floated like a ghost near a boarded-up ticket window; passing nearby, a horse-drawn buggy kicked up dust.

A bit up the track, I saw four men loading a norry with the parts of a much bigger one built out of two-by-fours. The driver told us that the big norry was used to carry lumber from Pursat to Moung Roessei, Phnum Thippadei and Battambang, but that it was cheaper to transport the big norry back to Pursat on the smaller one. He said we could join them for the roughly 50-mile trip, no charge, though I insisted we pay, $10 for the two of us.

Less than a mile out, a norry stacked high with timber came clacking at us head-on. Fortunately, norry crews have developed an etiquette for dealing with such situations: the crew from the more heavily laden norry is obliged to help disassemble the lighter one, and, after passing it, reassemble it on the track.

The whole process usually takes about a minute, since two people can carry a typical bamboo norry. But the big two-by-four platform required six of us lifting with all our strength. Aside from narrowly missing a few cows foraging around the tracks, we made it to Pursat without incident. The norry station was a busy cluster of railside huts where one could buy food, drink and basic supplies. I had planned to leave the next morning, but a bout of food poisoning—was it the bai sach chrouk?—delayed us a day.

On our second morning, a thin, shirtless young man named Nem Neang asked if I wanted a ride to Bamnak, where he would be driving a passenger norry in about 15 minutes. Just what I needed. He said there were usually ten norries a day from Pursat, and for an average day of work he would collect 30,000 to 40,000 Cambodia riel (roughly $7 to $10). But he worried that the railroad was going to be improved—the Cambodian government is working on it— and that the laws against norries might actually be enforced.

Neang's norry was crowded with 32 passengers, each of whom had paid the equivalent of 75 cents or less for the ride. At an early stop, a motorbike was brought on, and several passengers had to sit on it until more room opened up. Among this tightly packed crowd—a tangle of legs, bags and chatter—I met a Muslim woman named Khortayas, her hair covered in a floral head scarf, on her way to visit her sister in Bamnak. A merchant named Rath told me she took the norry twice each month to bring back beds to sell.

Near the town of Phumi O Spean, a small white dog started chasing the norry, trailing us relentlessly. As we slowed, the dog darted ahead, briefly running up the track as if it were our leader. The absurdity of the scene caused a minor sensation, and somebody suggested that the dog wanted a ride. Neang stopped, picked up the

pup and brought it aboard. Our new canine friend rode the rest of the way, being stroked by one or another of the passengers or standing with two paws on the driver's lap.

At Bamnak, we switched to a norry carrying concrete pipes, refined sugar, soy milk, crates of eggs and other supplies. In Kdol, we joined a young mother and her child on a norry returning from a lumber delivery. And in Romeas, we chartered a norry driven by a man who had bloodshot eyes and smelled of moonshine. The town of Bat Doeng had no guesthouse, but our norry driver's brother, a construction worker named Seik Than, lived nearby and offered to let us stay with him. He and his wife, Chhorn Vany, grilled a whole chicken for our dinner.

It was in Bat Doeng that we boarded our final norry, the one driven by the man with the bum ankle and low fuel. Having to push part of the way made the journey to Trapeang Leuk seem a lot longer than 15-odd miles. From there—basically the end of the line—we caught a *tuk-tuk*, a type of auto-rickshaw, for the five-mile ride to Phnom Penh and a hot shower in a backpackers' hotel. It felt like the height of luxury.

In the days that followed, whomever I told about the bamboo train seemed charmed by the novelty of the thing. But an English teacher from the United Kingdom whom I met at a café in Phnom Penh recognized something else.

"That's great to hear," he said.

"Why?" I asked.

"Because after what happened here, you worry about the state of the human spark. But this reassures me it's still there."

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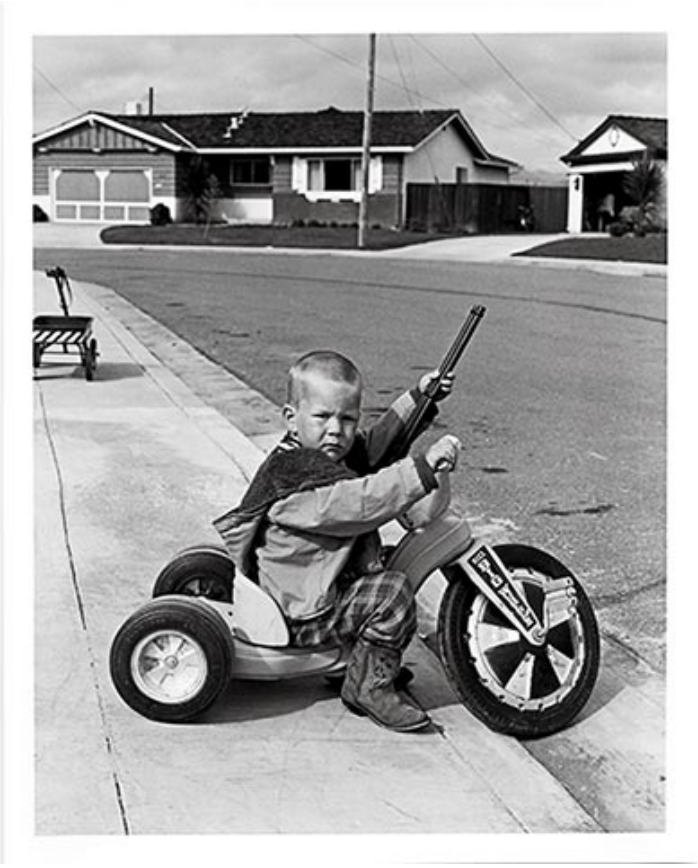
Find this article at:
http://www.smithsonianmag.com/people-places/Catching-the-Bamboo-Train.html

Shooting the American Dream in Suburbia

Bill Owens was seeking a fresh take on suburban life when he spotted a plastic-rifle-toting boy named Richie Ferguson



- By Owen Edwards
- *Smithsonian* magazine, October 2010

Bill Owens spent the late 1960s and early ’70s as a photographer for the *Livermore Independent News*, a thrice-weekly newspaper serving towns and communities east of San Francisco Bay, some of which were being swallowed by new housing developments. In those clusters of cookie-cutter tract houses, freshly painted and sodded, Owens faced a daunting task.

“I worked all week taking pictures for the newspaper, which often sent me to places where there weren’t any images,” Owens recalls. “But I still had to come back with a picture.”

Over time, Owens got to know the people in the new houses, and he discovered their devotion to the American dream—“three kids, the dog, the station wagon, the boat,” as he puts it. On weekends, he made pictures for himself—most of them portraits that reflected that dream. Or not. “I would go to houses in the East Bay where sometimes there was just no picture,” he told me. “I thought of those as ‘friend stops.’ ”

One day in 1971, he was leaving just such a stop in the town of Dublin when he spotted, in the next-door driveway, a crew-cut kid in cowboy boots riding a Big Wheel and holding a plastic rifle. He recognized the lad as 4-year-old Richie Ferguson. “The body language is just right,” Owens would later tell an interviewer, “and I didn’t pose him. I just said, ‘Richie!’—bang, took the picture—and you’re done.”

The Ferguson portrait became one of the most evocative images in *Suburbia*, a collection Owens published in 1972 to considerable acclaim. (Most recently, the picture was added to a new edition of Ken Light’s *Witness*

in Our Time: Working Lives of Documentary Photographers.) oberSoon private collectors and museums, including the Museums of Modern Art in San Francisco and New York City, were buying his work. Within the decade two sequels, *Our Kind of People* (1975) and *Working (I Do it for the Money)*(1977), followed. Owens is a "keen and sympathetic observer of the daily rituals of life amid tract homes," the *Los Angeles Times* later wrote.

His portraits were not news, but given the style and the subject matter, they were definitely new: they personalized a national aspiration and gave treeless neighborhoods the feeling of pioneer settlements. The décor might seem odd and the subjects might appear a bit disoriented, but the pictures have a relaxed intimacy that invites the viewer to look these new suburbanites in the eye, not down at them.

Owens, who is now 72, grew up on a farm in Citrus Heights, near Sacramento. Coming from the same sort of agricultural community that the new developments were devouring, he might have resented their upwardly hopeful inhabitants, but he says he didn't.

"My parents came through the Depression," he told me. "They weren't judgmental people, and I guess that was passed on to me." Plus, his influences—Lewis Hine, Dorothea Lange, Russell Lee and Arthur Rothstein, as well as Edward Steichen's landmark 1955 "Family of Man" exhibit at the Museum of Modern Art in New York—were acutely empathetic.

Owens came to photography in a roundabout way: after flunking out of Chico State College (now California State University, Chico) in 1960, he hitchhiked around the world and spent two years as a Peace Corps volunteer in Jamaica ("I needed to go somewhere where they spoke English," he says) before returning to Chico State to finish his degree in industrial arts. He then studied photography at San Francisco State College for three semesters before the *Livermore Independent News* found his name on a "seeking work" list in a local employment office.

In the 1980s, Owens gave up on photography. Or rather, he says, "pho- tography gave up on me. You can't make a living as a photographer if you live in the suburbs." He worked at odd jobs and eventually became a brewer and distiller of some note (he pioneered California's brew-pub movement) and the author of several books on beer and spirits. "I used to make beer when I was in college," he told me one recent afternoon, after

serving a glass of his own whiskey at his house in the East Bay town of Hayward. He took up picture-taking again with the advent of digital photography and after *Suburbia* was republished in 1999.

In 2000, nearly 30 years after his first portrait of Richie Ferguson, Owens made a second one of him for the *New York Times*. Ferguson, now a 43-year-old electrician, lives with his wife, Deanna, and their two children, ages 8 and 6, in Dublin, about a mile from where Owens first met him. He has graduated to a truly big wheel, a flame-painted Harley-Davidson motorcycle—a gift from Deanna. "I'd ridden dirt bikes as a kid, and when I turned 30 I guess my wife decided it was time for the real thing," he says.

Ferguson has no memory of Owens taking the now-famous portrait. "My family had an original [print of it]," he says, "but I didn't think it was a big deal. Kids don't think about those things. I guess, to me, he was just a guy taking pictures."

Now the more recent portrait hangs on gallery walls along with the original. "Bill calls me when he has an exhibition, and my wife and I always go," Ferguson says. "When people see me in the picture, they treat me like I'm famous."

Frequent contributor **Owen Edwards** is, like Bill Owens and Richie Ferguson, a resident of the San Francisco Bay Area.

Find this article at:
http://www.smithsonianmag.com/people-places/Shooting-the-American-Dream-in-Suburbia.html

Joyce Carol Oates Goes Home Again

The celebrated writer returns to the town of her birth to revisit the places that haunt her memory and her extraordinary fiction

- By Joyce Carol Oates
- Photographs by Landon Nordeman
- *Smithsonian* magazine, March 2010

Writers, particularly novelists, are linked to place. It's impossible to think of Charles Dickens and not to think of Dickens' London; impossible to think of James Joyce and not to think of Joyce's Dublin; and so with Thomas Hardy, D. H. Lawrence, Willa Cather, William Faulkner, Eudora Welty, Flannery O'Connor—each is inextricably linked to a region, as to a language-dialect of particular sharpness, vividness, idiosyncrasy. We are all regionalists in our origins, however "universal" our themes and characters, and without our cherished hometowns and childhood landscapes to nourish us, we would be like plants set in shallow soil. Our souls must take root—almost literally.

For this reason, "home" isn't a street address or a residence, or, in Robert Frost's cryptic words, the place where, "when you go there, they have to let you in"—but where you find yourself in your most haunting dreams. These may be dreams of numinous beauty, or they may be nightmares—but they are the dreams most embedded in memory, thus encoded deep in the brain: the first memories to be retained and the last memories to be surrendered.

Over the years of what seems to me both a long and a swiftly passing lifetime, "home" has been, for me, several places: Lockport, New York, where I was born and went to school, and nearby Millersport, New York, my home until the age of 18; Detroit, Michigan, where I lived with my young husband Raymond Smith, 1962-68—when he taught English at Wayne State University and I taught English at the University of Detroit; and Princeton, New Jersey, where we lived for 30 years at 9 Honey Brook Drive, while Ray edited the *Ontario Review* and Ontario Review Press books and I taught at Princeton University, until Ray's death in February 2008. Now I live a half-mile from that house in a new phase of my life, with my new husband, Charles Gross, a neuroscientist at Princeton University who is also a writer and photographer. The contemporary French provincial house in which we live on three acres fronting a small lake is "home" in the most immediate sense—this is the address to which our mail is delivered, and each of us hopes that this will be the last house of our lives; but if "home" is the repository of our deepest, most abiding and most poignant dreams, the landscape that haunts us recurringly, then "home" for me would be upstate New York—the rural crossroads of Millersport, on the Tonawanda Creek, and the city of Lockport on the Erie Canal.

As in a vivid and hallucinatory dream, I am being taken by my grandmother Blanche Woodside—my hand in hers—to the Lockport Public Library on East Avenue, Lockport. I am an eager child of 7 or 8 and this is in the mid-1940s. The library is a beautiful building like no other I've seen close up, an anomaly in this city block beside the dull red brick of the YMCA to one side and a dentist's office to the other; across the street is Lockport High School, another older, dull-brick building. The library—which, at my young age, I could not have known was a WPA-sponsored project that transformed the city of Lockport—has something of the look of a Greek temple; not only is its architecture distinctive, with elegantly ascending steps, a portico and four columns, a facade with six large, rounded, latticed windows and, on top, a kind of spire, but the building is set back from the street behind a wrought-iron fence with a gate, amid a very green jewel-like lawn.

The library for grown-ups is upstairs, beyond a dauntingly wide and high-ceilinged doorway; the library for children is more accessible, downstairs and to the right. Inside this cheery, brightly lit space there is an inexpressible smell of floor polish, library paste, books—that particular library smell that conflates, in my memory, with the classroom smell of floor polish, chalk dust, books so deeply imprinted in my memory. For even as a young child I was a lover of books and of the spaces in which, as indeed in a sacred temple, books might safely reside.

What is most striking in the children's library are the shelves and shelves of books—bookcases lining the walls—books with brightly colored spines—astonishing to a little girl whose family lives in a farmhouse in the country where books are almost wholly unknown. That these books are available for children—for a child like me—all these books!—leaves me dazed, dazzled.

The special surprise of this memorable day is that my grandmother has arranged for me to be given a library card, so that I can "withdraw" books from this library—though I'm not a resident of Lockport, nor even of Niagara County. Since my grandmother is a resident, some magical provision has been made to include me.

The Lockport Public Library has been an illumination in my life. In that dimension of the soul in which time is collapsed and the past is contemporaneous with the present, it still is. Growing up in a not-very-prosperous rural community lacking a common cultural or aesthetic tradition, in the aftermath of the Great Depression in which people like my family and relatives worked, worked and worked—and had little time for reading more than newspapers—I was mesmerized by books and by what might be called "the life of the mind": the life that was not manual labor, or housework, but seemed in its specialness to transcend these activities.

As a farm girl, even when I was quite young I had my "farm chores"—but I had time also to be alone, to explore the fields, woods and creek side. And to read.

There was no greater happiness for me than to read—children's books at first, then "young adult"—and beyond. No greater happiness than to make my way along the seemingly infinite shelves of books in the Lockport Public Library, drawing my forefinger across the spines. My grandmother was an avid reader whom all the librarians knew well, and whom they obviously liked very much; two or even three times a week she checked books out of the library—novels, biographies. I remember once asking Grandma about a book she was reading, a biography of Abraham Lincoln, and how she answered me: this was the first conversation of my life that concerned a book, and "the life of the mind"—and now, such subjects have become my life.

What we dream of, that we are.

What I most love about Lockport is its timelessness. Beyond the newer facades of Main Street—just behind the block of buildings on the northern side—is the Erie Canal: this impressive stretch of the 524-mile New York State Canal System connecting the Great Lakes with the Hudson River and traversing the breadth of the state. For residents of the area who have gone to live elsewhere, it's the canal—so deep-set in what appears to be solid rock, you can barely see it unless you come close, to lean over the railing of the wide bridge at the foot of Cottage Steet—that resurfaces in dreams: the singular height of the falling water, the steep rock walls, the gritty, melancholy smell of stone, froth, agitated water; the spectacle of the locks opening, taking in water and closing; the ever-shifting water levels bearing boats that seem miniaturized in the slow, methodical ritual-like process. "Locksborough," a contending name for the early 19th-century settlement, might have been a more accurate one, since there are numerous locks, to accommodate the especially steep incline of the land. (Lake Erie to the west is on a much higher elevation than the Hudson River, and Lockport—"Uptown" and "Lowertown"—is built on an escarpment.) Standing on the Big Bridge—"the widest bridge in the world," as it was once identified—you feel a sensation of vertigo as you peer down at, or into, the canal 50 feet below; not so overwhelming as the sensation you feel staring at the legendary falls at Niagara 20 miles to the west but haunting, unnerving and uncanny. (Think of "uncanny" in the Freudian sense—*Unheimlich*—a

sign/symptom of a deep-rooted turbulence associated with buried and unarticulated desires, wishes, fears.) In the midst of city-life, at the very noon-tide of day-life, there is the primary, primitive vein of elemental life in which human identity is vanished, as if it had never been. Falling water, turbulent water, dark frothy water churning as if it were alive—somehow, this stirs the soul, makes us uneasy on even cheery visits back home. You stare down into the canal for a long dazed minute and then turn back blinking—where?

You didn't let Joyce see, did you? Oh—Fred!

Not a thing for a little girl to see. I hope she didn't...

An early memory of being with Daddy—in Lockport—and there is a street blocked with traffic and people—one of the narrow streets that run parallel to the canal, on the farther side of downtown—and Daddy has stopped his car to get out and see what is happening—and I have gotten out too, to follow him—except I can't follow him, there are too many people—I hear shouts—I don't see what is happening—unless (somehow) I do see—for I have a vague memory of "seeing"—a blurred memory of—is it a man's body, a corpse, being hauled out of the canal?

Joyce didn't see. Joyce was nowhere near.

Yes, I'm sure!

Yet years later, I will write of this. I will write of a little girl seeing, or almost seeing, a man's body hauled from a canal. I will write of the canal set deep in the earth; I will write of the turbulence of falling water, steep rock-sides, the roiling water, unease and distress and yet at the core, childlike wonderment. And I will write—repeatedly, obsessively—of the fact that adults cannot shield their children from such sights, as adults cannot shield their children from the very fact of growing up, and losing them.

So strange!—"uncanny."

That, between the ages of 11 and 15—through sixth, seventh, eighth and ninth grades—I was a "commuter student" first at John E. Pound School on High Street, Lockport; then at North Park Junior High in the northeast section of town near Outwater Park. (Though the term "commuter student" wasn't in anyone's vocabulary at that time.) For five grades, I'd gone to a one-room schoolhouse in Millersport—then for no reason that was ever explained, to me at least, I was transferred to Lockport, seven miles to the north—a considerable distance for a child at the time.

In this era before school buses—at least in this rural corner of Erie County—such commuter students were required to wait out on the highway for Greyhound buses. Decades later I can recall the sudden sight—at a distance of perhaps a quarter-mile—of the large bus emerging out of nowhere, at the intersection of Millersport Highway with Transit Road, headed in the direction of my family home on Transit.

The bus! Not a greyhound, it seemed to me, but a large ungainly beast—a buffalo, or a bison.

For my predominant fear, for years, was that I would miss the bus, and miss school, prospects to be dreaded. And there was the daunting fact of the bus itself—Where would I sit each morning? With whom?—most of the other passengers were adults, and strangers.

Here began my "romance" with Lockport, which I experienced as a solitary individual mostly walking—walking and walking—along the streets of downtown, and along residential streets; over the wide windswept bridge above the canal at Cottage Street, and over the narrower bridge, at Pine Street; on paths above the towpath, winding through vacant overgrown lots in the vicinity of Niagara Street; and on the shaky pedestrian bridge that ran unnervingly close beside the railroad tracks crossing the canal. Many days, after school I went to my grandmother Woodside's house on Harvey Avenue, and later on Grand Street, across town; after visiting Grandma, I took a city bus downtown, or walked; to this day, I have a proclivity for walking—I love to be in motion, and I am very curious about everything and everyone I see, as I'd learned to be as a young child; and so I have felt invisible also, as a child feels herself invisible, beneath the radar of adult attention, or so it seemed to me at the time. For Lockport, which I'd previously experienced only in the company of my mother, my father or my grandmother, seemed very different to me, when I was alone. The small city—26,000 residents in the 1950s, now 22,000—became an adventure, or a series of adventures, culminating with the Greyhound bus to take me back home to Millersport.

Very few girls of 11 or 12 would be allowed today to wander alone as I did, or to take a bus as I did; to be allowed, or obliged, to wait for long headache-wracked minutes—or hours—in the dreary Lockport bus station, located near Lockport's largest employer, Harrison Radiator, a division of General Motors where my father worked as a tool and die designer for 40 years. (Why Daddy didn't drive me into Lockport in the morning and take me home in the late afternoon, I have no idea. Was his work schedule just too different

from my school schedule? There must have been some reason, but now there is no one left to ask.) What a desolate, ill-smelling place the Greyhound bus station was, especially in winter!—and winters are long, windy and bitter-cold in upstate New York; what derelict-looking individuals were to be found there, slouched in the filthy vinyl chairs waiting—or maybe not waiting—for buses. And I in their midst, a young girl with textbooks and notebook, hoping no one would speak to me, nor even look at me.

I was prone to headaches in those years. Not so severe as migraines, I think. Maybe because I strained my eyes reading, or trying to read, in that wanly lit, inhospitable waiting room, as on the jolting Greyhound bus itself.

How innocent and oblivious the 1950s seem to us now, at least so far as parental oversight of children is concerned. Where many of my Princeton friends are hyper-vigilant about their children, obsessively involved in their children's lives—driving them everywhere, calling their cellphones, providing nannies for 16-year-olds—my parents seemingly had no concern at all that I might be endangered spending so much time alone. I don't mean that my parents didn't love me, or were negligent in any way, but only that in the 1950s, there was not much awareness of the dangers; it wasn't uncommon that adolescent girls hitchhiked on roads like Transit Road—which I'd never done.

The consequence of so much unsupervised freedom was that I seem to have become precociously independent. For not only did I take the Greyhound bus into Lockport but from the bus station I walked to school; while at John E. Pound Elementary, I even walked downtown at noon, to have lunch in a restaurant on Main Street, alone. (How strange this is—wasn't there a cafeteria in the school? Couldn't I have brought a lunch packed by my mother, as I'd brought lunches in a "lunch pail" to the one-room schoolhouse?) Though I rarely eat in any restaurant alone as an adult, if I can avoid it, I loved these early restaurant excursions; there was a particular pleasure in looking at a menu, and ordering my own food. If any waitress thought it was peculiar that a girl so young was eating alone in a restaurant, it wasn't brought to my attention.

Later, in junior high, somehow it happened that I was allowed to see movies alone at the Palace Theatre after school—even double features. The Palace Theatre was one of those ornate, elegantly decorated dream-palaces first built in the 1920s; there was also, across town, the less reputable Rialto where Saturday serials were shown to hordes of screaming children. Of the prominent landmarks of Lockport, the Palace Theatre resides in my memory as a place of romance; yet romance fraught with some anxiety, for often I had to run from the theater before the second feature had ended, leaving behind its baroque splendors—gilt-framed mirrors in the lobby, crimson and gold plush, chandeliers, Oriental carpets—to rush to the bus station a block or two away, to catch the 6:15 p.m. bus marked Buffalo.

In the shadowy opulence of the Palace, as in an unpredictably unfolding dream, I fell under the spell of movies, as I'd fallen under the spell of books a few years earlier. Hollywood films—"Technicolor"—coming attractions—posters in the lobby: here was enchantment! These movies of the 1950s starring Elizabeth Taylor, Robert Taylor, Ava Gardner, Clark Gable, Robert Mitchum, Burt Lancaster, Montgomery Clift, Marlon Brando, Eva Marie Saint, Cary Grant, Marilyn Monroe—inspired me to a cinematic sort of storytelling, driven by character and plot; as a writer I would strive for the fluency, suspense and heightened drama of film, its quick cuts and leaps in time. (No doubt, every writer of my generation—of all generations since the 1920s—has fallen under the spell of film, some more evidently than others.)

From time to time, solitary men "bothered" me—came to sit near me, or tried to talk to me—quickly then I would move to another seat, hoping they wouldn't follow me. It was safest to sit near the rear of the movie house since ushers were stationed there. Once, sitting near the front, I felt an odd sensation—my foot being touched lightly—held, or pinched—as in a ghost-grip. To my astonishment I realized that a man in front of me had reached down somehow through the back of his seat to grip my foot in his fingers; I gave a little scream, and at once the man leapt to his feet and fled to an exit at the side, disappearing within seconds. An usher hurried down to ask me what was wrong and I could barely stammer an explanation, "A man—he was sitting in front of me—took hold of my *foot*."

"Your *foot*?" The usher, a boy of 18 or 20, frowned in distaste at this prospect, as I did—my *foot*! In some old *shoe*!

As there was no comprehending anything so preposterous, so totally unnatural if not silly, the moment of crisis passed—the usher returned to his post at the rear, and I returned to watching the movie.

I don't think that I have ever incorporated this random incident into any work of fiction of mine—it hovers in my memory as bizarre, and singular, and very *Lockportian*.

It is not boasted in histories of Lockport and environs that, along with such renowned past residents as William E. Miller (Republican Barry Goldwater's vice-presidential running mate in the 1964 election, in which Democrat Lyndon Johnson was overwhelmingly elected), William G. Morgan (inventor of volleyball) and more recently Dominic "Mike" Cuzzacrea (world record-holder for marathon running while flipping a pancake), the area's most "known" resident is Timothy McVeigh, our homegrown terrorist/mass-murderer. Like me, McVeigh grew up in the countryside beyond Lockport—in McVeigh's case the small village of Pendleton, where his father still resides; like me, for a while, McVeigh was bused into Lockport public schools. Like me, he would have been identified as "from the country" and very likely, like me, he was made to feel, and may have exalted in feeling, marginal, invisible.

He may have felt powerless, as a boy. He may have been watchful, a fantasist. He may have told himself, *Wait! Your turn will come*.

In a piece I wrote for the May 8, 1995, *New Yorker*, on the phenomenon of McVeigh—so cruel, crude and pitiless a terrorist that he never expressed remorse or regret for the many lives he'd taken, even when he learned that some of his victims were young children and not employees of the detested "federal government"—I observed that Lockport, well into the present, suggests a more innocent time imagined by Thornton Wilder or Edward Hopper, appropriated now by movie director David Lynch: the slightly sinister, surreal yet disarmingly "normal"-seeming atmosphere of a quintessential American town trapped in a sort of spell or enchantment. That much remains unchanged over several decades—there is the Niagara Hotel on Transit Street, for instance, already seedy and disreputable in the 1950s when I had to pass by it on my way to and from school—is a consequence not of nostalgic urban planning but of economic recession. Harrison Radiator Company has been restructured and relocated, though its sprawling buildings at Walnut Street remain, mostly vacant, renamed Harrison Place. The derelict bus station has closed, replaced by a parking lot and a commercial building; Lockport High has long since vanished, moved to a newer side of town; the stately old Niagara County Bank has been reborn as a "community college." But the Lockport Public Library remains unchanged, at least from the street—the beautiful Greek temple-facade remains, and the jewel-like green lawn; to the rear, a multimillion-dollar addition has tripled its size. Here is unexpected change in Lockport—a good change.

And there remains the canal—dug by immigrant labor, Irishmen, Poles and Germans who frequently died in the effort and were buried in the muddy banks of the canal—a waterway now placid, stately, a "tourist attraction" as it never was in its days of utility.

In America, history never dies—it's reborn as "tourism."

Postscript: October 16, 2009. As a guest of the Lockport Public Library inaugurating a lecture series in honor of a legendary Lockport resident, beloved teacher John Koplas, from whom my parents had taken night classes, I have returned to my hometown city—in fact, to the Palace Theatre! Instead of the 20 to 40 people I'd envisioned, there is an audience of more than 800 crowded into the now "historic" theater; on the marquee where once such names as Elizabeth Taylor, Clark Gable, Cary Grant were emblazoned is *Joyce Carol Oates Oct. 16*, above *Hell Rell Oct. 17*—a rapper from New York City.

Unlike the downscale Rialto, the Palace has been smartly renovated and refurbished, reborn as a theater that sometimes shows first-run films but more often is rented out to traveling productions, amateur local theater and one-time events like this evening's. Before my presentation I am brought downstairs to the "green room"—a barren corridor of dressing rooms, a furnace room, closets—how unnerving this is, to find myself behind the scenes of the Palace Theatre, the temple of dreams! And in this starkly lighted setting, so antithetical to romance, to be confronting my past—as in one of those dreams in which one's life flashes before one's eyes—Am I really here? Here—in the Palace Theatre where long ago in the 1930s, before he'd started to work at Harrison's, my father Frederic Oates was a sign painter, making posters for coming attractions?

On stage, I am greeted with enthusiastic applause. Perhaps I am perceived as one who has swum across a vast stretch of water, or climbed through an abyss.

Am I really here? Is this—possible?

Fifty years since I've left Lockport, more or less—and now for the first time I have been formally invited back to "speak"—I can't resist telling the audience that I hope this will become a custom, and that I will be invited back again in another 50 years.

Scattered laughter, murmurings. Is "Joyce Carol Oates" being funny, or—ironic?

Gently ironic, in any case. For truly I am tremendously moved and my eyes are welling with tears, and I am particularly grateful that my brother, Fred, and my sister-in-law, Nancy, are here tonight in the audience—all that's left of my immediate family.

My presentation is informal, improvised, laced with "gentle ironies"—in fact, it's this very memoir of Lockport in an early handwritten draft. The audience seems appreciative, as if they are all old friends/classmates of mine—as if I am one of them and not a visitor who will depart in the morning. More than once I'm tempted to shut my eyes and in a feat of verbal legerdemain recite the names of long-ago classmates—names as deeply imprinted in my brain as the street names of Lockport—a kind of valentine-poem, a sentimental homage to the past.

At the end of my talk, amid a wave of applause—warm, welcoming, buoyant—I am presented with a framed pen-and-ink drawing of the Lockport Public Library, by gracious Marie Bindeman, the current director of the library.

How I wish that my mother, my father and my grandmother Blanche Woodside were here with me tonight—that they were alive to share this extraordinary moment. *How proud we are of you, Joyce!*—for pride is the lifeblood of family, recompense for hardship, endurance, loss.

Unexpected questions from the audience: "Do you think that there is a teleological purpose to the universe, and do you think that there is an afterlife?" Yet more unsettling: "Do you think that you would be the writer you are today if you'd had a middle-class or wealthy background?"

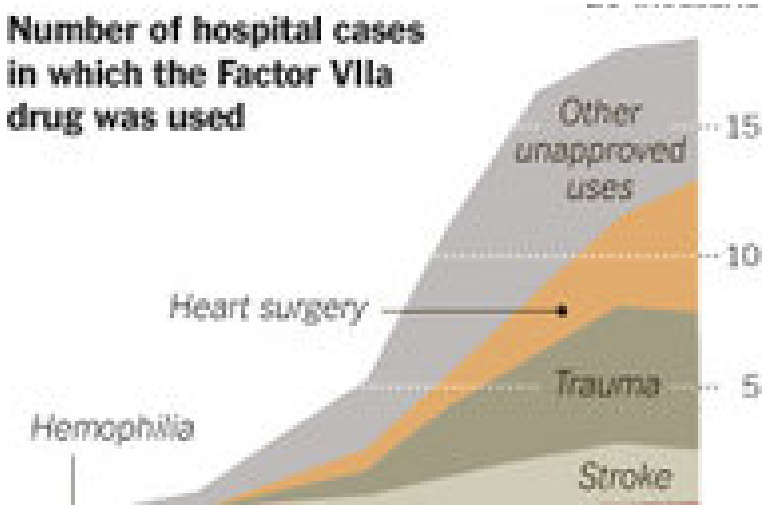
These questions, that seem to me not at all Lockportian, stop me in my tracks. Especially the second. Beyond the blinding lights, 800 people are waiting for my reply. In the exigency of the moment it seems that they really want to know, Without Millersport and Lockport—would there be "Joyce Carol Oates"?

Joyce Carol Oates' recent novel, *Little Bird of Heaven*, is set in a ficticious upstate New York town that bears a strong resemblance to the Lockport of her childhood. Photographer **Landon Nordeman** is based in New York City.

Find this article at:
http://www.smithsonianmag.com/people-places/Joyce-Carol-Oates-Goes-Home-Again.html

Drug That Stops Bleeding Shows Off-Label Dangers

By GINA KOLATA



A powerful, costly drug approved in 1999 for a small group of patients who may bleed uncontrollably during surgery is now used in a host of other surgical situations, sometimes with serious negative effects, two new studies report.

The studies present a cautionary tale, researchers say, that makes clear the pitfalls of a common medical practice — using new drugs in situations in which they have never been rigorously tested. The drug, sold as NovoSeven, was approved for people who lack a gene to make a particular blood-clotting protein called Factor VIIa and for certain people with hemophilia who can't tolerate another drug that can stop bleeding. The drug, which is Factor VIIa, is made by baby hamster kidney cells that have the gene for Factor VIIa added to them. The baby hamster cells secrete the protein into a solution containing newborn calf serum, and the protein is then extracted from that solution and purified. It takes a year to produce — most of that time, nine to 10 months, is devoted to testing the drug for purity and safety. The drug costs $10,000 a dose, but can be a lifesaver for these patients.

It is also used for other patients, according to the new studies, in The Annals of Internal Medicine. In fact, the small group for whom it was approved accounts for only 3 percent of the 18,000 times a year the drug is used in hospitals. Ninety-seven percent of the time when it is used in hospitals, it is given to patients with other reasons for bleeding, including having heart surgery or a hemorrhagic stroke, in which bleeding in the brain causes damage.

For such patients, one of the papers concluded, the drug not only fails to improve survival, it increases the likelihood of a blood clot in the heart or brain, resulting in a heart attack or the kind of stroke in which blood flow to a part of the brain is blocked. The drug is also used in trauma surgery, and in that use as well it fails to show improved survival. In trauma patients who receive the drug, however, there do not appear to be more clots than would otherwise occur.

"It's scary," said Dr. Jerry Avorn, a professor of medicine at Brigham and Women's Hospital in Boston who wrote an editorial commenting on the studies. "This is a powerful drug, and we don't fully understand it," said Dr. Veronica Yank of Stanford, an author on both papers.

In heart surgery, the researchers report, one out of every 20 people given Factor VIIa would be expected to have a serious clot in the heart or brain. When the drug is used to control bleeding in or around the brain, as in patients suffering from hemorrhagic stroke, one out of 17 patients would get a dangerous clot at the higher dose that is often used and one out of 33 would get a clot in situations where doctors used a lower dose.

The clots, said Dr. Yank, can occur anywhere in the body, obstructing blood vessels. "Some patients got more than one clot," she added.

Doctors say they give the drug because they can see an immediate effect: The bleeding stops. “It’s very dramatic,” said Dr. Mark Gladwin, chief of pulmonary and critical care medicine at the University of Pittsburgh Medical Center. And so, he added, “there is a very compelling motivation to use it.”
And the doctors who use the drug during surgery may not see a longer-term effect — clotting — which can occur days later. And they would have no way of knowing if the drug saves lives in the long run. Dr. Gladwin pointed out that doctors routinely administer drugs for unapproved uses.
Companies cannot promote drugs for such uses, but doctors are free to prescribe them. Novo Nordisk, the maker of the Factor VIIa drug, says that it does not promote unapproved uses and that it worked with the Food and Drug Administration to include warnings against such uses on the drug’s label.
As for the high cost, insurers pay for Factor VIIa as part of the general cost of treating hospitalized patients, so the drug may not be specifically identified. “Typically, the health plan would not know that it was used,” said Susan Pisano, a spokeswoman for America’s Health Insurance Plans, an industry group. Payment for Factor VIIa “would be part of a global payment,” she said.
Trauma surgeons were among the most enthusiastic early adopters of Factor VIIa, but they were also among the first to curtail use.
“I have used it, and virtually every trauma surgeon in the world who has access to it has used it,” said Dr. Ernest Moore, chief of surgery at Denver Health, an affiliate of the University of Colorado.
Many doctors got interested when they saw a paper, about a decade ago, describing an Israeli soldier who had a gunshot wound to the abdomen, got Factor VIIa, and was saved from what it seemed would have been certain death. In addition, research studies indicated that Factor VIIa was important in initiating clotting, giving credibility to the report.
As trauma surgeons began using the drug, Dr. Moore said, they had “the unforgettable experience of seeing people who were bleeding to death suddenly stop bleeding.” And, he added, “there is no question that in the right circumstances it can be a miracle treatment.”
But trauma surgeons’ unbridled enthusiasm for Factor VIIa was tempered recently when studies began to show no survival benefit.
He is using it less often now, as are many other trauma surgeons, Dr. Moore said. It is not clear that other medical specialties had a similar awakening, but some institutions, like the University of Pittsburgh Medical Center, have taken steps to control the drug’s use. The Pittsburgh hospital began requiring that doctors who wanted to use Factor VIIa get permission from a hematology consultant.
The one exception was patients who were bleeding into the brain, taking a blood thinner and about to have emergency neurosurgery. The consultants often refuse permission, said Dr. Franklin Bontempo, director of the coagulation laboratory at the University of Pittsburgh Medical Center.
Some doctors want to use it for routine bleeding in trauma patients or in patients having liver transplants. That is unnecessary, they often are told. Others call because a patient is bleeding into the lungs, coughing up blood, and the doctor is, quite understandably, worried, wanting to give Factor VIIa to make the bleeding stop. In that situation, Dr. Bontempo said, the hematologist will suggest other methods. “Often that takes care of the problem,” he said.
The lesson in the story of Factor VIIa, Dr. Yank said, is that anecdotal reports, even ones citing results as powerful as bleeding cessation, can be misleading. Using a drug for an unapproved use can be risky. A single measurement of outcomes can miss the big picture of risks and benefits. And the risk-benefit picture for the approved use may be quite different from what occurs when the drug is used in other situations
“You may be correct in assuming the drug has the same benefits,” Dr. Yank said, “but then again, you may not.”

http://www.nytimes.com/2011/04/19/health/19surgery.html?_r=1&nl=health&emc=healthupdateema2

A Beast in the Heart of Every Fighting Man

By LUKE MOGELSON

Max Becherer/Polaris
THE TEAM LEADER Staff Sgt. Calvin Gibbs, on patrol in Kandahar Province, Afghanistan, 2010

Last May, in the small village of Qualaday in western Kandahar Province, a young Army lieutenant and his sergeants met with several elders to discuss the recent killing of a local mullah. The desert heat was fierce, and the elders led the soldiers across their village to sit under the shade of nearby trees. Three days had passed since they were last there; during that interval the place appeared to have been abandoned. When they sat down, some of the soldiers removed their helmets, and a few elders their sandals and turbans. A freelance photographer was permitted to make an audio recording of the discussion. The lieutenant wanted to know where everyone had gone. One elder explained: People left because they were afraid.
"Ask them, 'Do they understand why we shot this dude?' " the lieutenant told his interpreter. During their last patrol to Qualaday, soldiers in the platoon had attacked Mullah Allah Dad with rifles and a fragmentation grenade that blew off the lower halves of his legs and badly disfigured his face. The soldiers claimed that Allah Dad was trying to throw a grenade at them. Two days after the killing, however, a company commander attended a council during which the district leader announced that people believed the incident had been staged and that the Americans had planted the grenade in order to justify a murder.
"Tell them it's important that not only the people in this village know, but the people in surrounding villages know, that this guy was shot because he took an aggressive action against coalition forces," the lieutenant told his interpreter. "We didn't just [expletive] come over and just shoot him randomly. We don't do that."

Last month, in a military courtroom at Joint Base Lewis-McChord near Tacoma, Wash., 22-year-old Jeremy Morlock confessed to participating in the premeditated murder of Mullah Allah Dad, as well as the murders of two other Afghan civilians. In exchange for his agreement to testify against four other soldiers charged in the crimes, including the supposed ringleader, Staff Sgt. Calvin Gibbs, the government reduced Morlock's mandatory life sentence to 24 years, with the possibility of parole after approximately 8. The rest of the accused, who are still awaiting trial, contest the allegations against them.

The story that has been told so far — by Morlock in his confession and by various publications that relied heavily on the more sensational accusations from interviews hastily conducted by Army special agents in Afghanistan — is a fairly straightforward one: a sociopath joined the platoon and persuaded a handful of impressionable subordinates to join him in sport killing as opportunities arose. There may indeed be truth to this, though several soldiers in the platoon give a more complicated account. Certainly it's a useful narrative, strategically and psychologically, for various parties trying to make sense of the murders — parents at a loss to explain their sons' involvement and lawyers advocating their clients' innocence and a military invested in a version of events that contains and cauterizes the problem.

On the day of Jeremy Morlock's confession, I watched as several of his friends and relatives took the stand to vouch movingly for his character and struggle to fathom how the young man they knew could have committed the crimes to which he confessed. I watched, too, as Morlock himself recounted his failed ambition to follow in the footsteps of his father, a former master sergeant who died in a boating accident not long before Morlock deployed. "If he had been alive when I went to Afghanistan," Morlock told the judge, "I know that would have made a difference. . . . I realize now that I wasn't fully prepared for the reality of war as it was being fought in Afghanistan."

Among the witnesses who testified that day was Stjepan Mestrovic, a sociologist who specializes in war crimes. Mestrovic was allowed to study an internal 500-page inquiry into the Fifth Stryker Brigade's "command climate," the purpose of which was to assess whether shortcomings in leadership might be partly to blame for the murders, and to identify any officers who should be held to account. In court, Mestrovic said he was shocked by how dysfunctional the brigade appeared to have been, and he added, "In a dysfunctional unit, we cannot predict who will be the deviant — but we can predict deviance."

I met with Mestrovic later that evening and asked him to elaborate. Before becoming involved in Morlock's case, he served as an expert witness at trials related to Abu Ghraib, the Baghdad canal killings and Operation Iron Triangle, a case with some similarities to this one, in which American soldiers in Iraq murdered three unarmed noncombatants. He excoriated the tendency of the Army — and the news media — to blame such crimes on "a few bad apples" or a "rogue platoon." Close examination of these events, Mestrovic argued, invariably reveals that the simplistic bad-actor explanation "doesn't fit the picture."

Of course, while the murders in southern Afghanistan reflect most glaringly upon the men who committed them, the need to revisit these crimes goes beyond questions of culpability and motive in one platoon. As with Abu Ghraib and Haditha and My Lai, it's hard not to consider how such acts also open a window onto the corroding conflicts themselves. This isn't to suggest that military personnel are behaving similarly throughout Afghanistan as a result of the conditions there; it is only to say that 10 years into an unconventional war whose end does not appear imminent, the murder of civilians by troops that are supposed to be defending them might reveal more than the deviance of a few young soldiers in a combat zone.

Criminal allegations aside, the return of the Fifth Stryker Brigade to Joint Base Lewis-McChord last summer would still have been a somber one. During its year in Afghanistan, 35 soldiers were killed and around 230 wounded. The toll represents one of the highest casualty rates of any brigade deployment to the war. The Fifth Brigade, with roughly 4,000 soldiers, comprised seven battalions; each battalion had about four companies, each company about four platoons. While most of these units shifted continually among the southern provinces — from Kandahar to Helmand to Zabul — Third Platoon, Bravo Company, was from the outset stationed west of Kandahar, at a forward operating base called Ramrod.

The war was not what they expected. By September 2009, two months after their arrival, the soldiers of the Third Platoon were conducting two missions a day to villages and compounds scattered throughout an area of operations many felt was too vast for them to influence. "We went to the same town every few weeks," one of the defendants, Pfc. Andrew Holmes, said through his lawyer in response to my written questions. "We did not seem to have any familiarity with the locals. The unit was always making empty promises on how often we would return. On top of that, there were I.E.D.'s everywhere." Several members of the platoon said that

the prevalence of improvised explosive devices and near absence of actual combatants engendered frustration. "A lot of guys felt gypped," another soldier told me. "All the other units have these great stories about firefights, then here we are, we're not getting anything. We had to sit there and just wait to get blown up." (Three soldiers from the Third Platoon, on condition of anonymity, were willing to discuss their deployment and the crimes with me. It should be said that the allegiances and grievances that no doubt arose during their year in Afghanistan, and that can have only worsened during subsequent investigations and legal proceedings, might very well have created biases.)

In November, one of the vehicles in a Third Platoon convoy passed over a pressure-plate bomb that exploded directly underneath its driver, Sgt. Robert Samuel, breaking several of his bones and completely severing his left leg. Within the platoon, Samuel had been an extremely popular noncommissioned officer and squad leader, particularly among the younger soldiers. "Once that happened, it was kind of a big reality check," the soldier quoted above told me. By this time, low morale had already led to widespread misconduct, and the majority of the Third Platoon (at least 15 soldiers, according to Army investigations) was getting stoned several times a week. "It's commonplace," the same soldier said; he added that no one was forced to submit to urine tests. "All the local nationals that work on the F.O.B., they all get high. All it takes is you trade them a porno mag, and they give you an ounce of hash."

Brig. Gen. Stephen Twitty, the investigating officer who, in the wake of the murders, was assigned to conduct a command-climate inquiry into the Fifth Brigade, would later find that the Third Platoon "had significantly lower standards and discipline than other units." In his report — the same one Mestrovic referred to, and which The New York Times has reviewed — Twitty writes that both the platoon leader, Lt. Roman Ligsay, and his noncommissioned counterpart, Sgt. First Class Julio Bruno, were regarded as "weak leaders, lacking confidence, self-serving, focusing on wanting to be liked by the soldiers so failing to enforce standards, and not engaged in the platoon's daily activities." The soldiers I spoke with agreed with this assessment.

Sgt. Samuel's replacement was Calvin Gibbs, a physically imposing staff sergeant from Billings, Mont. At 25, Gibbs had already served two tours — one in Iraq, one in Afghanistan — and he quickly demonstrated tactical instincts that earned him the esteem of his seniors, who often placed him in the lead. His confidence and aggression made a strong impression on the other soldiers, especially those with little combat experience. "He's the kind of guy, he would've been on the poster for GoArmy.com," one soldier told me. "He's what you want a soldier to look like, act like, speak like. He's like the epitome of soldier." Another said: "Gibbs was just a really personable guy. Easy to like, funny, in shape. He just had some sinister hobbies."

Jeremy Morlock, a corporal at the time, would later tell investigators that a week or two after joining them at Ramrod, Gibbs began talking about "some of the stuff that he had gotten away with in Iraq." As an example, Morlock said, Gibbs related having killed an Iraqi family driving in a car. (Gibbs has not been charged with any crime related to his service in Iraq. Army investigators failed to find any witnesses to this event; the medic attached to Gibbs's old platoon said in a sworn statement that he had heard that Gibbs and others had fired on a swerving vehicle one night, killing a man, woman and child.) Not long after, Morlock further claims, Gibbs "tossed out this scenario" in which it would be possible to kill an unarmed Afghan in such a way that would make it appear to have been a legitimate engagement. During the deployment, according to Morlock, Gibbs had acquired several fragmentation grenades off the books. The "scenario" would involve shooting an Afghan, detonating one of the grenades and later explaining to superiors that the explosive had been thrown by the victim.

Morlock and another soldier accused of murder, Adam Winfield, have characterized Gibbs as a sociopath who orchestrated the killings, and Winfield further claims Gibbs used his rank as a noncommissioned officer to coerce him into participating. The "kill team" moniker, instantly and unanimously adopted by the news media, comes from a leaked video interview in which Winfield tells an Army special agent that Gibbs "thought I was weak and I'm not good enough to be on his quote-unquote 'kill team.' Then he asked me if I would be in." Gibbs, from the beginning, has denied any wrongdoing.

There is an obvious incentive for Morlock and Winfield to advance this characterization. But the Third Platoon soldiers I spoke with paint a more complete picture. "Gibbs as this kind of Mansonesque kingpin is just completely out the window," one of them said. Another said that one day during the deployment, Gibbs "showed me a bunch of his devices that he was going to use for some of the staged killings he planned on carrying out, kind of pitching me scenarios on how I could jump in and be a part of it." He added: "I think at

the end of the day what it boiled down to is these guys wanted some stories to tell when they got home. They weren't getting the action they thought they deserved. So they went out and made their own action."
The novelist Tim O'Brien, a Vietnam veteran, has written that "in war you lose your sense of the definite, hence your sense of truth itself, and therefore it's safe to say that in a war story nothing is ever absolutely true." Between January and June 2010, three Afghans were killed during three Third Platoon patrols — this we know. As for what exactly happened in La'l Muhammad Kalay, Kari Kheyl and Qualaday, accounts differ. Investigations have been impeded by the inaccessibility of any victim's corpse and the logistical difficulty of traveling to each of the three villages. Consequently, proving anything with material evidence appears unlikely. Nonetheless, four young veterans face life sentences.
The purpose of the patrol to La'l Muhammad Kalay on Jan. 15 was for Lieutenant Ligsay and the company executive officer, Capt. Patrick Mitchell, to meet with village elders. While the officers convened with an elder in his private compound, the rest of the platoon fanned out to establish security. On the village's periphery, Morlock took cover behind a low mud wall, where he monitored a group of local farmers tending a poppy field. The closest soldier to him was Specialist Ryan Mallett, who had settled in behind some rubble on a nearby hillside, giving him a clear view of his platoon-mates.
During pretrial hearings in a Lewis-McChord courtroom, Mallett would later testify that he watched Morlock call to one of the farmers and motion for him to approach. When the farmer — a beardless teenager in a colorful shirt, whose name was Gul Mudin — reached a distance of 10 to 20 feet, Morlock ordered him to stop. In the written "stipulation of fact" that he confessed to in March, Morlock states that during this time a soldier named Andrew Holmes was behind the wall beside him and that the two of them explicitly agreed to implement Gibbs's "scenario" with a fragmentation grenade that Gibbs had given Morlock.
Holmes, a 20-year-old from Boise, Idaho, was Morlock's direct subordinate and one of the few privates in the platoon. He enlisted in the Army the day after he turned 18 and celebrated his 19th birthday in Afghanistan. "As a new private, Holmes was very charismatic," one soldier told me. "Not scared, didn't stutter, didn't make stupid blunders based on insecurity or overzealousness. He was a very calm, collected guy — knew what he was doing."
Holmes, who has been charged with conspiring with Morlock and Gibbs to commit murder, denies having any knowledge of Morlock's plan. He maintains that he did not join Morlock behind the wall until after Morlock stopped Mudin and that no discussion about murdering him ever took place. In court, Mallett corroborated that only when Mudin "got close" did Morlock yell for Holmes, who at that point was positioned 80 to 90 feet away. Once Holmes reached Morlock, according to Mallett's testimony, the two soldiers shared "a brief exchange," which lasted a couple of seconds, and none of which Mallett could hear. Holmes then moved to the corner of the wall and aimed his machine gun down an empty road.
Morlock says in his confession that before he dropped his grenade over the wall, he "prepped" it by removing its thumb safety, pin and spoon, and stuffed the parts in his pocket, so as not to leave any evidence that might later identify it as American. He says he then told Holmes "to get ready to fire." Mallett testified, however, that he was watching Holmes look down the empty road when he heard Morlock yell: "Grenade! Grenade! Holmes, shoot!" Holmes stood up and got off a short burst of automatic fire, Mallett said, before Morlock grabbed him by his flak-jacket and pulled him down just before the grenade detonated.
Another soldier I spoke with remembered things somewhat differently. Claiming he was on "an elevated position" about 30 feet behind Morlock, this soldier said that before Morlock called for Holmes, "Morlock was fumbling around with something in his hands. I couldn't really make out what it was at the time. He looked back over, called Holmes up to him. Once Holmes got to about maybe 10 or 15 feet from Morlock's position, as he's walking up, Morlock with his right hand kind of made a shot-put motion over the little wall. As soon as he did that, he yelled out: 'Contact! Contact! Contact!' and gave Holmes a direct order to initiate fire."
It is unclear whether Holmes's bullets hit Mudin. Mallett says he saw the rounds strike the outer wall of a nearby compound, and that Mudin was still standing during the short interlude between Holmes's gunfire and the explosion. A second soldier I spoke with, also claiming he witnessed the event, told me: "Holmes was pretty shellshocked. He obviously wasn't aware that there was a grenade."
Upon hearing the blast, the officers and the sergeants in the village elder's compound rushed downhill to the mud wall, where Morlock reported that Mudin had thrown the grenade at him and Holmes. Mudin was lying in a pool of blood; his eyes were glazed over; he did not appear to be breathing. Nevertheless, Captain

Mitchell instructed one of his staff sergeants, Kris Sprague, to "make sure he's dead," and from a short remove, Sprague shot Mudin once in the shoulder. (Mitchell claims this was not the intention of his order; he said he wanted Sprague to check the body for signs of life.)

As it happened, it was Calvin Gibbs who, along with the platoon medic Specialist Alexander Christy, entered Mudin's biometrics into the digital database used by the military to keep track of Afghan nationals. Christy would later tell Army special agents that Gibbs approached him previously and asked for a set of trauma shears, the heavy-duty scissors medics use to cut through uniforms and bootlaces. As Gibbs scanned Mudin's fingerprints and irises, according to a sworn statement Christy provided the agents, Gibbs brought out the shears, glanced around and "began to cut off the pinky finger." While Christy would end up clarifying that he had not actually seen Gibbs cut it off, agents searching F.O.B. Ramrod did discover two fingers, each wrapped in cloth, hidden near the Third Platoon's living area.

Two pictures that were taken at La'l Muhammad Kalay at the end of the patrol — one of Morlock and one of Holmes, each kneeling over Mudin's nearly stripped corpse, grabbing a fistful of hair to lift his bloodied face upward — have since been widely disseminated, drawing comparisons to Abu Ghraib and prompting the Army to denounce them as "repugnant to us as human beings." Morlock smiles widely; Holmes, cigarette in hand, appears uneasy. "He was ordered to be in the picture," one of the soldiers who witnessed the killing told me. I asked him why. "We're infantry," he said. "Obviously, you want to get in combat. If someone tries to kill you, you're supposed to kill them back. It's called a 'made man.' You pulled your weight. That's why Holmes was told to get in the picture."

In a 2006 mental-health survey, 55 percent of marines and 40 percent of soldiers serving in Iraq said they would report the injuring or killing of an innocent noncombatant, and about 10 percent admitted they had mistreated civilians themselves, either by destroying their private property or physically assaulting them. "This survey should spur reflection on our conduct in combat," Gen. David H. Petraeus said in a letter to the troops. "We are, indeed, warriors. We train to kill our enemies. . . . What sets us apart from our enemies in this fight, however, is how we behave." The following year, the number of soldiers who reported having mistreated civilians grew; subsequent surveys omitted "items that could potentially be incriminating," according to the colonel who led them, and didn't include any questions about unethical behavior.

A number of soldiers in the Third Platoon seem to have been vaguely aware of the possibility of foul play in the killing of Gul Mudin. But the ubiquitous portrayal of a "kill team" murdering with impunity might be exaggerated. "Probably about a month afterward," one of the soldiers told me, "the majority of the platoon had figured out one way or another what had really happened." Most disapproved — Holmes, some say, especially. "He was really rocked," another soldier said. "He was terrified by the notion that this had been orchestrated and he'd essentially been used."

Even those who condemned the murder, and the prospect of future ones, chose not to alert their superiors. "See no evil, hear no evil: that's the mentality," said the soldier quoted directly above. "It's a horrible mind-set, I understand that. It's not going to translate well in the media. But we just didn't care. There's no excuse for it. . . . But that was Afghanistan. If it happened, you're like: 'Hmm, how 'bout that? That's [expletive] crazy.' You give your opinion — either that's stupid or that's not stupid — and then you go back to the gym, or you go get yourself some damn food, or you watch TV on your laptop."

A month after Mudin was killed, one member of the Third Platoon did try to blow the whistle. As a high-schooler in Cape Coral, Fla., Specialist Adam Winfield was an avid consumer of American history. When he was 17, he brought a recruiter home; eventually, he obtained his parents' consent to join the Army, which he did as an infantryman, despite scoring high enough on his entry exam to qualify for any number of less-hazardous specialties. He completed his first four-year contract right after his unit was mobilized for its deployment, then opted to re-enlist. He wanted to become an officer and was accepted into Washington State University. While home on leave in late October, Winfield filled out enrollment paperwork, intending to begin classes at the end of his tour.

By the time Winfield returned to F.O.B. Ramrod from his furlough, Staff Sergeant Gibbs had joined the platoon. Winfield's father, Christopher, a former Marine, says his son's correspondence became noticeably apprehensive, "like he was in a dark place, like he was depressed." Then, on Feb. 14, Winfield wrote his father a Facebook message that included the following: "There are people in my platoon . . . can get away with 'murder' and they get nothing but praise from squad leaders. Then a rumor floated around the platoon

that I was going to rat out said individuals for what they have done. Now I'm at a crossroads. Should I do the right thing and put myself in danger for it? Or just shut up and deal with it because I'm a quitter?"
Later that night, Christopher Winfield was able to connect with his son on instant messenger, at which point Adam told him about the death of Gul Mudin, and added: "Pretty much the whole platoon knows about it, it's O.K. with all of them pretty much. Except me. I want to do something about it. The only problem is I don't feel safe here telling anyone."
Winfield asked his father to contact the Army inspector general and tell him what happened. Christopher says he called the 24-hour hotline and left a message. He called the Florida senator Bill Nelson and left a message. (Nelson's office denies receiving the call.) He called the headquarters for Army Criminal Investigation Command and left a message. He called the operator at Lewis-McChord and left a message. He called the chaplain's office and left a message. Finally, with his son still online, he got through to the base's Installation Operations Center, where the NCO on duty, Staff Sgt. James Beck, heard him out, commiserated with his situation and regretted that there was little he could do. While Christopher was still on the phone, Adam messaged him, "I have proof that they are planning another one in the form of an AK-47 they want to drop on a guy." Christopher says he relayed this information to Beck, who suggested he advise Adam to direct his allegations to his chain of command.
A recent Army investigation into its response to Christopher Winfield's allegations, reviewed by The Times, reveals that Beck did not tell anyone else about the call; neither did he enter it into the Operation Center's daily staff duty log. "It is clear that SSG Beck exhibited an egregious error in judgment," the investigating officer summarizes. None of the other authorities Christopher left messages with called him back, and his conclusion was that Adam was on his own. He told his son to lie low and try to stay away from Gibbs.
On Feb. 22, one week after Christopher Winfield spoke with Beck, the Third Platoon visited the village of Kari Kheyl. The objective of the day's mission, Operation Kodak Moment, was to photograph every resident and document where they lived. While Lieutenant Ligsay consulted with elders, Morlock says in his written confession that he and Gibbs encountered a villager and agreed to implement one of their scenarios using an AK-47 that Gibbs had brought along in his assault pack. Morlock also claims that they enlisted a third soldier, Specialist Michael Wagnon II, who now also faces murder charges.
At 29, Wagnon was older than most in the platoon. He generally kept to himself and is one of the few junior enlisted soldiers not implicated in any drug use. He was also one of the platoon's only junior enlisted men to have been deployed before, with two tours in Iraq. Those who served with him have invariably called Wagnon "a good soldier," "honest" and "a family man." (It has been reported elsewhere that Wagnon kept as a trophy a skull fragment from another Afghan civilian. During pretrial hearings, however, witnesses testified that what Wagnon had was probably a piece of jawbone from a camel that was killed by an I.E.D.)
In his written confession, Morlock says that Gibbs asked him and Wagnon whether they were willing to participate in murdering the villager, and Wagnon replied: "This isn't my first rodeo. I'm in." He says that he and Wagnon covered the man, whose name was Marach Agha, while Gibbs brought out the AK-47, fired several rounds into the wall of the compound and then used his own rifle to shoot Agha repeatedly, discarding the AK-47 on the ground near where he fell. Morlock says that at this point, he and Wagnon fired their weapons in the dead man's general direction. "This part was Gibbs's entire plan, and makes the story more concrete and more believable," Morlock explained to special agents last May. "And lets Gibbs know that we were on board and not a threat to him."
Wagnon and his lawyer say that not only was Wagnon unaware of any conspiracy to commit a crime, he wasn't even near Gibbs when he shot Agha. As with the event at La'l Muhammad Kalay, the only third-party witness to take the stand during pretrial hearings was Specialist Ryan Mallett, and the testimony he provided seems indeed to corroborate Wagnon's claim. In court, Mallett said that he was 65 to 100 feet away from Wagnon when the distinct sound of AK-47 fire came from the opposite side of a compound.
One soldier I spoke with who did not testify also told me that Wagnon was not with Gibbs or Morlock when the shooting started. "There's any number of people that were around him," the soldier said. "But everybody's terrified — you know, the sensationalism and being told not to talk about anything." He added: "Morlock was far, far behind Wagnon. Anyone can attest, he was never near him. They didn't have any conversation or anything like that. And Gibbs most certainly didn't have any conversation with Wagnon, or was around him in that vicinity."

Upon hearing shots, Mallett and the other soldier say, Wagnon turned and ran down an alley, toward the gunfire. Wagnon's lawyer allows that his client, assuming the victim was an enemy combatant, did fire his weapon when he reached the scene. "I found that Gibbs was exposed and was firing," Wagnon, who was in military confinement for ten months, said in response to written questions. "When I came around the corner, I saw Gibbs's burst. When I saw the Afghan man, he was either falling or trying to get up, and his hand was reaching for the AK-47." To the question "What was going through your mind?" Wagnon responded, "That the Afghan man was trying to kill my squad leader and that Staff Sergeant Gibbs was in danger."

Once again, Staff Sgt. Kris Sprague hurried to the action with Lieutenant Ligsay. This time they found Agha lying next to the AK-47, still breathing. Gibbs told them that Agha shot at him but that his weapon jammed, enabling Gibbs to return fire. About a minute later, Agha died. Lieutenant Ligsay moved the body to the center of the village, where Agha's cousin and father-in-law identified him. When Ligsay asked why Agha would want to attack Americans, the men answered that he was a religious man who did not know how to shoot an AK-47. "I repeatedly asked them both why he would have a weapon," Ligsay later told Army special agents. "We showed them the AK-47, and they did not know where he got it from."

One of the earliest investigations into U.S. war crimes took place in 1902, when a Senate committee agreed to examine mounting allegations of misconduct in the Philippine-American War. The conflict cost the lives of hundreds of thousands of civilians, and though many of these deaths were from disease, veterans testified at Congressional hearings about rampant brutality by American soldiers. Years later, the ongoing violence in the Philippines would inspire a young George C. Marshall, on his first assignment fresh out of military school, to tell a fellow officer: "Once an army is involved in war, there is a beast in every fighting man which begins tugging at its chains. And a good officer must learn early on how to keep the beast under control, both in his men and himself."

After interviewing 80 witnesses for his command-climate inquiry, General Twitty recommended that Roman Ligsay — who after the deployment was promoted to captain — and his enlisted counterpart, Sgt. First Class Julio Bruno, both receive letters of reprimand (Ligsay for an excessive-force incident that did not result in criminal charges, and Bruno for failing to enforce standards in the platoon), and that Capt. Matthew Quiggle, their immediate superior, receive two letters of concern, a milder action. Lt. Gen. Curtis Scaparrotti, who appointed Twitty, also recommended a letter of admonition, which falls between "reprimand" and "concern," for Col. Harry D. Tunnell IV, the former commander of the Fifth Brigade.

In explaining his recommendations, Twitty returns more than once to the difference between causing criminal behavior and failing to prevent it. "While the alleged criminal acts may have been identified earlier or perhaps prevented with stronger leader presence," he writes, "I found nothing to indicate that the alleged criminal acts occurred as a result of the command climate set by the leaders above them." No one in a leadership position, from Tunnell down to Ligsay, is responsible for the crimes of the Third Platoon, according to Twitty. At the same time, under different leadership, the crimes might never have happened.

Twitty acknowledges that "the platoon's standards and discipline were so alarming that one might question how the company and battalion levels of command did not know of many of the incidents that occurred within the platoon." But he then goes on to explain, "Upon further investigation, one would find that many of the incidents were not reported above platoon level."

To some, this may sound like a whitewash. Indeed, the plausible deniability of the field-grade officer is an American military tradition that dates back at least to Vietnam. But Twitty's investigation makes no attempt to minimize the role of Colonel Tunnell, the brigade commander.

Even before deploying to Afghanistan, Tunnell had acquired a reputation as a controversial leader and had been sharply criticized by several colonels and generals for championing aggressive tactics that are now out of sync with current Army doctrine. Army Times and The Washington Post both published articles questioning Tunnell's leadership long before General Twitty conducted his investigation.

In March 2003, Tunnell commanded an airborne infantry battalion that dropped into northern Iraq and commenced a year of hard fighting in and around Kirkuk. In October, when his patrol was ambushed, Tunnell was shot in the leg and had to be airlifted to Germany. While convalescing in the U.S., Tunnell wrote a paper about his tour in Iraq that concluded, "It is virtually impossible to convince any committed terrorist who hates America to change his or her point of view — they simply must be attacked relentlessly." A few years later, Tunnell was assigned to review a draft of a new Army field manual premised on a philosophy antithetical to his own. The manual — "Counterinsurgency," by Gen. David Petraeus and Gen. James F. Amos — was

published in December 2006 and has since radically altered how the American military operates in Iraq and Afghanistan. The following spring, Tunnell assumed command of what was then the newly created Fifth Stryker Brigade at Joint Base Lewis-McChord.

Neither Twitty nor anyone else has accused Tunnell of illegal activity. In his own written statement to Twitty, Tunnell is remarkably frank about his disdain for counterinsurgency (COIN). His primary objection to the doctrine is that it cannot be effectively implemented because U.S. Army forces "are not organized, trained or equipped" to carry out the peaceful development work that counterinsurgency demands of them. He also argues that Americans are not "culturally suited" for such work.

According to Twitty, Tunnell's fervent repudiation of counterinsurgency in Afghanistan created "frustration and confusion" among lower-level commanders, who believed his orders contradicted the fundamental strategy of the war. One lieutenant colonel writes in the statement he submitted for Twitty's report: "Stories of his negative reactions to this generally accepted truth about how the Army operated were legend. . . . We knew instinctively that we would have to do some of the things that Colonel Tunnell didn't want to see — such as work to improve local government institutions — so we set about preparing to do so in semisecret." Because lower-ranking officers adhered to counterinsurgency independently, Twitty concludes, the bellicose philosophy espoused by Tunnell was never actually put into practice. The general finds that "at the platoon level and below, Colonel Tunnell's . . . philosophy had minimal impact on the soldiers." However poorly Colonel Tunnell led the Fifth Brigade, however dysfunctional its command climate might have been as a result, and however vocally he prioritized killing over counterinsurgency, there can be "no causal relation," according to Twitty, between these failures and faults and anything an individual soldier might or might not have done.

Mestrovic, the war-crimes expert who testified at Morlock's court-martial, adamantly disagrees. He argues that the ramifications of Tunnell's leadership would have been complicated, subtle and far-reaching. Mestrovic rejects the notion that members of the Third Platoon would have been unaffected by Tunnell's views. "For a society to be functional, the beliefs and norms must have synchronicity," Mestrovic explained to me. "Tunnell was out of sync with the general norm. To put that in practical terms, people like Jeremy [Morlock], on the very bottom of the food chain, would think things like, Anybody who believes in COIN is just a [vulgarity]. And they *admired* Tunnell. To this day, Jeremy admires Tunnell."

Specialist Adam Winfield's parents say that after Kari Kehyl, their son sank into a severe depression. Rumors that he was considering snitching, according to the Winfields, led to his being ostracized by the rest of the platoon. A key element of Winfield's defense is that Gibbs relentlessly threatened and antagonized him. Gibbs denies threatening Winfield, and the three soldiers I spoke with all say that allegations of intimidation are unfounded. Other soldiers told investigators that Winfield had indeed been threatened, and Christopher Winfield told me that by March, "Adam was at such a point mentality-wise that he was hoping he would step on a mine. He was hoping he'd get blown up and just end this mess."

On May 2, during the mission to the small village of Qualaday, Winfield was told he would be going in with Gibbs. While First Lt. Stefan Moye met with a local resident, Gibbs led a team on a search of the surrounding area. (By this time, Ligsay had been transferred to a staff position at headquarters.) Shortly after separating from the rest of the platoon, Winfield and Morlock both claim, they found an unarmed man inside a compound. Gibbs asked them if they wanted to kill him, and they agreed.

The man, Mullah Allah Dad, was brought outside, where, Winfield told investigators, "Sergeant Gibbs said: 'Just put him down in that ditch right there. Put him on his knees.' " Winfield and Morlock both claim that after Allah Dad was lowered to his knees, they took cover behind a sand berm about 15 feet away. Winfield and Morlock say Gibbs activated an American fragmentation grenade and tossed it at Allah Dad's feet. In his confession, Morlock says that as he did so, Gibbs yelled: "Kill him! Kill him!" During his initial questioning, Winfield remembered Morlock giving the order to shoot before the grenade detonated.

Morlock and Winfield both admit firing their rifles. Winfield, whose lawyer now claims he deliberately aimed high, told Army special agents: "I took a man from his family. I don't know if it was my bullets that killed him or the grenade that killed him. But I was a part of it." Christopher Winfield, who has had many conversations with his son about this moment, told me: "Fear set in for him. He said he was having a huge anxiety attack. He couldn't feel his fingers. He couldn't feel his feet. He panicked . . . almost passed out." Christopher said that for a moment, while trying to decide what to do, his son even considered shooting Gibbs.

Winfield and Morlock both say that after the explosion, Gibbs walked up to Allah Dad and shot him in the head. Morlock says he himself then ran over and planted a Russian-style grenade next to Allah Dad. According to Winfield, it was Gibbs who planted the grenade.

The platoon medic later described finding "an elderly man facedown with both of his legs almost completely amputated, his jaw crushed and several gunshot wounds." He also told investigators that he watched Gibbs pull one of Allah Dad's teeth, using his fingers. "It kind of just peeled out, because his face was so messed up."

Minutes after the explosion, Allah Dad's wife appeared and became hysterical. "I've never seen anybody in my life more upset than her," the soldier who was ordered to keep her away from the body told me. "It looked like the worst thing ever in the world had just happened to her a thousand times over. She was screaming, crying. She had a baby 2-year-old kid. She was holding it, and then her son, who was maybe not even 5, was in tow behind her. I had to move her. She kept trying to come back. I escorted her about 75 meters away, and she just walked off."

Later, Adam Winfield said during his videotaped interview, Gibbs told him he was a made man.

In 1971, when Lt. William Calley Jr., who had led his platoon in the massacre of hundreds of unarmed civilians, including women, children and the elderly in the Vietnamese village of My Lai, was found guilty of premeditated murder and sentenced to life in prison, public outrage erupted across the country. Thousands of telegrams advocating clemency were sent to the White House, mass protests were held nationwide, a popular folk song was written and Georgia's governor, Jimmy Carter, instituted American Fighting Man's Day in solidarity with the convicted war criminal. President Nixon immediately ordered Calley released to house arrest, just three and a half years of which he would serve before being freed entirely by a federal judge. Aubrey Daniel, the Army lawyer who prosecuted Calley, and who wrote a letter of protest rebuking Nixon for his involvement, would later say of the reaction: "It was a country that wanted this war to end and a country that didn't want to believe that this had happened. But if it did, it wanted to say that it's our fault collectively, and not his fault."

Such a sense of collective responsibility does not seem to be shared by the generation that has grown up with the wars in Iraq and Afghanistan, and that has read about such wartime atrocities as the gang rape, murder and immolation of a 14-year-old girl near al-Mahmudiyah, Iraq; the killing of women and children in Haditha; the abuse of prisoners at Abu Ghraib; and the executions of Iraqis in a Baghdad canal and of the three men in the Iron Triangle. Indeed, it's hard to imagine any significant mobilization of support for the American soldiers and marines charged with these crimes, much less a public outcry that would persuade elected officials to intervene on their behalf.

If we lack a sense of collective responsibility for these more recent war crimes, Mestrovic blames this on our readiness to believe that such occasional iniquities are aberrations perpetrated by a derelict few, rather than the inevitable result of institutional failures and, more generally, the nature of the conflicts in which we are engaged. It is much easier to accept the assessment of the officer who told General Twitty that the Fifth Brigade had "absolutely the worst command climate I have ever operated under" but that nonetheless "nothing about the unit climate led to the killings . . . that was simply the work of a sociopath."

Whether or not it's appropriate to hold Tunnell in some way accountable for the crimes supposedly committed by Gibbs, there are parallels between them. Both fought in northern Iraq in the early part of the invasion, and both seem to have brought those experiences with them, years later, when they were sent to a very different kind of war. (Tunnell's critics have pointed out that Gibbs was assigned to Tunnell's security detachment before joining the Third Platoon.) Another colonel wrote in his statement to General Twitty that Tunnell told him that "he was after revenge for being shot in the leg while serving in Iraq" and that he kept the metal rod from his leg on his desk to "use it as an illustration." If the violence in Kirkuk in 2003 instilled in the mature, highly educated Tunnell a desire for vengeance and reservations about the guidance from his own chain of command, what might it have done to Calvin Gibbs, then a 19-year-old machine-gunner fighting in the same city?

Stephen N. Xenakis, a retired brigadier general and a former senior adviser to the Defense Department, told me that while extensive research has been done on the psychological effects of deployments for veterans trying to reintegrate into society, the Army has so far failed to examine how those same effects influence soldiers when they return to war. "What's it like for the guy who's now on his fourth combat tour, and how

effective is he?" Xenakis asked me. "And does he have other problems? I don't know that the system, either from the leadership standpoint — the combat-effectiveness standpoint — or the medical side, is asking that."
Studies show that over the course of our military history, American soldiers have become increasingly more willing to kill. In World War II, just 15 to 20 percent of infantrymen actually fired their rifles at the enemy during battles; in Korea that number increased to 55 percent; in Vietnam it reached 90. Retired Lt. Col. Dave Grossman, author of the book "On Killing," attributes the trend to changes in military training. The "methods that increased the firing rate from 15 percent to 90 percent," Grossman writes, "are referred to as 'programming' or 'conditioning' " intended to address — or redress — "the simple and demonstrable fact that there is within most men an intense resistance to killing their fellow man."
Xenakis perceives a disconnect between this type of training and the less violent aspirations of counterinsurgency. He says the doctrine is "a great theoretical idea" but that the training of the soldiers who are expected to implement it — infantrymen — has not caught up. "And I think it hasn't caught up to understanding the mind-set of these young kids," Xenakis added. "I even see it when I sit down with the squad leaders and the platoon sergeants. They're in the war-fighter mentality. They're gung-ho. They've got to have combat skills, there's no doubt about it. It's what's going to save them. But I don't think it's set up in a way that also teaches them what they have to know for the COIN doctrine."
Military lawyers say that legal actions for supposed crimes in Iraq and Afghanistan spiked after Abu Ghraib. Commanders, wary of being accused of turning a blind eye to misconduct, became far more likely to recommend investigations; investigators, subject to similar concerns, became far more likely to recommend criminal charges. In some cases, defense lawyers say, such a climate resulted in overzealous prosecutions of honorable men doing the best they could in unconventional, complicated wars.
At the same time, it seems safe to say, cases like the pending courts-martial at Joint Base Lewis-McChord afford only glimpses of the horrors those wars can sometimes occasion.
Among the dozens of sworn statements in General Twitty's report, one includes additional allegations that were never investigated, never prosecuted, never the subject of national magazine articles and the evening news. The statement of Maj. Ryan O'Connor, an officer in a battalion in the Fifth Brigade, stationed far away from Ramrod and Sergeant Gibbs, appears toward the end of Twitty's report. It is never elaborated on, and its reliability is impossible to ascertain. "Around April 2010," O'Connor writes in an abrupt departure from the matter at hand, "two different platoons . . . had direct fire contact which appeared to both the S3 and me to need further investigation." O'Connor describes one incident in which an Afghan suspected of being a triggerman was shot while running from the scene of an I.E.D. explosion. "There was no cellphone or weapons found on the killed individual," O'Connor writes, and he recommended that the battalion commander open an investigation. The commander declined, saying he had reviewed the reports and found it unnecessary.
A few days later, soldiers from another platoon shot and killed three more men. In their report, the soldiers claimed that they had been fired upon and had later discovered weapons, ammunition and I.E.D. parts. The I.E.D. parts turned out to be "some old AA batteries and a couple strands of electronic wire. The ammunition was old, discarded brass. These items amounted to no more than the average Afghan pocket litter," O'Connor writes. More troubling, photos of the bodies appeared to him to indicate that two of the men took bullets to the head while the third was shot in the back. "The scenario that jumped immediately into my head was 2x simultaneous head shots, and the third guy took off running and so the shooting had to catch up to him."
O'Connor also found "inconsistencies" in the various reports describing the incident. "Something was not right," he says.
Once again, O'Connor and his fellow officer took their concerns to their commander, "insisting that he initiate an investigation." The commander's superior instructed him to conduct an inquiry in-house, without alerting any authorities outside the unit. O'Connor says he and the officer exhorted the battalion commander to request an investigator, and that still the commander refused. "He said he did not want anyone from outside . . . coming here and poking around," O'Connor writes, "because they don't understand . . . and they won't have any idea or context for 'the kind of fight we've had here.' "
When he came home on leave last April, a few weeks before becoming the subject of an investigation, Andrew Holmes alarmed his mother, Dana, by giving away all of his belongings, including his most prized possession: a set of custom-made golf clubs he'd saved up to buy himself in high school. Dana says he was convinced he would be killed. Now Holmes's family members try to see him once a month at Lewis-

McChord, where he has been detained since his return from Afghanistan. On a recent visit, Dana says, her son told her that his time in pretrial confinement has made him "grateful that he came back, at least." She says, "He said he'd rather be judged by eight than carried by six."

While Jeremy Morlock was home on leave at the same time, his girlfriend became pregnant, and they now have a 5-month-old girl.

Adam Winfield's lawyer reports Winfield is having suicidal thoughts. "He's not the same kid," Christopher Winfield told me recently. "He's my son, but he's not the same kid that left."

Recently Michael Wagnon was released from pretrial confinement. He must wear an ankle monitor, but he will be able to live with his wife and three children.

As for the families of the three slain men in Afghanistan — Gul Mudin, Mullah Allah Dad and Marach Agha — they reportedly each received $11,300.

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http://www.nytimes.com/2011/05/01/magazine/mag-01KillTeam-t.html?ref=magazine

First an Outcast, Then an Inspiration
By CELIA McGEE

Courtesy of Reginald and Aliya Browne

IN the fall of 1932, fresh out of high school, Elizabeth Catlett showed up at the School of Fine and Applied Arts of the Carnegie Institute of Technology in Pittsburgh, having been awarded a prestigious full scholarship there. But she was turned away when it was discovered that she was "colored," and she returned home to Washington to attend Howard University.

Seventy-six years later, the institution that had rejected her, now Carnegie Mellon University, awarded her an honorary doctorate in recognition of a lifetime's work as a sculptor and printmaker. By then, after decades of living and making art in Mexico, she had become a legendary figure to many in the art world, to the point where some were even surprised to learn she was still alive.

But not everyone, and certainly not the far younger, primarily African-American artists included along with her in the show "Stargazers: Elizabeth Catlett in Conversation With 21 Contemporary Artists," on view now at the Bronx Museum of Art. "A lot of people like her are just kind of myths," said Hank Willis Thomas, whose gold-chain and cubic zirconia nod to both the abolitionists of the 19th century and to rappers, "Ode to CMB: Am I Not a Man and a Brother," is in the show and shares with much of Ms. Catlett's work a concern with the history of slavery and "the black body as commodity," he said. "A lot of her work," he added, "especially from the '60s and '70s, could pass as art of today."

Ms. Catlett, now 96, is known for her work's deep engagement with social issues and the politics of gender, race and deprivation. She started down this road during the Depression, when she participated in the Federal Art Project, and followed it consistently into the era of the activist Black Arts movement in the '60s and beyond. Which is not to say she has focused on message at the expense of form: she prepared for her M.F.A. under Grant Wood at the University of Iowa ("he was so kind," she recalled recently, and he always addressed her as "Miss Catlett") and also studied in New York with the Modernist sculptor Ossip Zadkine and at the Art Students League, developing her own brand of figurative modernism in bronze, stone, wood, drawings and prints.

Though that style has often been compared to Henry Moore's, her work has always been grounded in her perspective as a black woman and artist, ruminating on communal struggle, pride, resistance, resilience and history, particularly through her depictions of the female form.

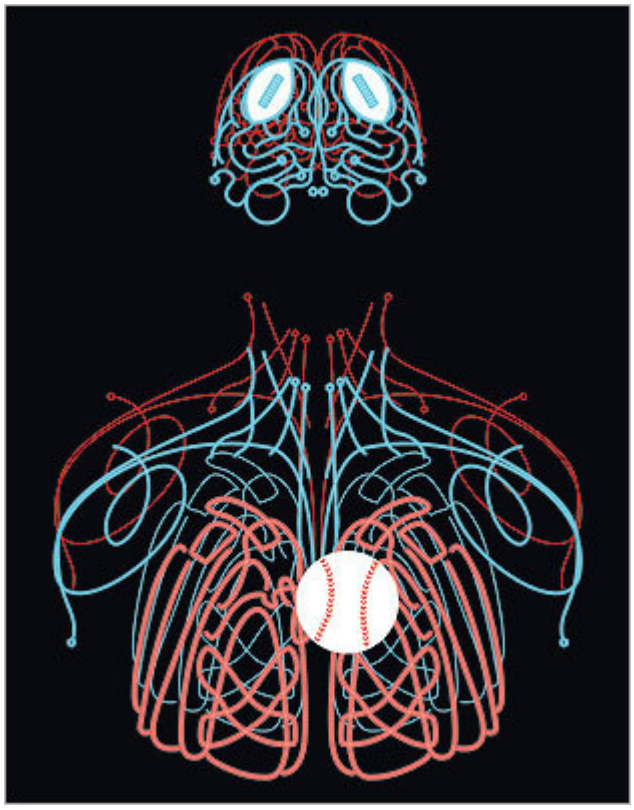
The curator of the Bronx Museum show, Isolde Brielmaier, has juxtaposed 31 of Ms. Cattlet's works with pieces by 21 other artists — less to point out her direct influences on them, Ms. Brielmaier said, than to

explore resonances between the older artist and the younger ones. The idea, she added, was to make the show about "what all the artists are thinking, and to look at the past and the future."
Ms. Catlett herself, who is back in New York this week for a panel discussion about "Stargazers" at the museum on Friday, demurs about her influence on later generations. (She is, however, clear about the most important advice she can offer an artist, she said during her previous visit to the city, in the fall: "Never turn down a show, no matter where it is.") She has lived much of her life, after all, on the margins of an art history she and other artists of color were not invited to help write for a very long time.
In 1947, while on a fellowship in Mexico, she married the artist Francisco Mora, whom she had met through the Taller de Gráfica Popular printmaking collective. Their left-wing political associations did not endear her to the State Department, which declared her an undesirable alien when she took Mexican citizenship in 1962. This, on top of Ms. Cattlet's race, contributed to her relative obscurity in the mainstream American art world.
The photographer Carrie Mae Weems, a generation older than most of the other artists in "Stargazers," recalled encountering Ms. Catlett "through reading on my own," in the late 1960s. "She wasn't taught to me in class, as most black artists were not taught to me in class, and most women artists."
The show gets its title from Ms. Catlett's black-marble "Stargazer" (2007), a reclining female figure that manages to feel just as powerfully assertive as her standing red-cedar sculpture "Homage to My Young Black Sisters" of 1968, with its black-power salute. The reversal of the traditional passivity of the odalisque figure, said the Moroccan-born artist Lalla Essaydi, who upends the convention in her own work, "is definitely something I quote." And Ms. Catlett's more militantly upright sculptures seem to reappear in Sanford Biggers' monumental woodcut "Afro Pick" (2005), and in Roberto Visani's recycling of guns and other weapons into works that are street-wise, loaded with history and totemic.
In keeping with Ms. Brielmaier's aim for the show, the impact is not always a matter of visible influence. Mickalene Thomas, for example, said her intricately bedizened paintings and pattern-happy photographs do not draw on Ms. Catlett's work in any obvious way, but that "she's been very inspirational."
"I like how her draftsmanship and sculpting have informed the political impact of images she created," Ms. Thomas said, allowing work created with a specific ideological bent to nevertheless "take the African American experience and make it universal."
Another artist in the show, Xaviera Simmons, also talked about her intense admiration for Ms. Catlett's formal skills, and for the fact that she is "still working in her 90s, and making art that's so technically savvy and stunning."
"That's kind of diva," Ms. Simmons said.
Ms. Simmons is friends with Ms. Catlett's granddaughters (one of whom, Naima Mora, is known to students of another discipline as a winner on "America's Next Top Model"). When Ms. Brielmaier decided to include her large-scale photograph "One Day and Back Then (Seated)," which shows Ms. Simmons sitting in the type of rattan chair made famous by Huey P. Newton and wearing little more than black paint and an Afro wig, "I was a little afraid of offending my best friends' grandmother," she said. But then again, she thought, Ms. Catlett "has her nudes" — and ultimately, "we all work in the same tradition."

http://www.nytimes.com/2011/04/24/arts/design/elizabeth-catlett-at-the-bronx-museum-of-art.html?ref=design

How teams take over your mind

When it comes to sports, loyalty isn't always a choice



(Mark Pernice)

By Leon Neyfakh April 24, 2011

Before they lost six games in a row during the opening week of baseball season this year, the Boston Red Sox looked invincible. Unapologetically stacked, with no weak spots in their lineup and two expensive, freshly bought stars in Carl Crawford and Adrian Gonzalez, the team seemed destined to win 100 games before strolling into the World Series and winning that too.

But the Red Sox declined to be constrained by those expectations. Instead, they came out of the gate defiantly terrible. As a disappointing opening-night loss turned into a helpless weeklong streak, people stopped dreaming about 100 wins and started wondering instead how much disappointment Sox fans were going to put up with before they started bailing.

Of course, it was exactly the wrong question. As Globe columnist Brian McGrory suggested on April 8, that dreadful opening stretch was the best thing that could have happened to this year's Red Sox and their fan base. The team everyone had expected to tick off one easy victory after another had proved itself deeply vulnerable. Suddenly, rooting for the Sox would feel like it mattered again.

It may seem bizarre to argue that a team can strengthen its bond with the people who feel invested in its success by getting its butt kicked. But the link between losing and loyalty is less puzzling to experts in the growing field of fan studies, a burgeoning effort in the academy whose practitioners are interested in how sports fans think and why they feel as intensely as they do about their favorite teams.

Why are some teams so easy to love and obsess over? What would it take for the Sox to truly lose the loyalty of their fans? As specialists in psychology, media studies, and marketing consider these questions, what they're finding is that loyalty in sports is a deeper matter than just following the Sox because they're from Boston, or hopping on and off the bandwagon as the Patriots' fortunes rise and fall. Having a winning record, these researchers have found, is just a small part of what makes franchises like the Sox, or the Celtics, or the Bruins, the objects of intense dedication. Instead, their findings point to a variety of factors that contribute to fanship, including our instinct for tribal affiliation, our desire to participate in tradition, and our hunger for compelling characters and dramatic story lines.

Fandom, it turns out, is a surprisingly clear window into our brains, and into how loyalty in general works. Sports teams, in this light, are not just groups of athletes in competition with each other, but rather complex systems that are designed to secure our allegiance by seizing upon our human needs and vulnerabilities. Think of them as loyalty-making machines, which exist to create fans out of people who might not otherwise care about them by reaching into their heads and pushing the right buttons.

"[Fandom] isn't often looked at as a distinct cultural phenomenon," said Daniel Cavicchi, an American studies professor at the Rhode Island School of Design who maintains a blog about the history of fan culture. "We pay so much attention to stars and to teams and to games, that we sort of tend to ignore the audience, or assume the audience is just there—that they've paid for their tickets and they're showing up. But actually there's a lot going on."

The people of Boston have plenty of occasion to mull such things at the moment, as the Celtics face off against their New York rivals, the Bruins struggle against their ancient nemesis from Montreal, and the Sox work to get their swagger back. While the outcomes of all the games those teams are playing will undoubtedly matter a great deal, there's a way in which the real competition is for our long-term allegiance. And the extent to which our loyalties hold through thick and thin, it turns out, may tell us less about the athletes we follow than it tells us about ourselves.

Before we go any further, it's important to note that fanship runs along a spectrum—one that researchers have spent a lot of energy trying to define over the years. One scale, developed by fanologists George Milne and Mark McDonald in 1999, puts casual fans who get a kick out of watching the occasional game on one end, and runs all the way to the guy who skips out on his brother's wedding to watch the playoffs. Somewhere in the middle you might find less personally invested fans who start caring about a team only when it is playing in a championship.

Adam Earnheardt and Paul Haridakis, a pair of professors who have coedited an anthology of essays on fanship called "Sports Mania," are preparing a study that will determine which team in the United States has the "best," or most devoted, fans. By isolating the differences between people who obsessively check scores and wear throwback jerseys and those who tune in and pay attention every once in a while, Earnheardt and Haridakis hope to find insights about the underlying causes of loyalty and group identification.

"People become passionate about sports because of certain needs they have," said Haridakis. "What makes someone stay loyal to a losing team? What makes a fair-weather fan bail as soon as a team starts losing?"

Haridakis, who teaches at Kent State University, has focused his fan research on what he calls "social identification," a fancy term for various forms of tribalism that find expression when people start seeing themselves as part of a group with a common purpose. The more loyal a fan is to the sports team he or she loves, the more stubborn that sense of identification will be: Speaking of less devoted fans, Haridakis cited the term "CORFing," which is an acronym for "cutting off reflective failure" that refers to people's tendency to distance themselves from a losing team by talking about it in the third person. Diehard fans don't do much CORFing, Haridakis said, though they are known to "BIRG"—"bask in the reflective glow"—by saying things like "We won!" when their team prevails.

BIRGing and CORFing aren't hard to understand: Most people just want to see their favorite teams win, and they pull away when the losing becomes a pattern. But that's not the only way people respond to their teams. Lots of losing teams have maintained extremely loyal fan bases, while some very successful teams have actually lost the allegiance of certain fans even as their performance has improved. And that's where things get interesting.

Rich Campbell, a marketing professor at Sonoma State University, has argued that fans' self-esteem doesn't always come from winning: Sometimes they feel more honorable and individualistic if they see themselves as part of an embattled but proud group. Campbell also cites teams like the Dallas Cowboys, which transformed

from very bad to very good during the 1990s and in the process accrued stadiums full of new fans while alienating old ones who didn't want to be associated with the Johnny Come Latelys. (In Boston, this alienation takes the form of rants from longtime fans about neophyte "pink hats.")
Such calculations are related to what Kevin Quinn, a professor at St. Norbert College and author of "Sports and Their Fans," refers to as tribal affiliation. "Humans are inherently tribal creatures, and this is a way to have a tribe," Quinn said.

(Dina Rudick/Globe Staff)

In many cases, research has shown, that tribal connection goes back to a fan's childhood, when parents or siblings encouraged him or her to root for a particular team. Jonathan Gray, editor of "Fandom: Identities and Communities in a Mediated World," compared the inheritance of sports fandom to the way in which preference for particular soap operas tends to be passed down within families from one generation to the next. "If a grandma watches one soap, then the mother watches that soap, and the daughter watches that soap," Gray said. "It's something you can all talk about." By the same token, he said, love of the Sox or the Bruins can be imprinted on a child at an early age, and grow from mere imitation to a way to pay homage to one's family, or school, or neighborhood.
If tribalism and honor exert a strong pull, there may be an even more powerful force at work in getting fans addicted to teams: the human need for narrative. Especially for franchises with long histories, like those in Boston, a big part of what hooks fans—what pushes a casual fan deeper into the spectrum—is the multitude of story lines that can be seen in longstanding rivalries, the career arcs of players, and of course, individual games.
Great story lines get people invested in a team's progress, according to experts who have studied media coverage of sports. "Stories matter," said Walter Gantz, a communications professor at Indiana University. For an example of this, one need look no further than what is perhaps the greatest narrative of modern Boston sports: the 2004 Red Sox postseason, in which they dramatically battled back from an 0-3 playoff deficit to the hated New York Yankees and went on to win the World Series for the first time since 1918.
Richard Johnson, curator at the Sports Museum of New England, got audibly emotional as he talked about that particular narrative last week over the phone, saying he didn't think a novelist could have gotten away with writing it the way it really happened—no one would ever buy such a perfect plot. Not only was it a storybook come-from-behind victory against the bitterest of rivals, Johnson said, "there was also Curt Schilling's bloody sock!"
Compelling story lines tend to involve not machinelike excellence (like the Yankees, or the preseason Sox of this year), but flawed teams, like the Red Sox of the Impossible Dream season in 1967, or the young Patriots of 2001. "For a team to be lovable, it helps not to be great or too great, but rather to have a chance to win or get lucky," said Lawrence Wenner, a professor at Loyola Marymount University, author of the book "MediaSport," and the former editor of the Journal of Sport and Social Issues.

Narrative has a self-reinforcing property: The more enmeshed in the story you become, the more fun it is to pay attention to a game that gets you deeper into the story. When you know a team deeply, experts point out, you're able to keep track of multiple story lines at once. If you knew that the Larry Bird-Magic Johnson rivalry stretched back to their college years, the Celtics-Lakers rivalry of the 1980s was that much more engrossing.

"The more you know about the history of the Red Sox, the more meaningful the experience of watching them play is," said Quinn. "There were probably a lot of non-dry eyes among people who aren't typically emotional [when the Sox won the 2004 World Series], and it's because they were plugged into that soap opera."

That said, as much as it felt like a soap opera, part of the reason it was so intense was that it wasn't one—there was no script, no guaranteed ending. That series was as real and unpredictable as it gets. And that might be the most important point of all to make about how a team grabs our minds. Sports experts call it "eustress"—the addictive combination of euphoria and stress that grips fans in the presence of a game, and becomes only more intense when the games are close. Studies have shown that rewards delivered at unpredictable intervals have especially powerful effects on our animal brains, and are decidedly more pleasurable and addictive than rewards that arrive on a set schedule. Is there a better description of a sports season?

Think of it next time you're watching a Red Sox game and you see a swarm of costumed maniacs flailing about in the bleachers with their faces painted and their voices cracking. Even if the score is 15-0 in favor of the other guys, maybe just take a second to reflect on what's happening: They're not just rooting because they want Boston to win, or because they want to see Papi hit a home run. They're rooting—and, suddenly, you're rooting along with them—because this abstract institution called a baseball team has enchanted and captivated them at a level they may not even control, worming its way into their brains and tickling them, with precision, in all the right spots. Do you really need 100 games?

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http://www.boston.com/bostonglobe/ideas/articles/2011/04/24/how_teams_take_over_your_mind/?page=full

Could You Live in 144 Square Feet?

A Yale graduate student's low-impact, low-budget home on wheels.

(Photos by Harold Shapiro)
By Jaci Conry May 17, 2009

Just how much space does one person really need? According to Elizabeth Turnbull, about 144 square feet. Last spring, after being accepted to the Yale School of Forestry & Environmental Studies, Turnbull did some math. She figured that over the course of her two-year master's program in Urban Ecology and Environmental Design, her rent and utilities would add up to around $14,000. A little more calculating led the energetic 26-year-old to conclude she could design, build, and live in her own tiny green house -- it's portable and currently parked on the property of "a benevolent New Haven citizen," she says -- for roughly the same cost.

The design of her home was based on her 6-foot-tall frame. "It was really fun to tailor the house based on my own ergonomics and my needs," she says. The 8.5-foot-by-18.5-foot house includes a sleeping loft, kitchenette, and combined living area and study. (That same benevolent citizen lets her use a bathroom in the main house, though Turnbull might one day add a composting toilet.)

Turnbull has a background in environmental studies and in building -- she worked for O'Neil Fine Builders in Beverly before returning to school -- so this project made sense. "I wanted to see how green I could be, how lightly I could tread on the earth," she says.

After consulting with others who'd built houses similar to hers -- there's a whole movement of tiny-house aficionados -- Turnbull began construction last summer. Once word got out about the project, help flooded in. Her high school alma mater, the Governor's Academy in Byfield, allowed her to use its grounds as the building site. Local vendors and building professionals donated materials, and friends, family, and dozens of strangers helped out at building parties Turnbull organized by hanging up flyers. Others offered help after reading about her project in stories that appeared in The Daily News of Newburyport.

"My goal was to use only environmentally considerate materials," says Turnbull, "products that were recycled, reclaimed, and natural." The house is heated with efficient and clean-burning propane, and three solar panels right outside provide electricity. Turnbull plans to add a rainwater catchment system this summer, and does her cooking on an efficient yacht stove. The house has soy-based insulation, donated by the Green Cocoon in Salisbury, that emits no chlorofluorocarbons or carcinogens. Low-VOC-emitting paint was used throughout the house, and the floors, a gift from Wood Flooring Design in Salisbury, are made from sustainably harvested wood. The ceiling was donated by Second Wind Sails in Gloucester, a company that repairs, resells, or finds creative reuses for old sails (shower curtains and bags are more typical than ceilings). The windows and door were castoffs from other building projects. "The world is full of things that people want to get rid of or already have," says Turnbull. "Before you buy materials, look around."

After graduation, Turnbull wants to help inspire others to explore low-budget, low-impact structures. "People can feel paralyzed by all of their stuff -- myself included, before this project," she says. "It's fun and gratifying to design around not what you think you should have, but what you need."

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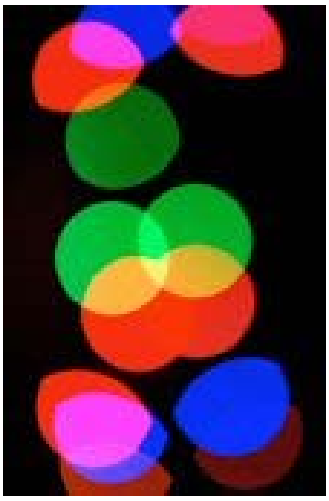
http://www.boston.com/bostonglobe/magazine/articles/2009/05/17/could_you_live_in_144_square_feet/?camp=obinsite

Hearing the voices of colours



A spectacular case of psychosis, rather oddly described as 'Methamphetamine Induced Synesthesia', in a case report just published in *The American Journal on Addictions*.
The report concerns a 30-year-old gentleman from the Iranian city of Shiraz with a long-standing history of drug use who recently started smoking crystal:
Six months PTA [prior to admission] (October 2009), he started smoking methamphetamine once a day, and gradually increased the frequency to three times a day.
Two months PTA (January 2010), he developed symptoms of auditory and visual hallucinations (seeing fairies around him that talked to him and forced him to conduct aggressive behavior), self-injury, and suicidal attempts.
He developed odd behaviors such as boiling animal statues. He was hearing the voices of colors, which were in the carpet. Colors moved around and talked to each other about the patient. He also saw the heads of different kinds of animals gathering on a board, and they talked to him.
Finally, his mother brought him to the emergency room of Ebnecina Psychiatric Hospital in Shiraz.
The authors are using the term 'synaesthesia' very liberally as it usually refers to an experience in one sense automatically triggering sensations in another – such as numbers having specific colours or tastes.
I'm not sure that 'hearing the voices of colours' necessarily qualifies as this could as much a delusion (a distorted belief) or a hallucination (that isn't specifically tied to seeing the colours) rather than a genuine synaesthetic experience.
As the authors didn't investigate any further and only have the gentleman's word for his experiences, it's a little hard to say.
However, it's also worth noting that our concept of synaesthesia is no longer tied to 'crossing of the senses' as synaesthesia for increasingly meaningful things is being discovered.
Only recently, two confirmed and tested cases of 'swimming-style synesthesia' were reported in the journal *Cortex* where different colours were reliably triggered by the sight of people doing different swimming strokes.

http://mindhacks.com/2011/04/12/hearing-the-voices-of-colours/

Please Take the Gold Watch. *Please!*

The abolition of mandatory retirement, and how it changed America in unexpected ways.
By Emily YoffePosted Thursday, April 14, 2011, at 7:02 AM ET

In the 1970s, W. Glenn Campbell had a brilliant idea for reviving the backwater California think tank he ran: He would hire pre-eminent scholars who were being let go from their universities because they had reached the age of mandatory retirement. So in the 1970s, Campbell lured philosopher Sidney Hook, physicist Edward Teller, and Nobel Laureate economist Milton Friedman to the Hoover Institution at Stanford University. "That was the key, the breakthrough," says Melvyn Krauss, a Hoover senior fellow emeritus. Prior to their arrival, Krauss says, Hoover couldn't attract well-known scholars in their prime. But with these big names at Hoover, other luminaries, and lots of donor money, followed.

Mandatory retirement was an idea that took hold of the workplace in the early 20th century. By the 1970s, about half of American workers had a non-negotiable deadline for leaving, usually at age 65. For some, the departure may have been welcome; for others, it felt like being prematurely put out to pasture. (Friedman was active at Hoover for nearly 30 years, until his death at age 94.)

Then, as civil rights law expanded beyond race to encompass age, disability, and gender 25 years ago, mandatory retirement was struck down by Congress. In 1986, as part of a series of congressional actions to address age discrimination, it became illegal in almost all cases to force people out of jobs at any age. Joseph Quinn, a professor of economics at Boston College, wrote in a research paper that this move "sent an important message to society that the appropriate age to retire was not necessarily 65."

The elimination of mandatory retirement became a turning point in the way Americans retire. It helped reverse a 100-year trend of people departing from the workforce in ever greater numbers and at an ever-earlier age. Because of increasing longevity, establishment of generous pension plans, and mandatory removal from the workplace, retirement had become something unprecedented: a third stage of life, potentially as long as childhood and one's working years. Then, in the 1980s, the foundation of this third stage began to crumble.

Until the end of the 19th century, retirement planning was pretty simple for most Americans: You worked until you died. Sometimes, people became too old or incapacitated to continue on the farm or in the factory, and the lucky ones were cared for by family. In the 1880s, about 75 percent of men 65 and older were still in the labor force, writes Dora L. Costa, professor of economics at UCLA, in *The Evolution of Retirement.* But from that point on, until the 1980s, older men's participation in the workforce began steadily falling. By 1900, it had dropped to 65 percent. (Historical figures only reflect men's employment because of women's far lower participation in the labor force.)

There were several causes for this decline. One was the appearance of pensions for Union Civil War veterans. In *Working Longer,* Alicia H. Munnell and Steven A. Sass of the Center for Retirement Research at Boston

College write that many veterans left the workforce when they received a guaranteed stream of pension income. Pensions also became a more regular fixture as Americans shifted from self-employment, largely in agriculture, to working for companies.

In 1900, the Pennsylvania Railroad came up with an innovation: mandatory retirement. The company offered pensions to all its workers, but to collect they would have to retire at age 70. In a World Bank paper, economist Samuel H. Williamson writes that imposing a universal age of departure relieved companies of the unpleasantness of having to evaluate the fitness of their older workers individually and solved the growing problem of a glut of elderly, incapacitated employees.

The arrival of Social Security—the first retirement checks for workers who had reached age 65 were delivered in 1940—helped make leaving the workplace an even more reasonable proposition. In 1948, a Bureau of Labor Statistics study finds, just under 50 percent of men 65 and older were still in the workforce. By 1968, it was just under 30 percent, and by 1988 just under 20 percent. A chart from Quinn's paper shows that had this linear trend continued, only about 10 percent of men ages 65 to 69 would still have been working by the end of the 20th century. But in the 1980s, that all stopped. "A century-old trend has come to a halt, and reversed," writes Quinn. "The era of earlier and earlier retirement is over and is not coming back."

Last year, the employment rate of men 65 and older had ticked back up to 22 percent. The employment of older women, although their absolute numbers are far smaller, has also shown a dramatic rise. From 1977 to 2007 the number of women age 65 and older in the workforce increased almost 150 percent. That's not all. In the same period, the percentage of people of both sexes age 75 and up who are still working has increased more than 170 percent.

"There's a whole new world out there," says economist Quinn. "The incentives are different, and people are behaving differently." For one thing, people are no longer given a gold watch and pushed out the door. For another, reforms in Social Security have created a financial incentive to work longer. For a third, the world of "defined benefit" pensions is being replaced by "defined contribution" pensions. In the former, workers are guaranteed a monthly check for as long as they live. In the latter, workers accumulate a pot of money, as in an IRA, and whatever's in the pot better be enough to last.

Given these financial changes, the elimination of mandatory retirement has allowed people to work as long as they need to for as long as they feel able. The argument of *Working Longer* is that many Americans should shift their planned retirement from their early to late '60s, which will dramatically increase the financial security of their nonworking years. And Quinn writes that given the demographic bulge of older Americans, keeping them in the workforce will ease the burden on entitlement programs.

But social scientists love to find perverse incentives and unintended consequences, and in this case, some say protecting older workers' ability to stay on the job has also made employers more reluctant to hire them. "Basically, it's a mess," says Sass of the world of retirement today. He says employers liked mandatory retirement because it allowed for an orderly and predictable departure from the payroll. But that certainty is gone at a time that, more than ever, older workers need to find new jobs. In the 1980s, Sass says, about 75 percent of 50-year old workers would be at the same company 10 years later. Today, only half of 60 year-olds are working at the same place that employed them at age 50. In *Working Longer,* he and Munnell float what he calls the "somewhat scandalous" suggestion that the prohibition on mandatory retirement be repealed—allowing companies to impose it, he suggests, at the "politically feasible" age of 70. "Unless employers have an assurance they have a way to get rid of older employees, they won't hire older workers," he says.

Being stuck with people who just won't accept it's time to go is particularly acute in academia. A 2006 article in the *Boston Globe* found that more than 9 percent of tenured professors on Harvard's faculty of arts and sciences were 70 or older, compared with none in 1992. (The abolition of mandatory retirement laws started applying to colleges and universities only in 1994.) The article notes that Columbia University offered generous financial incentives to get older faculty to leave, yet it had a higher percentage of tenured faculty over age 70 than Harvard. Former Harvard President Lawrence Summers said, "The aging of the faculty, caused in large part by the absence of mandatory retirement, is one of the profound problems facing the American research university."

The United States was one of the first countries to abolish mandatory retirement, this British government report finds, and it was eventually followed by Australia and New Zealand. This year, the United Kingdom will eliminate mandatory retirement. Other countries with aging populations and decreasing numbers of workers are grappling with their mandatory retirement laws. In Japan, the mandatory retirement age has

gradually increased; it started at 55 in 1994 and will become 65 in 2013. In France, the mandatory retirement age private employers can impose increased to 65 from 60 in 2003.

Joanna Lahey, an assistant professor at the Bush School of Government and Public Service at Texas A & M University, says that in Europe—and elsewhere—there's a widespread, but mistaken, belief that if an old person keeps working a young person will be prevented from finding a job. "It's not true," she says. "More people working means greater productivity, which expands the economy. When women entered the labor force, they didn't actually take men's jobs away. There isn't a fixed number of jobs." (Lahey says even at universities it's more complicated than an old professor blocking a young one. For instance, she says, increasingly when one professor retires that slot is filled by two, or more, nontenured adjuncts.)

In the United States, there remain a few exemptions to the anti-mandatory retirement laws. Public safety is the biggest one: Pilots are stripped of their epaulets at age 65, and air-traffic controllers stop telling them when to land at age 56 (although there are some exemptions for them). In addition, the law lets companies remove highly paid, high-responsibility employees at age 65. Lahey says this is a rarely used mechanism that allows firms to gracefully retire over-the-hill executives in danger of destroying the place.

Ironically, this was used against the Hoover Institution's Campbell, who in time went from being a young director to an old director. Over the years, he had an increasingly combative relationship with the administrators of Stanford University. The university had had enough and told him he was retiring when he turned 65. Campbell threatened an age discrimination suit, but the Board of Trustees cited the exemption. The man who made his reputation by hiring forcibly retired scholars was himself forcibly retired.

http://www.slate.com/id/2291194/pagenum/all/#p2

Uncertainty entangled: The limits of quantum weirdness

- 03 May 2011 by **Anil Ananthaswamy**
- Magazine issue 2810

The end of quantum uncertainty? (Image: Paul Blow)

In a battle between the star principles of the quantum story, there can be only one winner. Or can there?

SOME middle-aged men have trains in their attics. Niels Bohr had Werner Heisenberg. In the winter of 1926-1927, the brilliant young German was working as Bohr's chief assistant, billeted in a garret at the top of the great Dane's Copenhagen institute. After a day's work, Bohr would come up to Heisenberg's eyrie to chew the quantum fat. They often sat up late into the night, in intense debate over the meaning of the revolutionary quantum theory, then its infancy.

One puzzle they pondered were the trails of droplets left by electrons as they passed through cloud chambers, an apparatus used to track the movements of charged particles. When Heisenberg tried calculating these seemingly precise trajectories using the equations of quantum mechanics, he failed.

One evening in mid-February, Bohr had left town on a skiing trip, and Heisenberg had slipped out to catch some night air in the broad avenues of Faelled Park, behind the institute. As he walked, it came to him. The electron's track was not precise at all: if you looked closely, it consisted of a series of fuzzy dots. That revealed something fundamental about quantum theory. Back in his attic, Heisenberg excitedly wrote his idea down in a letter to fellow physicist Wolfgang Pauli. The gist of it appeared in a paper a few weeks later: "The more precisely the position is determined, the less precisely the momentum is known in this instant, and vice versa."

Thus Heisenberg's notorious uncertainty principle was born. A statement of the fundamental unknowability of the quantum world, it has stood firm for the best part of a century. But for how much longer? Rumblings are abroad that a second quantum principle - entanglement - could sound the death knell for uncertainty. Is it goodbye Heisenberg, hello quantum certainty?

The profound implications of the uncertainty principle are hard to overstate. Think of our classical, clockwork solar system. Given perfect knowledge of the current positions and movements of its planets and other bodies, we can predict their exact positions and movements any time in the future with almost perfect accuracy. In the quantum world, however, uncertainty does away with any such ideas of perfect knowledge revealed by measurement (see "Fuzzy logic"). Its assertion that there are pairs of "complementary" quantities such as position and momentum, where exact knowledge of one precludes knowing the other at all accurately, also undermines any concept of predictable cause and effect. If you cannot know the present in its entirety, you can have no idea what the future might bring.

Since that Copenhagen winter, generations of physicists have tugged at Heisenberg's principle, giving it a tweak here or a new formal expression there as we have learned more about the vagaries of quantum measurements and the exchange of quantum information. The now-favoured version of the principle was

constructed in 1988 by two Dutch physicists, Hans Maassen and Jos Uffink, using concepts from the theory of information devised by the American mathematician Claude Shannon and others in the years following the second world war.

Squeezed entropy

Shannon had shown how a quantity that he termed entropy, by analogy with the measure of thermodynamic disorder, provided a reliable indicator of the unpredictability of information, and so quite generally of uncertainty. For example, the outcome of the most recent in a series of coin tosses has maximal Shannon entropy, as it tells you nothing about the result of the next toss. Information expressed in a natural language such as English, on the other hand, has low entropy, because a series of words provides clues to what will follow.

Translating this insight to the quantum world, Maassen and Uffink showed how it is impossible to reduce the Shannon entropy associated with any measurable quantum quantity to zero, and that the more you squeeze the entropy of one variable, the more the entropy of the other increases. Information that a quantum system gives with one hand, it takes away with the other.

But is that always the case? Not according to Mario Berta, a quantum information theorist at the Swiss Federal Institute of Technology in Zurich, and his colleagues. Quantum entanglement can have a distinctly weird effect on uncertainty.

Suppose an observer called Bob creates a pair of particles, such as photons of light, whose quantum states are somehow entangled. Entanglement means that even though these states are not defined until they are measured, measuring one and giving it a definite value will immediately pin down the state of the other particle. This happens even if the distance between the two particles is too great for any influence to travel between them without breaking the cosmic speed limit set by light - the seemingly impossible process decried by Einstein as "spooky action at a distance".

Bob sends one of these entangled photons to a second observer, Alice, and keeps the other close by him in a quantum memory bank - a suitable length of optical fibre, say. Alice then randomly measures one of a pair of complementary variables associated with the photon: in this case, polarisations in two different directions. Her measurement will be governed by the usual rules of quantum uncertainty, and can only ever be accurate to within a certain limit. In Maassen and Uffink's terms, its entropy will be non-zero. Alice tells Bob which of the quantities she measured, but not the value that she obtained.

Now comes the central claim. Bob's job is to find out the result of Alice's measurement as accurately as possible. That is quite easy: he just needs to raid his quantum memory bank. If the two photons are perfectly entangled,he need only know which quantity Alice measured and measure it in his own photon to give him perfect knowledge of the value of Alice's measurement - better even than Alice can know it. Over the course of a series of measurements, he can even squeeze its associated entropy to zero.

Berta's group published their work in July last year (*Nature Physics*, vol 6, p 659). Just a few months later, two independent teams, led by Robert Prevedel of the University of Waterloo, Ontario, Canada, and Chuan-Feng Li of the University of Science and Technology of China in Hefei, performed the tests. They worked: uncertainty could be reduced to previously unachievable levels simply by increasing entanglement (arxiv.org/abs/1012.0332, arxiv.org/abs/1012.0361). "The experiments are in perfect agreement with our theoretically derived relation," says Berta. "We were surprised how quickly the experiments were realised."

So is uncertainty's grip finally loosening? Initial reactions have been cautious. "This is a very beautiful and important extension of the Maassen-Uffink uncertainty relations," says Paul Busch, a quantum theorist at the University of York, UK, who was not involved with any of the teams. Uffink himself, a researcher at the University of Utrecht in the Netherlands, agrees. "It is admirable work," he says, "but there is of course a 'but'."

That "but", Uffink says, is that even if Bob is armed with entanglement and quantum memory, the experiments show only that it is possible for him to predict precisely the result of either of the two possible measurements that Alice makes - not both at the same time.

Uncertainty is dead

To both Uffink and Busch, the thought experiment devised by Berta and his team is reminiscent of the famous "EPR" thought experiment devised in 1935 by Einstein and his colleagues Boris Podolsky and Nathan Rosen. It, too, came to a similar conclusion: that entanglement could remove all uncertainty from one measurement, but not from both at once. In keeping with Einstein's general scepticism about quantum weirdness, he

interpreted the tension between the two principles as indicating that quantum mechanics was incomplete, and that a hidden reality lying beneath the quantum world was determining the outcome of the experiments.
While that debate is now largely considered settled (*New Scientist*, 26 February, p 36), the latest work opens up an entirely new perspective. Traditionally, debates about the validity of the uncertainty principle and the interpretation of the EPR experiment have remained distinct. Now there is another possibility: not that uncertainty is dead, but that there is a relationship between uncertainty and entanglement that has previously not been fully appreciated.
"They are different sides of the same coin," says Busch. Where two particles are perfectly entangled, spooky action at a distance calls the shots, and uncertainty is a less stringent principle than had been assumed. But where there is no entanglement, uncertainty reverts to the Maassen-Uffink relation. The strength of the Berta interpretation is that it allows us to say how much we can know for a sliding scale of situations in between, where entanglement is present but less than perfect. That is highly relevant for quantum cryptography, the quantum technology closest to real-world application, which relies on the sharing of perfectly entangled particles. The relation means there is an easier way to test when that entanglement has been disturbed, for example, by unwanted eavesdroppers, simply by monitoring measurement uncertainty.
As for the duel between uncertainty and entanglement, it ends in a draw, with the two principles becoming the best of friends after the event. "Because they are now part and parcel of the same mathematical scheme, you can't pick one and say this is logically superior to the other, or the other way around, because everything is logically connected somehow," says Busch.
But, he says - there is another "but" - while that is true within the confines of quantum theory, we might be able to tell which is the stronger principle by zooming out and considering a mathematical framework more general than that of quantum theory.
A quantum game that Stefanie Wehner played can help explain. Along with Jonathan Oppenheim of the University of Cambridge, Wehner, a researcher at the National University of Singapore, played it with 12-year-old kids in a cafe. She gave them a board with two squares, and gave one child a zoo of two tigers and two elephants. The child could place one tiger on each square, one elephant on each square, or a tiger on one and an elephant on the other. Without looking, a second kid had to guess which animal was on one of the squares.
"It made them understand why it's not possible to win all the time," says Wehner. Without some illicit sharing or extraction of information, they could only hope to guess right half the time.
The significance of the game is that it expresses questions of uncertainty and entanglement in terms of information retrieval. Guessing an animal or a photon state correctly depends on the correlation between information already held and information being sought. Entanglement provides a way to increase that correlation - effectively, to cheat.

Long live uncertainty

Oddly, though, even the weird "non-locality" embodied by entanglement does not guarantee success. Yet it is possible to envisage theories that do not break any laws of physics - in particular, the strict condition that no influence should travel faster than light, laid down in Einstein's special theory of relativity - and still allow you to be right 100 per cent of the time (*New Scientist*, 21 August 2010, p 33). What is it that keeps quantum theory as weird as it is, and no weirder?
Oppenheim and Wehner's answer, published in November last year, is disarmingly simple: the uncertainty principle (*Science*, vol 330, p 1072).
It is a satisfying twist to the story. Within the confines of quantum theory, entanglement can help to break down uncertainty, allowing us to be more certain about the outcome of certain experiments than the uncertainty principle alone would allow. On this level, entanglement comes up trumps. But zoom out and ask how the confines of quantum theory are set, and it seems that it is the uncertainty principle that stops things in the quantum world being weirder and more correlated than they already are. Uncertainty rules, and puts entanglement in a straitjacket. "It shows quite clearly that the uncertainty principle is far from dead," says Busch.
Iwo Bialynicki-Birula, a physicist who did seminal work reformulating the uncertainty principle in terms of information in the 1970s, once wrote that every physical theory has an eye-catching equation that can grace a T-shirt. Where relativity has $E = mc^2$, quantum mechanics has its uncertainty relation. Heisenberg's baby, born in an attic, could be adorning T-shirts for a while yet.

Fuzzy logic

In the 1927 paper that introduced the uncertainty principle to the world, Werner Heisenberg established that there are pairs of quantities in the quantum world that cannot both be measured to an arbitrary level of precision at the same time.

One such pair is position and momentum - essentially a measure of a quantum particle's movement. If you know a particle's position x to within a certain accuracy Δx, then the uncertainty Δp on its momentum p is given by the mathematical inequality $\Delta x \, \Delta p \geq \hbar/2$. Here, $\hbar$ is a fixed number of nature known as the reduced Planck constant.

This inequality says that, taken together, Δx and Δp cannot undercut $\hbar/2$. So in general, the more we know about where a particle is (the smaller Δx is), the less we can know about where it is (the larger Δp is), and vice versa.

The uncertainty principle also applies to other pairs of quantities such as energy and time, and the spins and polarisations of particles in various directions. The energy-time uncertainty relation is the reason why quantum particles can pop out of nothingness and disappear again. As long as the energy, ΔE, they borrow to do that and the time, Δt, for which they hang around don't bust the uncertainty bound, the fuzzy logic of quantum mechanics remains satisfied.

http://www.newscientist.com/article/mg21028101.700-uncertainty-entangled-the-limits-of-quantum-weirdness.html?full=true&print=true

Strange cosmic ray hotspots stalk southern skies

- 16:42 03 May 2011 by **Anil Ananthaswamy**

IceCube uses detectors buried in Antarctic ice (Image: NSF/B Gudbjartsson)

Cosmic rays crashing into the Earth over the South Pole appear to be coming from particular locations, rather than being distributed uniformly across the sky. Similar cosmic ray "hotspots" have been seen in the northern skies too, yet we know of no source close enough to produce this pattern.

"We don't know where they are coming from," says Stefan Westerhoff of the University of Wisconsin-Madison.

Westerhoff and colleagues used the IceCube neutrino observatory at the South Pole to create the most comprehensive map to date of the arrival direction of cosmic rays in the southern skies. IceCube detects muons produced by neutrinos striking ice, but it also detects muons created by cosmic rays hitting Earth's atmosphere. These cosmic ray muons can be used to figure out the direction of the original cosmic ray particle.

Good mystery

Between May 2009 and May 2010, IceCube detected 32 billion cosmic-ray muons, with a median energy of about 20 teraelectronvolts (TeV). These muons revealed, with extremely high statistical significance, a southern sky with some regions of excess cosmic rays ("hotspots") and others with a deficit of cosmic rays ("cold" spots).

Over the past two years, a similar pattern has been seen over the northern skies by the Milagro observatory in Los Alamos, New Mexico, and the Tibet Air Shower array in Yangbajain. "It is interesting that the pattern can be matched between [these experiments], at least qualitatively. They have very different techniques and systematic effects," says cosmic-ray physicist Paul Sommers at Pennsylvania State University in University Park. "I regard those hotspots as a good mystery."

It's a mystery because the hotspots must be produced within about 0.03 light years of Earth. Further out, galactic magnetic fields should deflect the particles so much that the hotspots would be smeared out across the sky. But no such sources are known to exist.

Cosmic funnel

One of the hotspots seen by IceCube points in the direction of the Vela supernova remnant, a possible source of cosmic rays, but it's almost 1000 light years away. Cosmic rays coming from such large distances should be constantly buffeted and deflected by galactic magnetic fields on route, and should thus have lost all directionality by the time they reach Earth. In other words, such long-distance cosmic rays should appear to come from all parts of the sky. That's not what has been observed.

Milagro has also seen hotspots that appear to come from implausibly distant sources. As an explanation, Felix Aharonian of the Dublin Institute for Advanced Studies in Ireland and colleagues have suggested that there could be a "tube" of magnetic field lines extending between the source and our solar system, funnelling the cosmic rays towards us. However, Aharonian admits the theory is highly speculative.

Others have proposed that a local phenomenon called magnetic reconnection – in which solar magnetic field lines cross and rearrange, converting magnetic energy to kinetic energy – could be accelerating local cosmic rays to energies in the TeV range and beaming them towards Earth, creating the observed hotspots. "It implies that we have a Tevatron in the solar system," says Aharonian, referring to the particle accelerator at Fermilab in Batavia, Illinois. "That's also crazy, but it is at least less crazy than other explanations."

Westerhoff's team presented their results at the American Physical Society's meeting in Anaheim, California, on Saturday.

http://www.newscientist.com/article/dn20436-strange-cosmic-ray-hotspots-stalk-southern-skies.html

Second experiment hints at seasonal dark matter signal

- 02:09 03 May 2011 by **Valerie Jamieson**, Anaheim
- For similar stories, visit the **Cosmology** Topic Guide

The Soudan mine is home to the CoGeNT experiment (Image: ShakataGaNai/(CC BY-SA 3.0))

Things just got a little less lonely for researchers who have been insisting for years not only that their experiment has found dark matter, but also that the dark matter signal varies with the seasons. Now a second experiment, called CoGeNT, is reporting similar findings, though both results are in conflict with two other teams' observations.

No one knows what dark matter is – astronomers merely detect its gravitational pull on normal matter, which it seems to outweigh by a factor of five to one. But many researchers believe it is made of theoretical particles called WIMPs, which interact only weakly with normal matter.

Since 1998, researchers running the DAMA experiment deep inside the Gran Sasso mountain in Italy have claimed to have found evidence of WIMPs.

DAMA uses an array of sodium iodide detectors to spot the rare moments when WIMPs slam into atoms in the detectors, producing flashes of light. The number of flashes ebbs and flows with the seasons, and DAMA team members argue that this is because Earth's velocity relative to the surrounding sea of dark matter changes as the planet orbits the sun. They say their observations could be explained by a WIMP weighing a few gigaelectronvolts.

Tense situation

However two other experiments have found no sign of dark matter with their detectors. One, called XENON100, uses 100 kilograms of liquid xenon deep below Gran Sasso mountain, and the other, called CDMS II, uses ultra-pure crystals of germanium and silicon housed in a deep mine in Soudan, Minnesota. Both experiments are so sensitive that they should have seen dark matter if the DAMA result is due to WIMPs. "The situation has created tension," says Dan Hooper, a theorist at the University of Chicago in Illinois.

Now another dark matter experiment called CoGeNT has found a seasonal variation in its results, reports team leader Juan Collar, who presented an analysis of 442 days of observations at the American Physical Society meeting in Anaheim, California, on Monday.

"We tried like everyone else to shut down DAMA, but what happened was slightly different," Collar said during his presentation.

Germanium crystal

The CoGeNT detector is tiny compared with many other dark matter experiments. It comprises a 440-gram crystal of germanium. Still, dark matter is so abundant that 100 million particles of it are expected to pass through the CoGeNT detector every second.

About once a day, one of these will wallop a germanium nucleus, sending the nucleus careering through the crystal, where it rips electrons from neighbouring atoms. An electric field sweeps these electrons towards an electrode to produce a tiny electrical signal.
Previously, the CoGeNT team reported an excess of events when it ran its experiment in the Soudan mine for 56 days (*Physical Review Letters*, DOI: 10.1103/PhysRevLett.106.131301). Team members said the excess could be due to some kind of background noise that physicists don't understand, or potentially to WIMPs weighing 7 GeV.

'Smoking gun'?

The experiment kept running continuously until a fire in the Soudan mine on 17 March halted observations. This motivated Collar and his colleagues to look for a seasonal variation in the 442 days of observations they had already collected. "I hope this isn't the final data we have taken," says Collar, who has not yet been allowed to return to the Soudan mine to check for damage.
The CoGeNT team finds that their signal changes with the seasons in exactly the same way as the DAMA result does. And it is consistent with a low-mass dark matter particle, like that reported by DAMA.
"The annual modulation is the closest thing to a smoking gun [for dark matter]," says theorist Jonathan Feng at the University of California, Irvine, who is not part of the CoGeNT team. "This is the first evidence we've seen it somewhere other than DAMA."

Weird WIMP

But Laura Baudis at the University of Zurich in Switzerland, who reported at the meeting on Monday that XENON100 still had seen no signs of dark matter, is not sure what to make of the results: "I need time to think about them."
Feng suggests that the discrepancy among all the experimental results may simply be due to the assumption that WIMPs interact the same way with protons and neutrons. If this is not the case, that could explain differences in the signals from xenon and germanium detectors, which each have a different ratio of protons to neutrons (arxiv.org/abs/1102.4331). "These experiments may look inconsistent, but a small theoretical tweak can bring everything in to line," he told *New Scientist*.
Both the CoGeNT and XENON100 teams are planning to enlarge their experiments. Approval has just been given to build the XENON1T experiment in the Gran Sasso mine, which will use 1 tonne of liquid xenon. And the CoGeNT team is planning to replace its single germanium crystal with four separate crystals, each weighing 1 kilogram, starting later this year.

http://www.newscientist.com/article/dn20434-second-experiment-hints-at-seasonal-dark-matter-signal.html

Freeze airframe: Targeting an icy killer in flight

- 03 May 2011 by **Paul Marks**
- Magazine issue 2810.

Ice spy with his little eye (Image: Andrew Gombert/EPA/Corbis)

In-flight icing of a plane's wings or tail can be deadly, but the frigid skies should soon be safer

ON 12 February 2009, a Colgan Air commuter plane plummeted from the sky onto a house in Clarence, near Buffalo, New York. All 49 people on the plane, and the homeowner, were killed. Pilot error was cited as the cause of the accident, but a major factor that had led to crew confusion was excessive ice build-up on the aircraft's wings. This had critically lowered the plane's airspeed - causing it to lose lift.

The fate of flight 3407 is just one among many air accidents in which ice played a part. In the US alone, there are up to 40 accidents every year in which in-flight icing plays a major role, according to the US National Transportation Safety Board. Between 1982 and 2000, these accidents accounted for the deaths of 819 people on American flights. To reduce the toll in future, engineers and atmospheric scientists have hatched some novel ideas to counter in-flight icing.

Top of the heap is an "ice forecast" system launched this month by the US National Center for Atmospheric Research (NCAR) in Boulder, Colorado. It gives pilots an extra layer of data on their aviation weather forecasts, showing them the likelihood of encountering ice on their planned route and altitude, and just how severe it will be, says lead developer Marcia Politovitch.

Oddly, it is liquid water droplets that must be present in the air for a plane to accumulate ice: water vapour, snow or ice itself is rarely a problem.

In-flight ice forms at altitudes up to 7300 metres (24,000 feet), when the aircraft's surfaces hit supercooled water droplets suspended in the air. These droplets are still liquid below 0 °C, but as they strike the wing or tail's leading edge, they flow over it and freeze, forming streaks of "glaze ice" that disrupt airflow. In air temperatures below -20 °C, the droplets freeze immediately on impact, creating heavy, wedge-shaped chunks dubbed "rime ice" (see diagram).

As ice accretes on the wings and tail, it changes their shape, creating drag. That, in turn, reduces the airspeed which is needed to generate lift - leaving the aircraft at risk of stalling.

NCAR's Forecast Icing Product - Severity (FIP-S) software analyses satellite radar images to detect the atmospheric conditions that lead to icing. "Recognising the potential for icing conditions to develop over time, and their degree of severity, are crucial for safe flight planning," says Politovitch.

Previous generations of the program only told pilots there was the potential - or not - for wing icing along their planned flight path. FIP-S improves on this by using the temperature at the tops of clouds, the sensed humidity levels and predicted water droplet sizes to calculate the probability and severity of icing. It then overlays this data on regular digital flight-planning weather maps provided by the National Oceanic and Atmospheric Administration's Aviation Weather Center.

Pilots can check FIP-S, which is updated hourly, before take-off or from an in-flight laptop to know when to be on the lookout for icing wings.
Once the crew are aware of icing, they have a number of options. Light aircraft have pneumatic rubber tubes, called "boots", embedded in their leading edges. These are inflated to snap off ice encrustations. Larger airliners usually have copper-alloy-based heating elements embedded in the leading edges of their wings and tail.
But there's a problem: finding the spare kilowatts to run these alloy-based de-icers for long enough to safely eradicate ice is becoming a problem as modern planes like the Boeing 787 replace hydraulic controls with power-hungry electric servos.
At Dartmouth College in Hanover, New Hampshire, Viktor Petrenko has developed a novel aircraft de-icing heater that rids surfaces of ice faster while using just 1 per cent of the power consumed by existing systems. Today's heaters make the mistake of staying on for long stretches of time, which melts the ice, but also heats the air and other parts of the wing, Petrenko says. To melt only the ice layer immediately in contact with the surface, he has developed a way of pulsing electric current into the heater in 1-millisecond bursts. "The ice then slides off on the liquid film," he says.
Goodrich Corporation of Uniontown, Ohio, is in advanced tests with Petrenko's system, says the firm's R&D chief, David Sweet.
An alternative approach is to make the aluminium surfaces in planes "icephobic", with a surface nanostructure that prevents ice crystals forming in the first place. Using metal-etching solutions, Richard Menini and colleagues at the University of Quebec in Chicoutimi, Canada, carved nanoscale patterns into the metal's upper layer, and then applied a coating of Teflon. Water droplets have a tough time gaining purchase on the roughed-up surface, boosting its ability to resist ice formation fourfold over that of "naked" aluminium.
Sweet warns that such materials face a problem in the air, as even when a wing's leading edge is coated in oil, ice still forms and is held in place by aerodynamic forces. "A slick surface doesn't necessarily help," he says. However, this technique may ultimately be put to good use in ground-based applications, such as power lines and bridges.

http://www.newscientist.com/article/mg21028106.100-freeze-airframe-targeting-an-icy-killer-in-flight.html

Deadly weather in US could become the norm

- 00:49 03 May 2011 by **Ferris Jabr**

It's been a severe start to the spring season in the United States. Tornadoes have ravaged the southeastern US, flooding threatens much of the Midwest, and wildfires are scorching Texas. But according to researchers, a confluence of seasonal oscillations in weather patterns, rather than climate change, is to blame. And growing populations mean that grim casualty figures from such events may become the norm.

"I don't think there's any way of proving climate change is responsible for the weather patterns this week and week before," says meteorologist Howard Bluestein, of the University of Oklahoma in Norman.

Part of the cycle

Tornadoes, floods and fires occur every year in America, and the outbreak of each this year is readily explained by short-term factors.

Texas has suffered drought since late 2010, producing the driest March on record. Ground temperatures in March and April were higher than usual, shrivelling the already rain-starved vegetation. The low humidity, heat, and high winds built a perfect tinder box for wildfires, which have so far burned more than 1.4 million acres in around 800 separate blazes across Texas .

Floods are largely explained by a combination of heavy rains and melting snow. Coupled with recent severe rainstorms, the snowmelt from a very white winter of 2010-2011 has pushed waters at the confluence of the Ohio and Mississippi rivers to record levels, threatening communities in Missouri and Illinois. Elsewhere, the waters have already overrun their levees and inundated nearby towns.

The conditions that create tornadoes are more complex and less well understood. They need the hot, humid air that fuels a thunderstorm and a strong jet stream, although scientists are not sure why this combination only sometimes produces twisters.

Around two weeks ago, a huge mass of humid air blew up from the Gulf of Mexico and draped itself upon the Southeastern United States. When the colder jet stream – narrow, swift moving and cold – began to churn the sultry air, a huge system of thunderstorms arose, along with hundreds of twisters. Between between April 14 and 16, 155 confirmed tornadoes struck, and the National Oceanic and Atmospheric Administration estimates another 362 twisters touched down between April 25 and 28, leaving a swath of destruction across the southern US. In all, more than 377 people have died and some are still missing.

Warming a factor?

Climate change cannot be directly blamed for such outbreaks. And even as scientists' climate models have improved, the question of whether increasing global temperatures will change the frequency and severity of dangerous weather in the future remains open.

Rising temperatures mean more of the warm soupy air from which thunderstorms are formed. At the same time, however, global warming could weaken the temperature difference between the equator and the poles, a gradient that generates the jet stream in the first place.

One possible outcome of these opposing forces is that a warmer world will produce more run of the mill thunderstorms, but fewer tornadoes. In a 2007 study, however, NASA climate scientist Anthony Del Genio NASA modeled a hypothetical future climate with twice the then-current carbon dioxide levels and surface temperatures 5 degrees Fahrenheit (2.8 degrees Celsius) warmer than typical. He concluded that despite a weakened jet stream, violent twister-generating thunderstorms will actually occur more frequently in a warmer world because of collisions between strong updrafts and speedy horizontal winds.

For now, there simply isn't enough data to say whether climate change makes severe thunderstorms and tornadoes more or less likely. But 2011 could prove to be the beginning of a trend.

"We can't say much about one particular outbreak, but if this if this is still happening ten years in a row, we will definitely be wondering what is going on," says Joshua Wurman, president of the Center for Severe Weather Research in Boulder, Colorado.

Either way, the breathtaking loss of life witnessed in the last month may become harder and harder to avoid. The April 2011 tornado outbreaks have killed far more people than anything in the past few decades, despite the fact that warning systems are better than ever.

One explanation is population density: "There are simply more people in harm's way than there used to be," says Bluestein. "Inevitably some people just aren't going to get out of the way. It's a sad horrible thing that

over 300 people lost their lives in the last outbreak, but if we didn't have the kind of warning systems we have now, thousands of people would have been killed."

Numbers game

NOAA currently estimates over 600 tornadoes touched down in the US in April. If the number stands, it would be a record for a month that is usually quieter than May, the most active month of the year for twisters. But comparing today's statistics to the historical record can be tricky - the number of people reporting tornadoes has increased dramatically over time, so older records may have missed many twisters.

"Today people report even the smallest tornadoes," says Bluestein. "With our cell phones and wireless internet it's as if no tree falling in the forest gets left unseen."

"2011 is certainly getting off to a roaring start for severe weather," says Del Genio. It's very interesting that we have had huge outbreak of tornadoes this April, but remember that the rest of year could turn out to be very calm – we just don't know yet."

http://www.newscientist.com/article/dn20433-deadly-weather-in-us-could-become-the-norm.html?full=true&print=true

The hunt is on for million-year-old ice core

- 29 April 2011 by **Wendy Zukerman**
- Magazine issue 2810.

Ice holds the clue to past climate (Image: David Boyer/NGS)

A RACE is on to retrieve the first million-year-old sample from deep within Antarctica's ice. It's a prize that could help us understand what drives major changes in Earth's climate.

Every 100,000 years or so, the Earth swings into an ice age - but it wasn't always this way. Until around 1 million years ago, our planet danced to a faster beat, with the ice age pulses occurring every 40,000 years. No one knows why the tempo slowed.

Currently, the shifts between ice ages and warm interglacial phases are thought to be influenced by three cyclical changes to Earth's motion. The Earth's axis wobbles or "precesses" on a 26,000-year cycle; it changes its average tilt on a 41,000-year cycle; and it shifts its orbit from being roughly circular to more elliptical on a 100,000-year cycle.

These changes alter the intensity of sunlight hitting the Earth at high latitudes, and so affect the extent of glaciation. The puzzling thing about the shift that happened a million years ago is that there was no obvious change to any of these cycles to make it happen.

"It's a real head spinner," says Tas van Ommen at the Australian Antarctic Division in Hobart, Tasmania. But climatologists are keen to find an explanation. "If we don't understand the switch, then we cannot claim to understand why we have the climate we have today," says Eric Wolff of the British Antarctic Survey in Cambridge, UK.

One possible explanation is that there was a slow decline in the concentration of carbon dioxide in the atmosphere, starting around 3 million years ago. This could have weakened the greenhouse effect and cooled the Earth so much that the tilt towards the sun every 41,000 years no longer provided enough heat to melt the glaciers that formed in between. Confirmation of this idea requires a direct record of the ancient atmosphere - and this can be recovered by analysing the air that became trapped in tiny bubbles within ice as the snow it formed from fell to Earth.

In 2005, the European Consortium for Ice Coring in Antarctica (EPICA) drilled an ice core in Dome C on east Antarctica's plateau that stretches our record of the ancient atmosphere back 800,000 years (*Quaternary Science Reviews*, DOI: 10.1016/j.quascirev.2010.10.002). That's frustratingly short of the crucial transition period, so to extract an older core, the EPICA consortium must now go back to its drill site.

It has been joined in the chase for the million-year-old core by three other teams: one from the Australian Antarctic Division; a US contingent; and one from the Chinese Arctic and Antarctic Administration. Although the groups collaborate, there is no doubt each wants to win the prize.

"China is there already, at Dome A," in east Antarctica, says van Ommen. The Australians are also close to committing to a drill site: van Ommen has just returned from a survey of the Aurora basin in east Antarctica, which is believed to hold the thickest ice in Antarctica.

Despite their head start, however, the Chinese may have run into trouble. Last month, Robin Bell of the Lamont-Doherty Earth Observatory in Palisades, New York, and her colleagues found that ice sheets in Dome A are growing from the bottom up. This could mean that any ancient ice that was once there may have melted and been replaced (*Science*, DOI: 10.1126/science.1200109).

Similar problems may stymie work at other potential drill sites, van Ommen says, but Wolff remains optimistic that the million-year-old ice core will be found. It is only recently that very deep cores have been drilled - and three of them contain ice more than 160,000 years old. "It would be surprising if we happened to have already collected the oldest ice available," Wolff says.

Taking the quick way down

Using conventional drilling methods, it will take three summer seasons in the remote reaches of Antarctica to get to the million-year-old ice that the teams hope lies 3000 metres down. New technology could speed up the task.

A drill assembly is typically a few tens of metres long and can only hold a core of ice of the same length. Longer cores have to be drilled piece by piece, with the drill returning to the surface with each one. For every piece, the stiff, hollow pipes that connect the drill assembly with the rig at the surface have to be assembled as the drill is lowered and dismantled when it comes up again.

Using a flexible coiled tube in place of the stiff pipes avoids this, allowing a hole 3000 metres deep to be drilled in just six days. The coiled drilling tube, which was developed for the oil industry, is also flexible enough to allow the drill to be steered sideways while deep down, opening up the possibility of taking multiple deep cores from a single hole (*Memoirs of National Institute of Polar Research*, special issue 56, p 5).

http://www.newscientist.com/article/mg21028105.100-the-hunt-is-on-for-millionyearold-ice-core.html?full=true&print=true

First partial transplant of a bioengineered larynx

- 29 April 2011 by **Duncan Graham-Rowe**
- Magazine issue 2810

EARLIER this year came news of a second successful voice box transplant. But the recipient, Brenda Jensen, was able to have a new larynx only because she was already taking immunosuppressant drugs to stop her transplanted kidney and pancreas being rejected.

Now Paolo Macchiarini of the Karolinska Institute in Stockholm, Sweden, and colleagues in Italy are developing a technique to treat the donor larynx so that the recipient's body accepts it as its own - and they have just announced their first successful partial transplant.

For a transplant to work, recipients usually have to take immunosuppressants for life to avoid rejecting the foreign tissue. The trouble is that these drugs can reduce life expectancy by 10 years, making it difficult to justify a larynx transplant in an otherwise healthy person when it's not critical for their survival, says Peter Belafsky at the University of California, Davis, who operated on Jensen.

Macchiarini's technique solves the rejection problem by stripping the donor tissue of cells and DNA before reseeding it with stem cells taken from the recipient's bone marrow. His team previously pioneered this bioengineering technique for human windpipe transplants.

"But the larynx is more complex than a windpipe," says Macchiarini. To find out if the technique could be adapted, his team gained consent to remove the larynxes from five cadavers and treated them with enzymes and detergents to remove donor cells. Tests showed that just 0.001 per cent of donor DNA remained - quantities small enough to suggest they could be transplanted without rejection.

The larynx contains two types of cartilage - elastic and hyaline - each with distinct properties. The stripped larynxes showed similar mechanical properties to those of a normal larynx, suggesting they could perform with the same degree of versatility after transplant.

Finally, the researchers showed that blood vessels would regrow in the treated larynxes, making it easier for them to integrate with the recipient's body after transplant (*Biomaterials*, DOI: 10.1016/j.biomaterials.2011.02.055).

In work still to be published, the team describe how they transplanted the cricoid into a patient. This lower section of the larynx is simpler than the upper part and mainly provides structural stability.

They stripped the donor's cells from the cricoid and seeded its outer surface with the recipient's adult stem cells to grow chondrocytes, the cells found in cartilage. "Stem cells were also used to flush the internal surface and seed islets of respiratory cells," says Macchiarini, before the cricoid was transplanted.

Although the researchers are still some way from a full bioengineered larynx transplant, Belafsky is impressed. "It's light years ahead of anything that anyone else is doing," he says.

http://www.newscientist.com/article/mg21028105.200-first-partial-transplant-of-a-bioengineered-larynx.html?full=true&print=true

Mind-controlled prosthetics to help amputees

- 28 April 2011 by **Ferris Jabr**
- Magazine issue 2810

Jesse Sullivan would like an upgrade (Image: Mark Gilliland/AP/PA)

ROBOTIC limbs controlled solely by the mind could be available to paralysed people within a year. Monkeys are being trained to control what might be the world's most sophisticated and human-like robot arm. But they never touch the prosthetic limb or fiddle with a remote control: they guide it with their thoughts alone. If trials are successful, in a few months from now people with spinal cord injuries could learn to do the same.

In 2008, Andrew Schwartz of the University of Pittsburgh in Pennsylvania published a landmark paper describing how two rhesus macaques learned to feed themselves marshmallows and fruit using a crude robotic limb controlled by electrodes implanted in their brains (*Nature*, DOI: 10.1038/nature06996). No brain-controlled prosthetic limb had ever carried out a more complex real-world task. Still, Schwartz envisioned a more elegant and nimble device that paralysed people could use - something much closer to a human hand.

Enter the Modular Prosthetic Limb (MPL), a bionic limb that closely approximates the form and agility of a human arm and hand. Born from the US Defense Advanced Research Projects Agency's Revolutionizing Prosthetics programme, and designed by Michael McLoughlin's team at the Johns Hopkins University Applied Physics Laboratory in Maryland, the MPL is made from a combination of lightweight carbon fibre and high-strength alloys. It has 22 degrees of freedom, compared with the human arm's 30, and can grasp precisely and firmly without crushing fragile objects. The wrist and elbow rotate with ease and, like an average human limb, it weighs just under 4.5 kilograms.

"I would say it's very close to human dexterity," says McLoughlin. "It can't do absolutely everything - it can't cup the palm, for example - but it can control all fingers individually. I don't think there is another limb that approaches it."

A prototype of the MPL has been tested by people who have had one or both arms amputated. Researchers surgically redirect nerves that would normally control the arm into unused chest muscle, where nerve signals are interpreted by electrodes that guide the robotic limb. "One of our patients, Jesse Sullivan, was able to use the arm almost from time zero. It was a very natural thing to do," says McLoughlin. "The brain still thinks the arm is there and if you can tap into those signals, you can really achieve something amazing."

But people paralysed from the neck down cannot benefit from this technique as brain signals cannot reach the chest. So in his work with rhesus macaques, Schwartz developed an array of 100 electrodes that eavesdrops on 100 neurons in the motor cortex. Once he had learned the electrical language the cortex uses to guide arm movement, he converted those signals into instructions for a crude robotic limb with a two-finger clamp. Now Schwartz is training his monkeys again, except this time he wants to teach them to use the five-fingered MPL and perform the kind of everyday but complex tasks we take for granted.
If the monkeys demonstrate that it is possible to steer the arm with brainpower alone, Schwartz and colleagues will give people with spinal cord injuries a chance to try the MPL. "For someone with spinal cord injury, it's a huge deal for them to be able to feed themselves," says McLoughlin. "Nobody has achieved this level of a control in humans with a brain-controlled prosthetic. We want to take it to a higher level than in the past."

http://www.newscientist.com/article/mg21028105.000-mindcontrolled-prosthetics-to-help-amputees.html?full=true&print=true

Digital legacy: Archaeology of the future

- 18:05 03 May 2011 by **Sumit Paul-Choudhury**

Plenty of data to sift through. But only if it lasts (Image: Sam Diephuis/Getty)

The historians of 2061 will want to study the birth of the world wide web. How on earth will they know where to start?
Today, historians have to piece together the details of their subjects' lives from tiny scraps of evidence. Their successors are more likely to be overwhelmed: the problem will be making sense of our vast digital legacies. What techniques will they use to make sense of this deluge?
Many of us now generate more data than we can manage – think of all those holiday pictures you'll never get round to organising into an album. The contents of our hard drives are jumbled messes; the web's lack of structure, coupled with anonymity and the use of aliases, will make the online world an equally formidable challenge for future historians.
All the HTML, MP3 and JPEG files that make up today's web are likely to remain readable for a very long time. But unpicking their original provenance and authenticity will be no mean feat, because data is often duplicated, edited, annotated and modified.
To safeguard our files, we tend to back them up, email documents to ourselves or post pictures online. Files also get passed between people. These actions often change the file, yet most of these changes are minor and usually invisible to a human being.
This is a mixed blessing for internet archaeologists. On one hand, the variations provide valuable insight into how information has spread. On the other, it makes it difficult to establish where it first came from, as anyone who's ever tried to track down the origins of an internet meme will appreciate.

Fuzzy filter

A brute-force way of sifting through all these files for provenance is "hashing": a mathematical technique that summarises a large piece of data as a much smaller number – or "hash value" – making it easy to compare files. But because even a tiny change to the original data will result in a completely different hash value, it can be hard to see the relation between copies.
Breaking each file up into segments and creating a separate hash for each segment can reveal when two files are mostly composed of identical segments and are thus likely to be related.
Such "fuzzy hashes" can be used to find near-identical copies, or to identify incomplete or early drafts – information that a biographer might find helpful.
The technique is not perfect, though: its ability to spot similarities is, well, fuzzy, and it works better for some file types than others. Compressing a picture slightly, for example, doesn't affect its appearance very much, but can change its hash values dramatically.

Write stuff

What about text? The internet is full of anonymous comments, status updates and blog posts. Historians may want to unmask the authors.
One way to do that is look for their characteristic "writeprints": their vocabulary, the length of the sentences they use, words and punctuation patterns they're particularly fond of, and even habitual grammatical mistakes. Normally this requires a substantial chunk of text to work on, but researchers at the National Institute for Computing and Automation Research in Grenoble, France, have designed a system that can link different aliases used by one person, using only the characters that make up their usernames.
You can try a simple version of this approach on the website I Write Like, which tells you which famous writer's output your own deathless prose most resembles. But I Write Like also illustrates some of the difficulties of this approach, notoriously failing to identify some of the writers it actually uses as references. More sophisticated approaches would undoubtedly do better, but changes in our writeprints over time again make it hard to be definitive about the author of a work. (Then again, such changes can be illuminating for literary sleuths: analysis of Agatha Christie's later works have been used to support suspicions that she suffered from dementia.)

Finding meaning

Writeprints confine themselves to the structure of text, but semantic analysis tools go further – trying to identify relevant information in the meaning of the text. That could help future researchers work out what you were like without having to trawl through every one of your status updates.
Defuse, a system under development by Aaron Zinman at the Massachusetts Institute of Technology, represents individual commenters on a website as coloured blocks, based on the kind of language they use and how closely they conform to community norms. It's an attempt to create a kind of "digital body", he says – a pixel portrait that mimics our ability to size someone up at a glance in the physical world.
But Zinman cautions against interpreting the output of such systems too literally. "It's important to understand how complex humans are," he says. "A biography of someone important may be hundreds of pages long, but it's still a condensed account of their life, written through a particular lens and with a particular objective. There are a million ways you can slice the data about a person, and they will look different in each one."
That's a point made more explicitly by Zinman's earlier project, Personas, which purports to reveal how the web sees you by searching for "meaningful" statements.

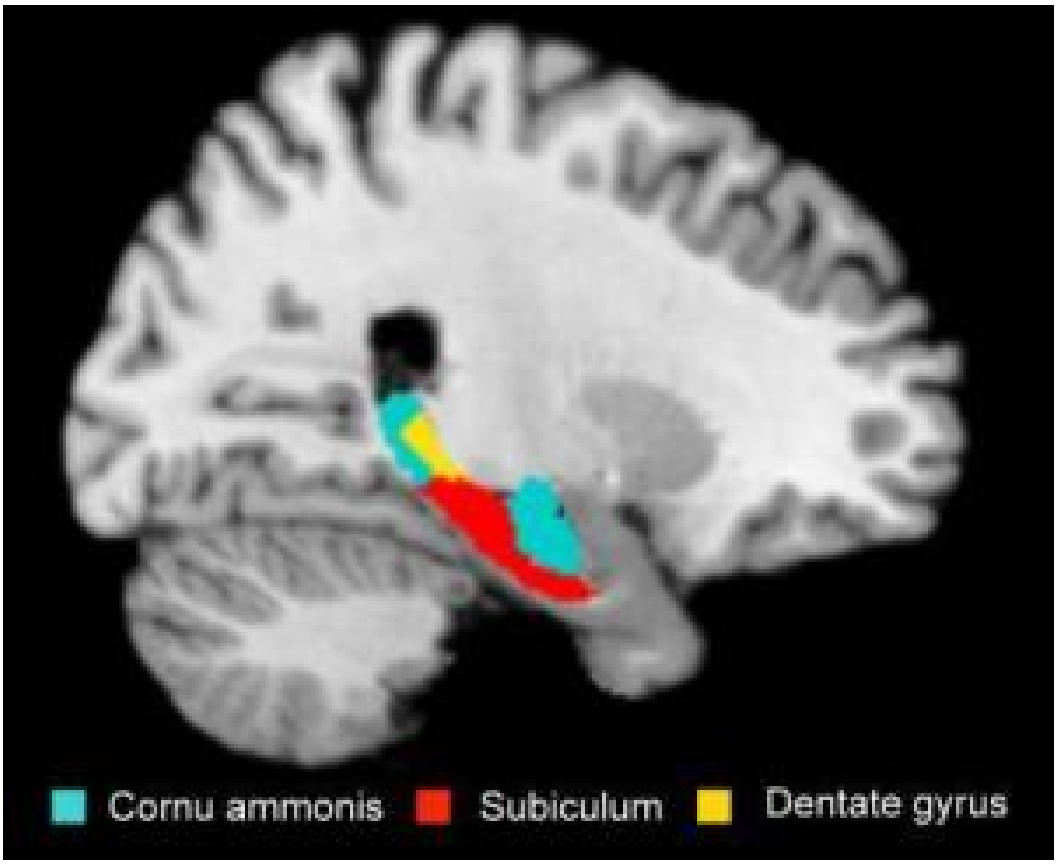
Real messiness

When I tried Personas myself, it came up with "management, education, news", which I'd say is more like a blurry telephoto picture of me than a finely detailed portrait. That's the point: Zinman intended it to illustrate how poorly today's machine learning captures the messiness of real people.
Viktor Mayer-Schönberger of the Oxford Internet Institute in the UK also strikes a cautionary note. "Digital memory only captures digital artefacts," he says. "The more we depend on it, the more tempted we are to attribute qualities to it that it doesn't actually have, like authenticity and comprehensiveness."
So even if the tools of the trade improve immeasurably over the next half-century, they'll still be limited by the records we leave behind us. While those records are becoming ever richer, with our locations and even our heartbeats now being recorded, the historians of 2061 may still get only a glimpse of what we were really like – or at least, who we considered ourselves to be.

Sumit Paul-Choudhury *is the editor of newscientist.com*

http://www.newscientist.com/article/dn20395-digital-legacy-archaeology-of-the-future.html

Scientists Identify Genetic Risk for Major Depression



Depressive patients carrying the risk allele show volume reduction in certain regions of the hippocampus. (Credit: MPI for Psychiatry)

ScienceDaily (May 3, 2011) — A new study reveals a novel gene associated with major depression. The research, published in the April 28 issue of the journal *Neuron*, suggests a previously unrecognized mechanism for major depression and may guide future therapeutic strategies for this debilitating mood disorder.

Major depression is a psychiatric disorder that is responsible for a substantial loss in work productivity and can even lead to suicide in some individuals. "Current treatments for major depression are indispensible but their clinical efficacy is still unsatisfactory, as reflected by high rates of treatment resistance and side effects," explains study author Dr. Martin A. Kohli from the Max Planck Institute of Psychiatry in Munich, Germany. "Identification of mechanisms causing depression is pertinent for discovery of better antidepressants."

While is likely that a combination of genetic and environmental risk factors contribute to major depression, identification of risk-conferring genes has been challenging due to the complexity of the genetics and the considerable environmental factors associated with the disease. Dr. Kohli and colleagues performed a stringent genome-wide association study of patients diagnosed with major depression and matched control subjects with no history of psychiatric illness. They identified SLC6A15, a gene that codes for a neuronal amino acid transporter protein, as a novel susceptibility gene for major depression. The finding was confirmed in an expanded study examining over 15,000 individuals.

The researchers examined the functional relevance of the genetic association between SLC6A15 and major depression. Already nondepressed subjects carrying the risk-conferring genetic variants showed lower expression of SLC6A15 in the hippocampus, a brain region implicated in major depression. Moreover, using human brain imaging, risk variant carriers with a positive life history of major depression showed smaller

hippocampi. Finally, in a mouse model, lower hippocampal SLC6A15 expression was linked to the effects of chronic social stress, a proven risk factor for depression.
The authors suggest that reduced SLC6A15 expression might lead to perturbation of neuronal circuits related to susceptibility for major depression. "Our results support the notion that lower SLC6A15 expression, especially in the hippocampus, could increase an individual's stress susceptibility by altering neuronal integrity and excitatory neurotransmission in this key brain region," says senior author Dr. Elisabeth B. Binder. "Because SLC6A15 appears amenable to drug targeting, our results may incite the discovery of a novel class of antidepressant drugs."

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

Journal Reference:

1. Martin A. Kohli, Susanne Lucae, Philipp G. Saemann, Mathias V. Schmidt, Ayse Demirkan, Karin Hek, Darina Czamara, Michael Alexander, Daria Salyakina, Stephan Ripke et al. **The Neuronal Transporter Gene SLC6A15 Confers Risk to Major Depression**. *Neuron*, Volume 70, Issue 2, 252-265, 28 April 2011 DOI: 10.1016/j.neuron.2011.04.005

http://www.sciencedaily.com/releases/2011/04/110427131816.htm

Rice's Origins Point to China, Genome Researchers Conclude

New research tracing back thousands of years of evolutionary history concludes that rice originated in China. (Credit: © Elwynn / Fotolia)

ScienceDaily (May 2, 2011) — Rice originated in China, a team of genome researchers has concluded in a study tracing back thousands of years of evolutionary history through large-scale gene re-sequencing. Their findings, which appear in the latest issue of the *Proceedings of the National Academy of Sciences* (*PNAS*), indicate that domesticated rice may have first appeared as far back as approximately 9,000 years ago in the Yangtze Valley of China. Previous research suggested domesticated rice may have two points of origin -- India as well as China.

The study was conducted by researchers from New York University's Center for Genomics and Systems Biology and its Department of Biology, Washington University in St. Louis' Department of Biology, Stanford University's Department of Genetics, and Purdue University's Department of Agronomy.

Asian rice, *Oryza sativa*, is one of world's oldest crop species. It is also a very diverse crop, with tens of thousands of varieties known throughout the world. Two major subspecies of rice -- japonica and indica -- represent most of the world's varieties. Sushi rice, for example, is a type of japonica, while most of the long-grain rice in risottos are indica. Because rice is so diverse, its origins have been the subject of scientific debate. One theory -- a single-origin model -- suggests that indica and japonica were domesticated once from the wild rice *O. rufipogon*.

Another -- a multiple-origin model -- proposes that these two major rice types were domesticated separately and in different parts of Asia. The multiple-origin model has gained currency in recent years as biologists have observed significant genetic differences between indica and japonica, and several studies examining the evolutionary relationships among rice varieties supported more than domestication in both India and China.

In the *PNAS* study, the researchers re-assessed the evolutionary history, or phylogeny, of domesticated rice using previously published datasets, some of which have been used to argue that indica and japonica rice have separate origins. Using more modern computer algorithms, however, the researchers concluded these two species have the same origin because they have a closer genetic relationship to each other than to any wild rice species found in either India or China.

In addition, the study's authors examined the phylogeny of domesticated rice by re-sequencing 630 gene fragments on selected chromosomes from a diverse set of wild and domesticated rice varieties. Using new modeling techniques, which had previously been used to look at genomic data in human evolution, their results showed that the gene sequence data was more consistent with a single origin of rice.

In their *PNAS* study, the investigators also used a "molecular clock" of rice genes to see when rice evolved. Depending on how the researchers calibrated their clock, they pinpointed the origin of rice at possibly 8,200 years ago, while japonica and indica split apart from each other about 3,900 years ago. The study's authors pointed out that these molecular dates were consistent with archaeological studies. Archaeologists have uncovered evidence in the last decade for rice domestication in the Yangtze Valley beginning approximately 8,000 to 9,000 years ago while domestication of rice in the India's Ganges region was around about 4,000 years ago.

"As rice was brought in from China to India by traders and migrant farmers, it likely hybridized extensively with local wild rice," explained NYU biologist Michael Purugganan, one of the study's co-authors. "So domesticated rice that we may have once thought originated in India actually has its beginnings in China."
"This study is a good example of the new insights that can be gained from combining genomics, informatics and modeling," says Barbara A. Schaal, Mary-Dell Chilton Distinguished Professor of Biology at Washington University in St. Louis, who is also a co-author. "Rice has a complicated evolutionary history with humans and has accompanied them as they moved throughout Asia. This work begins to reveal the genetic consequences of that movement."
The research was funded by a grant from the National Science Foundation Plant Genome Research Program.

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

Journal Reference:

1. Jeanmaire Molina, Martin Sikora, Nandita Garud, Jonathan M. Flowers, Samara Rubinstein, Andy Reynolds, Pu Huang, Scott Jackson, Barbara A. Schaal, Carlos D. Bustamante, Adam R. Boyko and Michael D. Purugganan. **Molecular evidence for a single evolutionary origin of domesticated rice**. *PNAS*, May 2, 2011 DOI: 10.1073/pnas.1104686108

http://www.sciencedaily.com/releases/2011/05/110502151357.htm

Shootingstars Provide Clues to Likely Response of Plants to Global Warming

A study of two rare species of shootingstar that grow in cliff habitats, the jeweled shootingstar (middle) and French's shootingstar (right) asked whether these are true species, glacial relicts now confined to refuge habitats, or variants of the widespread Mead's shootingstar (left) that adapted to the cliff microclimates. (Credit: Brad Oberle)

ScienceDaily (May 3, 2011) — Both migration and evolution played a role in the adaptation of shootingstars to warmer temperatures after the last ice age. Many scientists are concerned that plant and animal species may face extinction due to global warming, but biologists at Washington University in St. Louis are trying to predict exactly what will happen to them. Which species will migrate? Which evolve? Which change their behavior? Which become extinct?

Rather than peer into the future, they are looking backward, exploring how species alive today survived global warming at the end of the Pleistocene and asking whether their responses provide any guidance for us today.

For his dissertation Brad Oberle, a doctoral candidate in biology in Arts & Sciences at Washington University in St. Louis, delved into the post-Pleistocene history of three species of shootingstars (*Dodecatheon*). Dodecatheon is a genus of flowering plant in the Primrose family, the petals of whose nodding flowers flex upward, giving the flowers the appearance of a star falling to earth, trailing flames behind it.

Two of the species, the jeweled shootingstar (*D. amethystinum*), and French's shootingstar (*D. frenchii*), are rare and grow only in cliff habitats.

Are the rare species glacial relicts, species adapted to the cool wet conditions during the Pleistocene that gradually retreated to smaller and smaller refuges as the climate warmed? Or were they ecotypes, local variants of a widespread species, Mead's shootingstar (*D. meadia*), that had adapted to cliff microclimates but were genetically similar to Mead's shootingstar.

"As is typical of science," says Barbara A. Schaal, PhD, the Mary-Dell Chilton Distinguished Professor of biology in Arts & Sciences, Oberle's dissertation advisor, and his co-author, "the result was mixed. One species is probably a relict species, and the other is probably an ecotype. Some species responded to warming by migrating but other populations apparently adapted in place."

The article was published in the April 5th issue of the *Proceedings of the National Academy of Science* (PNAS).

"It's a lovely piece of work," Schaal says.

Why shootingstars?

"On hikes I took as a kid," says Oberle, who grew up in Missouri, "I noticed it felt very different if you were out in a glade, an open habitat with intense sunshine and high temperatures, than if you were down in a hollow, where it's more sheltered, cooler and tends to be a lot more moist. I also noticed that the plant communities in these two places also differed a lot."

"When I was just getting started on my Ph, I read a book called *The Terrestrial Natural Communities of Missouri* by Paul Nelson.

"One species I learned about, French's shootingstar, specializes in habitats that occur where ledges overhang the bottom of cliffs. These rock houses, as they're called, tend to form in sandstone cliffs because of the way sandstone weathers. The cliff habitats are typically damp and shelter other interesting plants, as well.
"And then, flipping through the book, I found the jeweled shootingstar, another rare species, but one that specializes on limestone cliffs. It usually grows on slopes at the top of the cliffs right before the rock face becomes vertical.
"It also tends to grow in little patches on the rock face itself," says Oberle, who admits both to learning technical climbing to prepare for his fieldwork and to twice falling off cliffs in the field.
"The widespread species, *D. meadia*, is a real mess," he says. "It's a beautiful plant and one that tends to catch a botanist's eye. And almost every botanist that looks at a population of this plant feels that population is special and unique. When botanists have that reaction, they tend to slap a name on the population and call it a new species. Fifty to 100 names have been thrown onto this one species of shootingstar because it's so beautiful, and comes up in the spring when everybody wants to go out and botanize," he says laughing.
"The number of species in the genus is still an open question," Oberle says, "but a revision of this genus published a few years ago named 18 species of *Dodecatheon* in the United States. The revision identified three species in the eastern U.S. and those are the species I worked with."

The relict hypothesis and the ecotype hypothesis

Botanists who believe the rare species of shootingstar are distinct species explain their distribution and ecology as a response to historical climate change.
These species really like cold and moist conditions. They throve throughout the last glacial period.
"If you roll the clock back to 20,000 years ago, St. Louis was 50 to 100 miles from a glacier that was about a mile thick," Oberle says.
These species were widespread at the last glacial maximum when conditions were cooler, but when the climate started to warm up, they couldn't adapt, so their ranges shrank and they became stuck -- i solated in these cliff habitats.
Other botanists, however, think that the shootingstars are just one big jumbled species. If you find an odd-looking shootingstar in a cliff habitat, it isn't because it had some special history, but instead because the cliff habitat has unusual characteristics and the process of natural selection produces local variants that are adapted to those characteristics. So the rare species are ecotypes, plants specialized for a particular habitat, not relicts.

What the hypotheses predict

As Oberle realized, these hypotheses make specific predictions that could be falsified by research.
The relict hypothesis predicts that the relict species will be genetically distinct from any other species in the area. It's doing its own thing and it has its own history and it should be possible to detect that history by looking at patterns of genetic variation.
The relict hypothesis also predicts that far flung populations of the relict species will occur in the same kind of habitat and be genetically more similar to one another than to plants that occur in different habitats, even if those plants are nearby.
The ecotype hypothesis makes a contrasting set of predictions. If the rare species are ecotypes, just local variants of the widespread species, their genomes should not vary markedly from that of another random population of the widespread species.
Further, if the rare populations are ecotypes, they should be more similar genetically to nearby ecotypes than they are to distant ones.

The fieldwork

To distinguish between these hypothesesm Oberle collected shootingstars across the eadtern United States, from Pennsylvania to Texas, and from Georgia up to Minnesota.
"One of the ironies of this project," he says ruefully, "was that I was doing this research about global warming and I was driving all over the country to do it. But it was a fantastic trip, and I got to see amazing places and meet very generous people.
"At every location, I'd take GPS coordinates, try to get a sense for how big the population of plants was, and then sample the plants in a consistent way.
"I measured a trait called specific leaf area, or the fresh leaf area per unit mass, because it gave me insight into how well the plants were adapted to the habitats where I found them.

"I also grabbed leaves for genetic analysis. I sequenced some DNA from all of the plants, but because DNA sequences don't vary much between plants, I turned to a technique called amplified fragment-length polymorphism (AFLP). That technique tends to be very sensitive; closely related individuals often have very different AFLP banding patterns.
"And finally, I collected a voucher specimen from every population for the herbarium at the Missouri Botanical Garden," Oberle says.

Some relicts, some ecotypes

The results, which ultimately emerged from the genetic work, depended on the species.
"Populations of jeweled shootingstar from Wisconsin and from Pennsylvania are genetically distinct from all other shootingstars in North America and very similar to one another even though they are so far apart," Oberle says.
This suggests the jeweled shootingstar is a relict, a plant that was widespread in the past but whose range has become fragmented and that that now survives only in refuge habitats.
French's shootingstar, on the other hand, is not genetically distinct from *D. meadia* at all, even though these plants look different and grow in different habitats. Although earlier work has showed they were genetically adapted to different circumstances, overall their genomes are very much alike. So French's shootingstar is probably just a simple ecotype of *D. meadia*.

Conservation recommendations

The results suggest that the two rare "species" of shootingstar in the eastern United States should be managed quite differently. Because the jeweled shootingstar is a relict, it's probably hanging on by a thread. If climate continues to warm, it is likely to go extinct.
"Because we know this species is genetically distinctive, the jeweled shootingstar should be a priority for conservation as climate continues to warm," Oberle says.
On the other hand, since French's shootingstar is an ecotype, that suggests that it's capable of adapting to changing climate.
And, because it isn't genetically distinctive, a population of French's shootingstar has the same conservation value as any other random population of *D. meadia*.
But, Oberle cautions, shootingstars may not respond to human-caused global warming as they did to the warming at the end of the last ice age, both because the warming is more rapid and because the habitat is now fragmented.

The sad part

"I was sad to come to the conclusion that *D. frenchii* wasn't really a distinct species, because it is a beautiful plant and it grows in a beautiful habitat, so part of me wanted to recognize the beautiful distinction of it, too.
"My family has owned a farm since the 1860s that is near one of these sandstone cliff habitats. My grandparents and my great-grandparents used to go there in the summertime to rest under the waterfall after working in the fields. And this cliff has a population of *D. frenchii*, one of the few populations in Missouri. So I have a family connection to this beautiful rare plant, and my research showed it is not as special as we thought it was.
"I felt almost as though I had caused an extinction, although the extinction was just an extinction on paper."

Story Source:

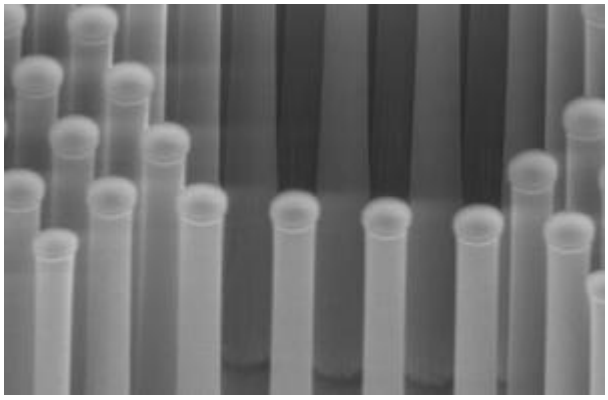
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Washington University in St. Louis**.

Journal Reference:

1. B. Oberle, B. A. Schaal. **Responses to historical climate change identify contemporary threats to diversity in Dodecatheon**. *Proceedings of the National Academy of Sciences*, 2011; 108 (14): 5655 DOI: 10.1073/pnas.1012302108

http://www.sciencedaily.com/releases/2011/04/110411152631.htm

Hydrogen Fuel Tech Gets Boost from Low-Cost, Efficient Catalyst



A team of researchers have engineered a cheap, abundant alternative to the expensive catalyst platinum and coupled it with a light-absorbing electrode to make hydrogen fuel from sunlight and water. The discovery was published in Nature Materials by theorist Jens Nørskov of the Department of Energy's SLAC National Accelerator Laboratory and Stanford University and a team of colleagues led by Ib Chorkendorff and Søren Dahl at the Technical University of Denmark. The team optimized a photo-electrochemical water splitting device by designing light absorbers made of silicon arranged in closely packed pillars, imaged above using a scanning electron microscope. After dotting the pillars with tiny clusters of the new catalyst and exposing the pillars to light, researchers watched as hydrogen gas bubbled up -- as quickly as if they'd used costly platinum. (Credit: Image courtesy of Christian D. Damsgaard, Thomas Pedersen and Ole Hansen, Technical University of Denmark)

ScienceDaily (May 3, 2011) — Scientists have engineered a cheap, abundant alternative to the expensive platinum catalyst and coupled it with a light-absorbing electrode to make hydrogen fuel from sunlight and water.

The discovery is an important development in the worldwide effort to mimic the way plants make fuel from sunlight, a key step in creating a green energy economy. It was reported in *Nature Materials* by theorist Jens Nørskov of the Department of Energy's SLAC National Accelerator Laboratory and Stanford University and a team of colleagues led by Ib Chorkendorff and Søren Dahl at the Technical University of Denmark (DTU).

Hydrogen is an energy dense and clean fuel, which upon combustion releases only water. Today, most hydrogen is produced from natural gas which results in large CO_2-emissions. An alternative, clean method is to make hydrogen fuel from sunlight and water. The process is called photo-electrochemical, or PEC, water splitting. When sun hits the PEC cell, the solar energy is absorbed and used for splitting water molecules into its components, hydrogen and oxygen.

Progress has so far been limited in part by a lack of cheap catalysts that can speed up the generation of hydrogen and oxygen. A vital part of the American-Danish effort was combining theory and advanced computation with synthesis and testing to accelerate the process of identifying new catalysts. This is a new development in a field that has historically relied on trial and error. "If we can find new ways of rationally designing catalysts, we can speed up the development of new catalytic materials enormously," Nørskov said.

The team first tackled the hydrogen half of the problem. The DTU researchers created a device to harvest the energy from part of the solar spectrum and used it to power the conversion of single hydrogen ions into hydrogen gas. However, the process requires a catalyst to facilitate the reaction. Platinum is already known as an efficient catalyst, but platinum is too rare and too expensive for widespread use. So the collaborators turned to nature for inspiration.

They investigated hydrogen producing enzymes -- natural catalysts -- from certain organisms, using a theoretical approach Nørskov's group has been developing to describe catalyst behavior. "We did the calculations," Nørskov explained, "and found out why these enzymes work as well as they do." These studies led them to related compounds, which eventually took them to molybdenum sulfide. "Molybdenum is an inexpensive solution" for catalyzing hydrogen production, Chorkendorff said.

The team also optimized parts of the device, introducing a "chemical solar cell" designed to capture as much solar energy as possible. The experimental researchers at DTU designed light absorbers that consist of silicon arranged in closely packed pillars, and dotted the pillars with tiny clusters of the molybdenum sulfide. When they exposed the pillars to light, hydrogen gas bubbled up -- as quickly as if they'd used costly platinum.
The hydrogen gas-generating device is only half of a full photo-electrochemical cell. The other half of the PEC would generate oxygen gas from the water; though hydrogen gas is the goal, without the simultaneous generation of oxygen, the whole PEC cell shuts down. Many groups -- including Chorkendorff, Dahl and Nørskov and their colleagues -- are working on finding catalysts and sunlight absorbers to do this well. "This is the most difficult half of the problem, and we are attacking this in the same way as we attacked the hydrogen side," Dahl said.
Nørskov looks forward to solving that problem as well. "A sustainable energy choice that no one can afford is not sustainable at all," he said. "I hope this approach will enable us to choose a truly sustainable fuel."

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

Journal Reference:

1. Yidong Hou, Billie L. Abrams, Peter C. K. Vesborg, Mårten E. Björketun, Konrad Herbst, Lone Bech, Alessandro M. Setti, Christian D. Damsgaard, Thomas Pedersen, Ole Hansen, Jan Rossmeisl, Søren Dahl, Jens K. Nørskov, Ib Chorkendorff. **Bioinspired molecular co-catalysts bonded to a silicon photocathode for solar hydrogen evolution**. *Nature Materials*, 2011; DOI: 10.1038/nmat3008

http://www.sciencedaily.com/releases/2011/05/110502110631.htm

Lichen Evolved on Two Tracks, Like Marsupials and Mammals

This image shows the fungal fruiting body of the newly identified lichen species, Xanthoparmelia hypofusca. (Credit: Hodkinson & Lendemer 2011)

ScienceDaily (May 2, 2011) — Lichen -- those drab, fuzzy growths found on rocks and trees -- aren't as cuddly and charismatic as kangaroos or intriguing as opossums, but they could be a fungal equivalent, at least evolutionarily.

A Duke research team has found that lichen that seem identical in all outward appearances and produce the same internal chemicals are in fact two different species, one living in North America and one in Australia. They're an example of "convergent evolution," in which two species evolve separately but end up looking very similar, like the Tasmanian wolf and the American wolf.

The lichens developed the same adaptations to survive and thrive in vastly different regions of the world. Since they show the same evolutionary patterns as marsupials and mammals, but are easier to study, they could become model organisms to further probe how mammals and other groups of organisms evolve, said Duke biologist Brendan Hodkinson.

"Lichen can often seem dull and uncharismatic, but these two species turned out to be quite intriguing," said Hodkinson, a graduate student in the lab of Duke lichenologist François Lutzoni. "They're like sugar gliders and flying squirrels or wombats and groundhogs. They're fungal examples of convergent evolution."

Scientists originally labeled specimens from both continents *Xanthoparmelia tasmanica*, which, like all lichen, is a type of fungus that "farms" algae. The lichen specimens were thought to be one species because they shared the same body plan and produced the same chemicals.

But given the lichens' geography and the natural history of other species, some scientists still questioned whether the organisms were truly identical, even though previous tests showed that they were.

When the question came up again in 2009, Hodkinson and James Lendemer of the New York Botanical Garden gathered lichen samples from North America and Australian specimens preserved in herbariums at

Duke and the New York Botanical Garden to find out. They studied the organisms' body structure and chemical composition and also found no difference.
But then the lichenologists looked at the organisms' DNA, which nobody had done before.
Hodkinson and Lendemer used this analysis and computer modeling of the lichens' evolution to digitally reconstruct a family tree. The tree clearly showed that the Australian lichen evolved on a branch completely separate from the North American lichen, suggesting that the organisms are separate species.
The lichenologists describe their work and rename the North American lichen species *Xanthoparmelia hypofusca*, following past lichen literature, in a paper that appears in the latest issue of the journal *Bibliotheca Lichenologica*.
Hodkinson added that lichen are important for another reason. Like canaries in a noxious coal mine, lichen die when the air is unhealthy. Scientists have already seen some species disappear in Europe since the beginning of the Industrial Revolution. A few were hardy and came back when air quality improved, but "we may not always be that lucky and we could see some lichen go the way of the Tasmanian wolf -- extinct," he said.

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

http://www.sciencedaily.com/releases/2011/05/110502110622.htm

No Nuts for 'Nutcracker Man': Early Human Relative Apparently Chewed Grass Instead

This photo of casts of two palates demonstrates the large size of the teeth of Paranthropus boisei (left), an early human relative that lived in East Africa between 2.3 million and 1.2 million years ago and was known as Nutcracker Man. Much smaller teeth from a human skull are shown on the right. A new study led by University of Utah researchers shows that Nutcracker Man didn't eat nuts as had been believed for decades, but instead used the large, flat teeth to chew grasses or plants known as sedges. (Credit: Melissa Lutz Blouin, University of Arkansas)

ScienceDaily (May 3, 2011) — For decades, a 2.3 million- to 1.2 million-year-old human relative named *Paranthropus boisei* has been nicknamed Nutcracker Man because of his big, flat molar teeth and thick, powerful jaw. But a definitive new University of Utah study shows that Nutcracker Man didn't eat nuts, but instead chewed grasses and possibly sedges -- a discovery that upsets conventional wisdom about early humanity's diet.

"It most likely was eating grass, and most definitely was not cracking nuts," says geochemist Thure Cerling, lead author of the study published in the May 2 online edition of the journal *Proceedings of the National Academy of Sciences*.

Study co-author Kevin Uno, a University of Utah Ph.D. student in geology, adds: "This study provides evidence that *Paranthropus boisei* was not cracking nuts, but was instead eating mainly tropical grasses or sedges. It was not competing for food with most other primates, who ate fruits, leaves and nuts; but with grazers -- zebras' ancestors, suids [ancestors of pigs and warthogs] and hippos."

Cerling and colleagues determined the extinct, upright-walking *Paranthropus boisei*'s diet by analyzing carbon isotope ratios in the tooth enamel of 24 teeth from 22 individuals who lived between 1.4 million and 1.9 million years ago and were closely related to and once thought part of the genus of human ancestors named Australopithecus. Both extinct Paranthropus and the human genus Homo arose from Australopithecus.

University of Utah researchers Cerling and Uno conducted the study with three scientists from the National Museums of Kenya -- anthropologist Emma Mbua and paleontologists Francis Kirera and Fredrick Manthi -- and with Frederick Grine of Stony Brook University, anthropologist Matt Sponheimer of the University of

Colorado at Boulder and famed anthropologist Meave Leakey, who is affiliated with the National Museums, Stony Brook and the Turkana Basin Institute in Nairobi.

Drilling for Evidence of Prehistoric Dinners

Cerling used a drill to pulverize some tooth enamel into powder, but only 2 milligrams per tooth and only from the broken surface of broken teeth, leaving the original surfaces intact for future study. Still, there was anticipation among officials at the National Museums of Kenya, where the teeth are housed.

"The sound of the drill may make a lot of paleontologists and museum staff cringe, but as the results of this study show, it provides new information that we can't get at any other way," Uno says. "And we've gotten very good at drilling."

Carbon isotope ratios in tooth enamel can reveal whether ancient animals ate plants that used what is called C3 photosynthesis -- trees (and the leaves, nuts and fruits they produce), shrubs, cool-season grasses, herbs and forbs -- or plants such as warm-season or tropical grasses and sedges that use what is known as C4 photosynthesis. (Sedges vaguely resemble grasses, but their stems' cross-sections usually are triangular, which means "sedges have edges" when rotated between thumb and finger.)

The study found that not only did the Nutcracker Man *Paranthropus boisei* not eat nuts or other C3 plant products, but dined more heavily on C4 plants like grasses than any other early human, human ancestor or human relative studied to date. Only an extinct species of grass-eating baboon had a diet so dominated by C4 plants.

Carbon isotopes showed the 22 individuals had diets averaging 77 percent C4 plants such as grasses, ranging from a low of 61 percent to a high of 91 percent.

That's statistically indistinguishable from grass diets of grazing animals that lived at the same time: the ancestors of zebras, pigs and warthogs, and hippos, Cerling says.

"They were competing with them," he adds. "They were eating at the same table."

The researchers also analyzed oxygen isotope composition in the fossil teeth, which indicated Paranthropus boisei lived in semi-arid savannah with woodlands along rivers or lakes.

Research in 2008 on two teeth from Nutcracker Man in Tanzania also indicated the creatures ate a diet of grasses and perhaps sedges. But with teeth from 22 individuals, the new study shows the species was eating grass and other C4 plants over a much longer time period (from 1.4 million to 1.9 million years ago) and bigger geographic area (a 500-mile-wide swath of East Africa) than was known before.

"Wherever we find this creature, it is predominantly eating tropical grasses or perhaps sedges, which include papyrus," Cerling says.

Rethinking the Diets of Early Human Ancestors and Relatives

The new study of Nutcracker Man may provoke a major change in how we view the diets of other early humans and human relatives.

"Much of the previous work has been on the size and shape of the teeth, along with microwear analysis," Cerling says. "Our results [on Paranthropus boisei] are completely different than the conclusions based on 50-plus years of research along those lines. It stands to reason that other conclusions about other species also will require revision. *P. boisei* greatly extends the range of potential diets for early human lineages."

Specifically, scientists have believed human ancestors in the genus Australopithecus -- which gave rise to now-extinct Paranthropus and to Homo or early humans -- also had head and tooth features suggesting they ate hard objects like nuts.

Cerling says carbon isotope ratios in australopiths' teeth now should be studied, since the Paranthropus findings bring in to question interpretations that are made without isotopic information on diets.

"The high proportion of C4 vegetation in the diet of *Paranthropus boisei* makes it different from any other hominin to date, even its closest relative, *Paranthropus robustus* from southern Africa," Uno says. "The results make an excellent case for isotope analysis of teeth from other members of our family tree, especially from East Africa."

A Brief Biography of 'Nutcracker Man'

The cranium of the extinct early human relative now known as *Paranthropus boisei* was discovered by Meave Leakey's in-laws, Mary and Louis Leakey, in 1959 at Olduvai Gorge in Tanzania, and helped put the Leakeys on the world stage.

Dated at 1.75 million years old, it initially was known as *Zinjanthropus boisei* (zinj for an African religion named Zanj, anthropus for ape-human and boisei after expedition benefactor Charles Boise) and later as *Australopithecus boisei*, before scientists decided it deserved a separate genus, making it *Paranthropus boisei*. The discovery of other *P. boisei* fossils revealed the species lived in East Africa (including Kenya and Ethiopia) from 2.3 million years ago to 1.2 million years ago. The short creatures had big, flat premolars and molars; thick tooth enamel; muscle-attachment surfaces for large chewing muscles; and powerful jaws. Those characteristics earned *Paranthropus boisei* the nickname Nutcracker Man -- a name that has been attributed to South African paleoanthropologist Phillip Tobias, a colleague of the Leakeys.

According to Dale Peterson's biography of anthropologist Jane Goodall, the Leakeys took privately to calling the Zinj skull "Dear Boy," and that it was Tobias who convinced them to switch the genus to Australopithecus and who also suggested that the thick molars made the skull look like a children's wooden toy named Nutcracker Man.

"So while the rather obscure and academic debates about naming and grouping the skull kept all the specialists entertained, for the public at large, this same fossil became simply Nutcracker Man," Peterson wrote.

"Nutcracker Man never has been used in the scientific literature, but that's the common name," Cerling says.

Story Source:

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

Journal Reference:

1. Thure E. Cerling, Emma Mbua, Francis M. Kirera, Fredrick Kyalo Manthi, Frederick E. Grine, Meave G. Leakey, Matt Sponheimer, Kevin T. Uno. **Diet of Paranthropus boisei in the early Pleistocene of East Africa**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1104627108

http://www.sciencedaily.com/releases/2011/05/110502151343.htm

Itch Receptors Work Through Pain Receptors on Sensory Neurons

A new study of itch adds to growing evidence that the chemical signals that make us want to scratch are the same signals that make us wince in pain. (Credit: © ampyang / Fotolia)

ScienceDaily (May 2, 2011) — A new study of itch adds to growing evidence that the chemical signals that make us want to scratch are the same signals that make us wince in pain.

The interactions between itch and pain are only partly understood, said itch and pain researcher Diana Bautista, an assistant professor of molecular and cell biology at the University of California, Berkeley. The skin contains some nerve cells that respond only to itch and others that respond only to pain. Others, however, respond to both, and some substances cause both itching and pain.

If itch and pain are closely linked, however, the implications are huge, Bautista said. If pain and itch use the same molecules to communicate with the brain, drugs now being developed to alleviate pain may also help quiet intractable itch.

"Some types of itch respond to antihistamines, but most itch, especially itch associated with chronic diseases like kidney and liver failure, diabetes and cancer, does not," she said. "Even allergic itch only partly responds to antihistamines. We've shown that one of the drugs now being looked at by pharmaceutical companies as a pain reliever also blocks some types of histamine-independent itch."

Bautista's new research, published in this week's print edition of the journal *Nature Neuroscience*, shows that two specific irritants induce itching by way of the wasabi receptor, a pain receptor familiar to sushi lovers. Other recent studies have shown that some itch inducers -- called pruritogens -- lead to activation of the capsaicin receptor, a pain receptor named for the incendiary chemical in chili peppers.

"It's starting to look like many pain receptors are linked to the itch system," she said. "Both itch and pain use some of the same molecules to send signals to the brain."

Bautista has genetically altered mice so that they don't produce the wasabi receptor, and hopes that the mouse strain will help lead to a better understanding of forms of itch that do not respond to antihistamines.

Itch and pain aspects of touch

Pain and itch are extremes of our sense of touch, which itself is not well understood, Bautista said. While research has shown in detail how touch receptors on the skin map to the brain, "it's really an open question which molecules are involved in detecting tactile stimuli, like vibrations or light touch, and how these molecules are modulated."

In her lab, she applies a huge variety of chemical and physical stimuli to the skin in order to study and isolate the specific receptors that respond to such stimuli. She also grows skin cells and sensory neurons in dishes to probe them more thoroughly.

"One of the cool things about touch cells is you can put them in a dish, and you can poke them, and they'll respond to touch with an electrical signal," Bautista told the Daily Californian news outlet last year.

Five years ago, Bautista showed that allyl isothiocyanate, the sinus-clearing ingredient in wasabi, hot mustard and garlic, causes pain solely by activating a receptor called TRPA1 on sensory nerves. The receptor is one of a group of transient receptor potential (TRP) ion channels in sensory nerves under the skin, including the mouth and mucus membranes, which detect temperature, mechanical abrasion and irritating chemicals. The capsaicin and heat receptor, dubbed TRPV1, is another such ion channel, as is TRPM8, a cold-activated

channel targeted by menthol and other cooling agents. When these receptors are activated, they open up and depolarize the nerve cell, which transmits an attention-grabbing pain signal through the spinal cord to the brain.

The pain work led to an interest in itch, and Bautista has accumulated a variety of agents that stimulate the itch reflex, including the plant called cowhage (Mucuna pruriens) and the drug chloroquine, an antimalarial that often causes a hellish, all-over itch. In some African countries up to 70 percent of the population develops itch from chloroquine, which causes many people to stop taking it.

Only between 5 and 20 percent of the skin's sensory nerves are sensitive to itch, and one group of them has histamine receptors that can be blocked by antihistamines to stop the itch. Both chloroquine and cowhage, however, cause a histamine-independent itch, as do opium compounds; inflammation, from asthma and allergies to skin rash; and eczema. These are currently untreatable and the focus of Bautista's research.

A common feature of itch receptors is that they are members of a family of G protein-coupled receptors widely used by the body to transmit signals from outside the cell into the cell interior. Bautista's colleague Xinzhong Dong in the Solomon H. Snyder Department of Neuroscience at Johns Hopkins University School of Medicine in Baltimore recently identified two new itch receptors, both of them Mas-related G protein-coupled receptors. One, MrgprA3, is stimulated by chloroquine, while the second, MrgprC11, is stimulated by BAM8-22, a peptide released by immune cells, including mast cells, during inflammation.

If sensory nerves contain pain receptors like TRPA1 and TRPV1, and itch receptors like MrgprA3 and MrgprC11, how does the cell distinguish between itch and pain? Bautista asked.

Focus on wasabi

Bautista tested both chloroquine and the mast cell chemical BAM8-22 on cultured mouse cells and found that both activate the wasabi receptor, TRPA1, causing a depolarization of nerve cells. In addition, knock-out mice that lack the receptor do not respond to either chemical, while a chemical that blocks the receptor also stops the itch.

Her interpretation of the results is that in sensory nerves with both the chloroquine itch receptor and the wasabi pain receptor, when chloroquine binds to its receptor, it subsequently opens the wasabi receptor, which depolarizes the nerve cell and sends an itch signal to the brain. Similarly, in the cells that have both a BAM8-22 itch receptor and a wasabi receptor, BAM8-22 triggers opening of the wasabi receptor. Both itch inducers trigger the pain receptors through G protein couplings inside the cell.

"These experiments provide a wonderful demonstration that chloroquine and BAM8-22 cause itch only through the wasabi receptor," she said. "If both pathways converge on the same ion channel, perhaps other molecules that cause itch also use this channel."

Bautista's coauthors, in addition to Dong, are UC Berkeley graduate students Sarah R. Wilson and Kristin A. Gerhold and research associate Amber Bifolck-Fisher, and Johns Hopkins graduate students Qin Liu and Kush N. Patel.

The work is funded by the National Institutes of Health, including an NIH Innovator Award, the Pew Scholars Program, the Rita Allen Foundation, the McKnight Scholars Fund and the National Science Foundation.

Story Source:

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

Journal Reference:

1. Bailong Xiao, Ardem Patapoutian. **Scratching the surface: a role of pain-sensing TRPA1 in itch**. *Nature Neuroscience*, 2011; 14 (5): 540 DOI: 10.1038/nn.2813

http://www.sciencedaily.com/releases/2011/05/110502092000.htm

Sniffing out Calories: Hormone Linked to Nose's Ability to Locate Food

Fresh baked chocolate chip cookies. An appetite-stimulating hormone causes people and animals to sniff odors more often and with greater sensitivity, according to a new study. The findings suggest ghrelin may enhance the ability to find and identify food. (Credit: © Stephen Bonk / Fotolia)

ScienceDaily (May 2, 2011) — The hormone ghrelin, known to promote hunger and fat storage, has been found to enhance exploratory "sniffing" in both animals and humans.

The research, by University of Cincinnati (UC) scientists, suggests that ghrelin may be designed to boost detection of calories in our environment through smell and link those inputs with natural regulation of metabolism and body weight.

Led by Jenny Tong, MD, and Matthias Tschöp, MD, both of UC's endocrinology, diabetes and metabolism division, the study appears in the April 13, 2011, issue of The *Journal of Neuroscience*, the official journal of the Society for Neuroscience.

"Smell is an integral part of feeding and mammals frequently rely on smell to locate food and discriminate among food sources," says Tong. "Sniffing is the first stage of the smell process and can enhance odor detection and discrimination."

The research team tested both rats and humans. Rats were given ghrelin and monitored for sniff frequency using a video-based behavior analysis system set to record the movement of the nose tip. The investigators also measured the ability of the rats to detect specific odors mixed in water.

Human subjects were evaluated before and after ghrelin infusion using a sniff magnitude test (SMT) developed at the University of Cincinnati by co-investigator Robert Frank, PhD. Subjects were instructed to take a natural sniff of several odorants using the SMT canister and rate the smells in order of pleasantness. Software connected to the canister allowed researchers to measure sniff pressure to determine overall sniff magnitude.

Data for both humans and rats show ghrelin enhanced odor detection and exploratory sniffing.

"Other studies have shown that hunger can enhance odor detection and sniffing in animals," says Tschöp. "Since ghrelin is a hunger-inducing stomach hormone that is secreted when the stomach is empty, this hormone pathway may also be responsible for the hunger-induced enhancement of sniffing and odor detection."

The scientists say this study could open up new avenues connecting metabolic control, chemo-sensation and behavioral neuroscience research. Future studies will explore the exact molecular pathways through which ghrelin affects sniff behavior.
The study was supported by grants from the National Institutes of Health and the Netherlands Organization for Scientific Research.

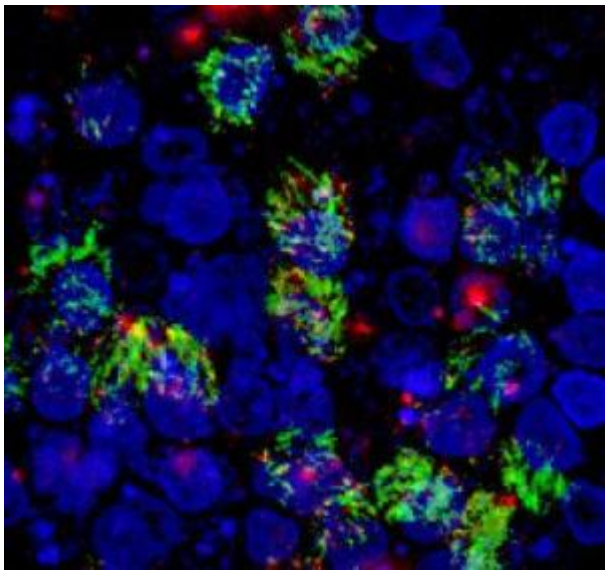
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Cincinnati Academic Health Center**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. J. Tong, E. Mannea, P. Aime, P. T. Pfluger, C.-X. Yi, T. R. Castaneda, H. W. Davis, X. Ren, S. Pixley, S. Benoit, K. Julliard, S. C. Woods, T. L. Horvath, M. M. Sleeman, D. D'Alessio, S. Obici, R. Frank, M. H. Tschop. **Ghrelin Enhances Olfactory Sensitivity and Exploratory Sniffing in Rodents and Humans**. *Journal of Neuroscience*, 2011; 31 (15): 5841 DOI: 10.1523/JNEUROSCI.5680-10.2011

http://www.sciencedaily.com/releases/2011/04/110412171200.htm

Receptor for Ebola Virus Identified



Cellular protein TIM-1 acts as a receptor for Ebola virus and Marburg virus. Microscope image shows TIM-1 expression (in green) on the surface of human airway cells. (Credit: University of Iowa)

ScienceDaily (May 3, 2011) — A team of researchers has identified a cellular protein that acts as a receptor for Ebola virus and Marburg virus. Furthermore, the team showed that an antibody, which binds to the receptor protein, is able to block infection by both viruses.

"This is the first receptor identified for Ebola and Marburg viruses," said Wendy Maury, Ph.D., associate professor of microbiology at the University of Iowa Roy J. and Lucille A. Carver College of Medicine and senior study author. "That's important because if you can identify and understand the first step in infection -- how the virus enters cells -- then perhaps you can prevent the infection by nipping it in the bud."

Ebola and Marburg viruses cause hemorrhagic fever in humans and other primates. For some strains, infection can lead to death in 50 to 90 percent of cases, and there is no cure or effective treatment. The findings are published online the week of May 2 in the *Proceedings of the National Academy of Sciences* Early Edition.

Maury led a multidisciplinary team that included colleagues from four UI departments as well as collaborators at the National Institute of Dental and Craniofacial Research (NIDCR) in Bethesda, Md., University of Texas Medical Branch in Galveston, Texas, and Biogen Idec, in Cambridge, Mass.

The researchers used a new bioinformatics-based approach, developed by John Chiorini at NIDCR, to identify a protein called TIM-1 as a receptor for Ebola and Marburg viruses. Subsequent experiments proved that both Ebola and Marburg viruses use TIM-1 is a receptor for infecting cells.

The study also showed that TIM-1 protein is widely expressed on epithelial cells that line various tissues in the body including mucosal surfaces of the airways and in the eyes.

Maury noted that these locations are consistent with some of the ways the Ebola virus is thought to be transmitted -- inhalation of aerosolized droplets and hand-to-eye contact.

A further collaboration with Paul Rennert, Ph.D., at Biogen Idec, a biotech company based in Cambridge, Mass., provided the team with antibodies targeted to TIM-1 and the team found that one of these antibodies, ARD5, very effectively blocks Ebola and Marburg virus entry into cells.

Finally, work performed by Robert Davey, Ph.D., in a BSL-4 lab (the highest level of biocontainment) at University of Texas Medical Branch verified that the ARD5 antibody blocks infection by infectious Zaire Ebola Virus in cells that express the TIM-1 protein.

The results suggest that being able to block Ebola's entry into epithelial cells, perhaps with a human-compatible version of the ARD5 antibody, might provide a way to prevent initial infection and potentially limit the spread of the disease during an outbreak.

Importantly, the study found that TIM-1 protein is not expressed on all the cell types that are infected by Ebola and Marburg.

"It's clear that there are other receptors for Ebola because while TIM-1 is found on a number of epithelial cells in the body, it is not found on some important cell types that are infected by Ebola," Maury said. "Ultimately, epithelial cells are not as important a target for the virus as some other cell types, but they may be the first entry point for Ebola, so they may provide a conduit that allows Ebola access to those other cells within the body."

The research team also included first author Andrew Kondratowicz, a UI graduate student, and UI researchers Paul McCray; Nicholas Lennemann; Patrick Sinn; Catherine Hunt; Sven Moller-Tank; David Meyerholz; Robert Mullins; Melinda Brindley and Lindsay Sanderfeld as well as Kathrina Quinn and Melodie Walker at the NIDCR.

The study was funded in part by grants from the National Institutes of Health.

Story Source:

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

Journal Reference:

1. Andrew S. Kondratowicz, Nicholas J. Lennemann, Patrick L. Sinn, Robert A. Davey, Catherine L. Hunt, Sven Moller-Tank, David K. Meyerholz, Paul Rennert, Robert F. Mullins, Melinda Brindley, Lindsay M. Sandersfeld, Kathrina Quinn, Melodie Weller, Paul B. Mccray, Jr., John Chiorini, and Wendy Maury. **T-cell immunoglobulin and mucin domain 1 (TIM-1) is a receptor for Zaire Ebolavirus and Lake Victoria Marburgvirus**. *PNAS*, May 2, 2011 DOI: 10.1073/pnas.1019030108

http://www.sciencedaily.com/releases/2011/05/110502151349.htm

'Apple a Day' Advice Rooted in Science

Everyone has heard the old adage, "an apple a day keeps the doctor away." We all know we should eat more fruit. But why apples? Do they contain specific benefits? (Credit: © Edyta Pawlowska / Fotolia)

ScienceDaily (May 3, 2011) — Everyone has heard the old adage, "an apple a day keeps the doctor away." We all know we should eat more fruit. But why apples? Do they contain specific benefits?

According to Dr. Bahram H. Arjmandi, PhD, RD, Margaret A. Sitton Professor and Chair, Department of Nutrition, Food and Exercise Sciences at The Florida State University, apples are truly a "miracle fruit" that convey benefits beyond fiber content. Animal studies have shown that apple pectin and polyphenols in apple improve lipid metabolism and lower the production of pro-inflammatory molecules. Arjmandi's most recent research is the first to evaluate the long-term cardioprotective effects of daily consumption of apple in postmenopausal women.

The results of this USDA-funded study will be presented at Experimental Biology 2011 on April 12 in Washington, DC.

This study randomly assigned 160 women ages 45-65 to one of two dietary intervention groups: one received dried apples daily (75g/day for 1 year) and the other group ate dried prunes every day for a year. Blood samples were taken at 3, 6 and 12-months. The results surprised Dr. Arjmandi, who stated that "incredible changes in the apple-eating women happened by 6 months- they experienced a 23% decrease in LDL cholesterol," which is known as the "bad cholesterol." The daily apple consumption also led to a lowering of lipid hydroperoxide levels and C-reactive protein in those women.

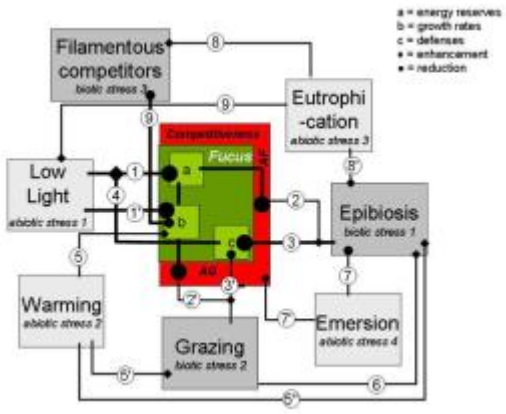
"I never expected apple consumption to reduce bad cholesterol to this extent while increasing HDL cholesterol or good cholesterol by about 4%," Arjmandi said. Yet another advantage is that the extra 240 calories per day consumed from the dried apple did not lead to weight gain in the women; in fact, they lost on average 3.3 lbs. "Reducing body weight is an added benefit to daily apple intake" he said. Part of the reason for the weight loss could be the fruit's pectin, which is known to have a satiety effect. The next step in confirming the results of this study is a multi-investigator nationwide study.

There is frequently some truth behind our common expressions, and in the case of 'an apple a day,' Dr. Arjmandi has shown that nutrition science backs up the expression. "Everyone can benefit from consuming apples," he said.
This research was performed by Drs. Sheau C. Chai, Shirin Hooshmand, Raz L. Saadat, and Bahram Arjmandi, Florida State University.

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

http://www.sciencedaily.com/releases/2011/04/110412131923.htm

Minor Cause, Major Effect: Interactions in Ecosystems Can Intensify Impact of Climate Change



Example of an interaction network of abiotic and biotic stresses on Fucus vesiculosus. Shading weakens energy reserves leading to weakened antifouling (AF) andanti-grazing (AG) defences, which enhances fouling and grazing pressure. Both reduce the photosynthetic area of the thallus which amplifies the energy shortage under low light conditions. Low light and temperature-stress reduce growth, which jeopardizes the alga's ability to compensate for tissue lost to grazers, the activity of which is enhanced by temperature stress. (Credit: Martin Wahl (based on Wahl et al., 2010; Weinberger et al., 2011, Table. 1))

ScienceDaily (May 3, 2011) — In a new study, marine biologists from the Leibniz Institute of Marine Sciences (IFM-GEOMAR), together with colleagues from six other countries, show that highly complex interactions in ecosystems can intensify the impact of climate change within a relatively short period of time. The study is published in the current issue of the journal *Advances in Marine Biology.*

Animals and plants living in coastal areas are tough organisms. For example, the inhabitants of the shallow Baltic Sea have to cope with fluctuating temperatures, with variable salinity and even with short term pH value changes. "In a few weeks, these natural fluctuations can exceed the average shifts that are predicted for the next century due to (global) climate change," Professor Martin Wahl, Marine Biologist at the Leibniz Institute of Marine Sciences (IFM-GEOMAR) in Kiel (Germany) explains. Is global change therefore negligible for coastal ecosystems? Professor Wahl, Dr. Inken Kruse and Dr. Mark Lenz from IFM-GEOMAR, together with 14 colleagues from European and American scientific institutions, answer this question with a definite "No." "Even the smallest variations in an ecosystem can have major consequences due to ecological intensification, says Professor Wahl." "On the other hand, stressors can even buffer each other in certain cases."

The authors from Germany, Finland, the Netherlands, the USA, Portugal, and Sweden explain the often surprising interactions between pressures due to abiotic stresses (e.g. warming) on the one hand and biotioc stresses (e.g. herbivores, parasites) on the other hand with the help of the stress ecology of macro algae. One of these macroalgae, the seaweed *Fucus vesiculosus*, commonly known as bladderwrack, inhabits the coasts of the North Sea and the Baltic Sea as well as the coast of the Atlantic and Pacific Oceans. "There it plays a key role in the ecosystems of shallow waters," Martin Wahl explains. "Even though the seaweed of the Baltic Sea should be accustomed to difficult (harsh) living conditions, its populations have diminished considerably in the last decades. „Actually, *Fucus vesiculosus* can live in depths of up to six meters. However, we find it now only in depths of up to two meters at the Western Baltic Sea," says Professor Wahl.

This shift cannot be explained solely by the direct effects of global change, which include eutrophication and bioinvasions. To understand this shift nevertheless, the authors of the recent study collected all available information about the bladderwrack from earlier studies, which e.g. included data on its distribution, data on light availability and nutrients, grazers, defense strategies, reactions to environmental pollution or the genetic variety of algae populations. "Thus we've been able to show a cascade of effects and interactions, which influence single algae or whole populations," Wahl says. To give an example: Shading weakens energy reserves leading to weakened antifouling and anti-grazing defenses, which in turn increases fouling and grazing pressure. Both reduce the photosynthetic area of the thallus, amplifying the energy shortage under low

light conditions. Low light and temperature-stress reduce growth, jeopardizing the alga's ability to compensate for tissue loss to grazers, the activity of which is augmented by temperature stress. "The list of possible intensifications is long and complex," Martin Wahl explains. To enhance the understanding of it the stress ecology of macroalgaeis currently being modelled.
The results of the new study are exemplary for ecosystems in coastal areas and shelf seas in general. "Hardly any species will perish because of a single effect of climate change, but we can't ignore it either," Wahl says summing up the results of the new study. He hopes for a new perception of the problem "because we still know far too little about the snowball effect which ecological intensification can cause."

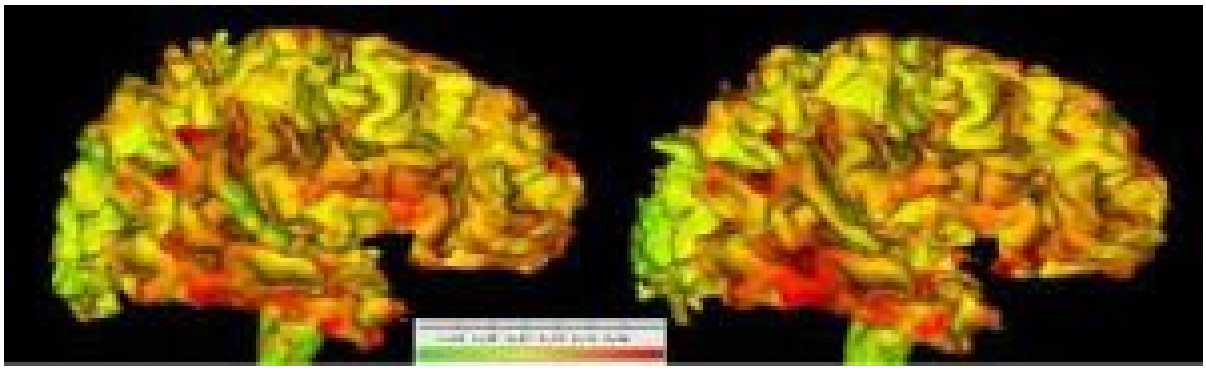
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Leibniz Institute of Marine Sciences (IFM-GEOMAR)**.

Journal Reference:

1. Wahl, M., V. Jormalainen, B. K. Eriksson, J. A. Coyer, M. Molis, H. Schubert, M. Dethier, A. Ehlers, R. Karez, I. Kruse, M. Lenz, G. Pearson, S. Rohde, S. A. Wikström and Jeanine L. Olsen. **Stress Ecology in FUCUS: Abiotic, Biotic and Genetic Interactions.**. *Advances in Marine Biology*, 59, 37-105 DOI: 10.1016/B978-0-12-385536-7.00002-9

http://www.sciencedaily.com/releases/2011/05/110502092324.htm

Brain Enlargement in Autism Due to Brain Changes Occurring Before Age 2



These images show brain maturation measured by cortical thickness for a representative subject with autism at age 2 (left) and age 4 (right). Thicker areas of cortex are shown in red, while thinner cortical areas are displayed in green. (Credit: Image created by Clement Vachet, Neuro Image Research and Analysis Laboratories, UNC Department of Psychiatry.)

ScienceDaily (May 3, 2011) — In 2005, researchers from the University of North Carolina at Chapel Hill found that 2-year-old children with autism have brains up to 10 percent larger than children of the same age without autism.

Now a follow-up study by UNC researchers has found that the children who had enlarged brains at age 2 continued to have enlarged brains at ages 4 and 5, but the amount of the enlargement was to the same degree found at age 2. This increased brain growth did not continue beyond 2 years of age and the changes detected at age 2 were due to overgrowth prior to that time point. In addition, the study found that the cortical enlargement was associated with increased folding on the surface of the brain (or increased surface area) and not an increase in the thickness of outer layer of the brain (or gray matter).

"Brain enlargement resulting from increased folding on the surface of the brain is most likely genetic in origin and a result of an increase in the proliferation of neurons in the developing brain," said Heather Cody Hazlett, PhD, assistant professor in the Department of Psychiatry, who is the lead author of the new study, which is published in the May 2011 issue of *Archives of General Psychiatry*.

In both the 2005 study and the new study, Hazlett and colleagues analyzed magnetic resonance imaging (MRI) scans of the children's brains using computer software developed for that purpose by Martin Styner, PhD, an assistant professor of computer science and psychiatry at UNC, and Guido Gerig, PhD, formerly at UNC and now at the University of Utah.

"From earlier work by our group on head circumference or head size in children with autism, we think that brain overgrowth in many children with autism may actually be happening around the first birthday. Together these findings suggest that we should be searching for genes that may underlie the over-proliferation of neurons in this early post-natal period," said Joseph Piven, MD, senior author of the new study and director of the Carolina Institute for Developmental Disabilities.

UNC is currently leading two separate studies aimed at that goal. Hazlett leads the Brain Development in School Age Children with Autism study, which is funded by Autism Speaks. "It was important to continue to follow these children to track their brain development to see if the brain and behavioral differences we observed were maintained as the children matured," said Hazlett.

UNC is also leading the Infant Brain Imaging Study (IBIS), a National Institutes of Health-funded multi-center study which includes four sites around the U.S. "We are studying infant children at high genetic risk for autism, by virtue of their having an older brother or sister with autism -- somewhere around 20 percent of those children will develop autism. We are doing brain scans and behavior assessments on those children at 6, 12 and 24 months of age to look at how the brain develops in the subgroup that develop autism before they have symptoms of autism at 6 months of age and over the interval that they develop autism -- between 6 and 24 months of age, in most cases," Piven said. "We are also looking at whether specific gene alterations may be responsible."

More information about IBIS is available at http://www.ibisnetwork.org/.

Authors of the May 2011 article in Archives of General Psychiatry, in addition to Hazlett, are Michele Poe, PhD, Guido Gerig, PhD, Martin Styner, PhD, Chad Chappell, Rachel Gimpel Smith, Clement Vachet, MS, and Piven.
The UNC authors are all affiliated with one or more of the following: The Department of Psychiatry in the School of Medicine, the Carolina Institute for Developmental Disabilities, the Frank Porter Graham Child Development Institute, and the Department of Computer Science in the College of Arts and Sciences.

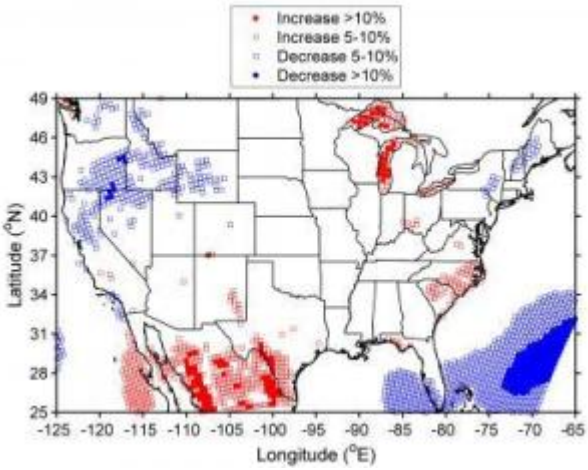
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of North Carolina School of Medicine**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Heather Cody Hazlett; Michele D. Poe; Guido Gerig; Martin Styner; Chad Chappell; Rachel Gimpel Smith; Clement Vachet; Joseph Piven. **Early Brain Overgrowth in Autism Associated With an Increase in Cortical Surface Area Before Age 2 Years**. *Arch Gen Psychiatry*, 2011; 68 (5): 467-476 DOI: 10.1001/archgenpsychiatry.2011.39

http://www.sciencedaily.com/releases/2011/05/110502161401.htm

Global Warming Won't Harm Wind Energy Production, Climate Models Predict



Results from the Canadian regional climate model show the difference in energy density (power in the wind) between 2041-2062 and 1979-2000. If the grid cell is red the future energy density is higher than the historical values and if it is blue the future energy density is lower than the historical values. Solid squares show differences above 10 percent while the open symbols show changes of plus or minus 5-10 percent. The white grid cells show that the future lies within 5 percent of the historical values. (Credit: Sara Pryor)

ScienceDaily (May 3, 2011) — The production of wind energy in the U.S. over the next 30-50 years will be largely unaffected by upward changes in global temperature, say a pair of Indiana University Bloomington scientists who analyzed output from several regional climate models to assess future wind patterns in America's lower 48 states.

Their report -- the first analysis of long-term stability of wind over the U.S. -- appears in the *Proceedings of the National Academy of Sciences* Early Edition.

"The greatest consistencies in wind density we found were over the Great Plains, which are already being used to harness wind, and over the Great Lakes, which the U.S. and Canada are looking at right now," said Provost's Professor of Atmospheric Science Sara Pryor, the project's principal investigator. "Areas where the model predicts decreases in wind density are quite limited, and many of the areas where wind density is predicted to decrease are off limits for wind farms anyway."

Coauthor Rebecca Barthelmie, also a professor of atmospheric science, said the present study begins to address a major dearth of information about the long-term stability of wind as an energy resource. Questions have lingered about whether a warmer atmosphere might lead to decreases in wind density or changes in wind patterns.

"We decided it was time someone did a thorough analysis of long term-patterns in wind density," Barthelmie said. "There are a lot of myths out there about the stability of wind patterns, and industry and government also want more information before making decisions to expand it."

Pryor and Barthelmie examined three different regional climate models in terms of wind density changes in a future U.S. experiencing modest but noticeable climate change (warming of about 2 degrees Celsius relative to the end of the last century).

The scientists found the Canadian Regional Climate Model (CRCM) did the best job modeling the current wind climate, but included results from Regional Climate Model 3 (created in Italy but now developed in the U.S.) and the Hadley Centre Model (developed in the U.K.) for the sake of academic robustness and to see whether the different models agreed or disagreed when seeded with the same parameters.

All three state-of-the-art regional climate models were chained to output from one of four atmospheric-ocean general circulation models to derive a complete picture of wind density changes throughout the study area -- the lower 48 United States and a portion of northern Mexico.

Comparing model predictions for 2041-2062 to past observations of wind density (1979-2000), most areas were predicted to see little or no change. The areas expected to see continuing high wind density -- and therefore greater opportunities for wind energy production -- are atop the Great Lakes, eastern New Mexico,

southwestern Ohio, southern Texas, and large swaths of several Mexican states, including Nuevo Leon, Tamaulipas, Chihuahua, and Durango.
"There was quite a bit of variability in predicted wind densities, but interestingly, that variability was very similar to the variability we observe in current wind patterns," Pryor said.
The Great Lakes -- Lakes Michigan, Superior, and Erie in particular -- consistently showed high wind density no matter what model was used.
Such predictions should prove crucial to American policymakers and energy producers, many of whom have pledged to make wind energy 20 percent of America's total energy production by 2030. Currently only about 2 percent of American energy comes from wind.
"There have been questions about the stability of wind energy over the long term, " Barthelmie said. "So we are focusing on providing the best science available to help decision makers." Pryor added that 'this is the first assessment of its type, so the results have to be considered preliminary. Climate models are evolving and improving all the time, so we intend to continue this assessment as new models become available."
Wind farms are nearly carbon neutral, and studies show that a turbine pays for itself after only three months of energy production. A typical turbine lasts about 30 years, Pryor says, not because parts break, but because advances in technology make it desirable to replace turbines with newer versions.
"Wind speed increases with height, so turbines are also getting taller," Pryor said. "One of our future projects will be to assess the benefit of deploying bigger turbines that extend farther from the ground."
This is also the week of the annual Offshore Technology Conference in Houston, the largest such energy conference in the world, which has increasingly focused on offshore wind energy production in recent years.
Last month, Pryor was appointed to the National Climate Assessment and Development Committee, convened by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration to help the U.S. government prepare for and deal with climate change. She also contributed to a special report used by the Intergovernmental Panel on Climate Change (IPCC). Barthelmie is a widely respected expert on wind energy, particularly in northern Europe, whose wind farms she has studied for years. She was the winner of the European Academy of Wind Energy's 2009 Academy Science Award. Both Pryor and Barthelmie are faculty in the IU Bloomington Department of Geography, a division of the College of Arts and Sciences, and the Center for Research in Environmental Science.
Pryor and Barthelmie's work was supported by grants from the National Science Foundation (BCS 1019603), the International Atomic Energy Authority, and the IU Center for Research in Environmental Sciences. The model output they analyzed were provided by the North American Regional Climate Change Assessment Program (NARCCAP). NARCCAP is funded by the National Science Foundation, the U.S. Department of Energy, the National Oceanic and Atmospheric Administration, and the U.S. Environmental Protection Agency Office of Research and Development.

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

Journal Reference:

1. S. C. Pryor, R. J. Barthelmie. **Assessing climate change impacts on the near-term stability of the wind energy resource over the United States**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1019388108

http://www.sciencedaily.com/releases/2011/05/110502151355.htm

Versatility of Stem Cells Controlled by Alliances, Competitions of Proteins

More like globs of proteins Transcription factors may compete or cooperate within cells, producing complex bindings across hundreds of nucleotides, determing what kind of cells stem cells become. William Fairbrother, center, postdoctoral researcher Alec DeSimone and technician Luciana Ferraris analyzed hundreds of thousands of DNA letters and found previously unspotted patterns of protein interactions. (Credit: Mike Cohea/Brown University)

ScienceDaily (May 3, 2011) — Because they can change into any other cell, stem cells are the subject of intense research, but how they "decide" to specialize, or differentiate, hasn't been understood. A new study using a unique technology shows that proteins must jostle and join behind the scenes to make it happen, as well as to restore flexibility to cells that already had made their choice.

Like people with a big choice to make, stem cells have a process to "decide" whether to transform into a specific cell type or to stay flexible, a state that biologists call "pluripotency." Using a technology he invented, Brown researcher William Fairbrother and colleagues have discovered new molecular interactions in the process that will help regenerative medicine researchers better understand pluripotency.

In a paper published in advance online in the journal *Genome Research*, Fairbrother's team showed that different proteins called transcription factors compete and cooperate in the cells to produce complex bindings along crucial sequences of DNA. This game of molecular "capture the flag," played in teams and amid shifting alliances, appears to be a necessary part of what determines whether stem cells retain their pluripotency and whether specialized, or differentiated, cells can regain it.

In recent years scientists have reported spectacular successes in turning fully differentiated cells back into pluripotent stem cells, a process called reprogramming. But the animals derived from these cells often suffer higher rates of tumors and other problems, Fairbrother said. The reason may be because the complex details of the reprogramming process haven't been fully understood. He said there are many misconceptions about how reprogramming transcription factors interact with DNA.

"Most people think of a protein binding to DNA as a single, surgical thing where you have this isolated binding event," Fairbrother said. "But in fact we show that sometimes these binding events occur over hundreds of nucleotides so they seem more like great greasy globs of proteins that are forming. In addition, the proteins interact with each other, diversifying their function by appearing in complexes with with different partners at different places."

By employing a high-throughput, high-resolution binding assay that he's dubbed MEGAShift, Fairbrother and his colleagues, who include pathology researchers from the University of Utah School of Medicine, were able to analyze the interactions of several key transcription factors in a region of 316,000 letters of DNA with a resolution as low as 10 base pairs. Through hundreds of thousands of array measurements, lead authors Luciana Ferraris and Allan Stewart, Fairbrother, Alec DeSimone, and the other authors learned previously unspotted patterns of protein interactions.

"How do stem cells stay in the state where they can keep their options open?" Fairbrother said. "A key player is POU5F1. But what are the key players that could interact with it and modulate its function? We've developed technology to look at that question."

One of several findings in the paper concerned POU5F1 and its archrival, POU2F1, which binds to exactly the same eight-letter DNA sequence. Which protein binds to the sequence first influences whether a stem cell specializes or remains pluripotent. Experiments showed that a determining factor was a third protein called SOX2. SOX2 helped both proteins bind, but it helps POU2F1 more than POU5F1. In contrast, the team found that another player, NANOG, exclusively helps POU5F1.

"Who binds next to a protein is a determinant of who ends up binding to a sequence," Fairbrother said.

With support from the National Institutes of Health, Fairbrother's group is also applying MEGAShift to other questions, including how protein-protein interactions affect the formation of RNA-protein complexes, which can be even more complicated than binding DNA.

They will also look at the problem of narrowing the field of hundreds of genomic sequence variations that exist naturally in the population down to the real genetic "causal variants" of disease risk. MEGAShift can sort through which variants associated with disease result in an altered binding event that results in a clinical manifestation, such as diabetes or lupus.

In addition to Fairbrother, DeSimone, Ferraris and Stewart, other authors on the paper Matthew Gemberling at Brown, Dean Tantin at the University of Utah, and Jinsuk Kang also at the University of Utah.

The research was funded by the National Human Genome Research Institute.

Story Source:

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

Journal Reference:

1. L. Ferraris, A. P. Stewart, J. Kang, A. M. DeSimone, M. Gemberling, D. Tantin, W. G. Fairbrother. **Combinatorial binding of transcription factors in the pluripotency control regions of the genome**. *Genome Research*, 2011; DOI: 10.1101/gr.115824.110

http://www.sciencedaily.com/releases/2011/04/110427171515.htm

Caves and Their Dripstones Reveal the Uplift of Mountains

In a recent Geology paper, geologists from the universities of Innsbruck and Leeds report on ancient cave systems discovered near the summits of the Allgäu Mountains that preserved the oldest radiometrically dated dripstones currently known from the European Alps. (Credit: Michael Meyer)

ScienceDaily (May 3, 2011) — Singer Bob Dylan once asked "How many years can a mountain exist before it is washed to the sea?" -- an intriguing geological question for which an accurate answer is not easily provided.

Mountain ranges are in a constant interplay between climatically controlled weathering processes on the one hand and the tectonic forces that cause folding and thrusting and thus thickening of Earth's crust on the other hand. While erosion eventually erases any geological obstacles, tectonic forces are responsible for piling and lifting up rocks and thus for forming spectacular mountain landscapes such as the European Alps. In reality, climate, weathering and mountain uplift interact in a complex manner and quantifying rates for erosion and uplift, especially for the last couple of millions of years, remains a challenging task.

In a recent *Geology* paper, Michael Meyer (University of Innsbruck) and colleagues report on ancient cave systems discovered near the summits of the Allgäu Mountains (Austria) that preserved the oldest radiometrically dated dripstones currently known from the European Alps.

"These cave deposits formed ca. 2 million years ago and their geochemical signature and biological inclusions are vastly different from other cave calcites in the Alps," says Meyer, who works at the Institute of Geology and Paleontology at the University of Innsbruck, Austria. By carefully analysing these dripstones and using an isotopic modelling approach the authors were able to back-calculate both, the depth of the cave and the altitude of the corresponding summit area at the time of calcite formation. Meyer and colleagues thus derived erosion and uplift rates for the northern rim of the Alps and -- most critically -- for a geological time period that is characterized by reoccurring ice ages and hence by intensive glacial erosion.

"Our results suggest that 2 million years ago the cave was situated ~1500 meters below its present altitude and the mountains were probably up to 500 meters lower compared to today," states Meyer. These altitudinal

changes were significant and much of this uplift can probably be attributed to the gradual unloading of the Alps due to glacial erosion.
Dripstones have been used to reconstruct past climate and environmental change in a variety of ways. This latest study is novel, however, as it highlights the potential of caves and their deposits to quantitatively constrain mountain evolution on a timescale of millions of years and further shows how the interplay of tectonic and climatic processes can be understood. Key to success is an accurate age control provided by Uranium-Lead dating. This method is commonly used to constrain the age of much older rocks and minerals but has only rarely be applied to dripstones -- i.e. only those with high Uranium concentrations -- and luckily this is the case for the samples from the Allgäu Mountains.

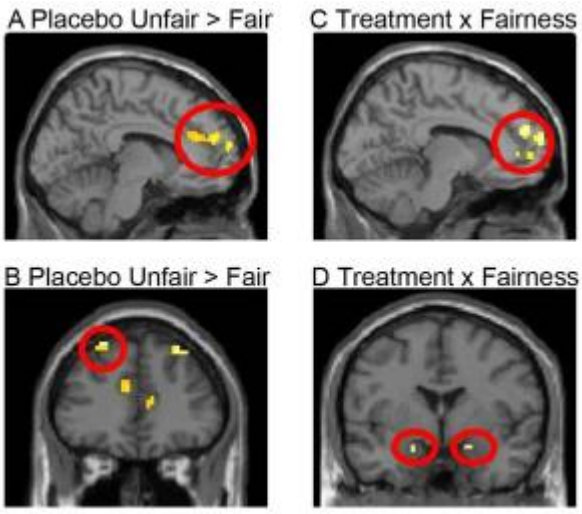
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Innsbruck**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. M. C. Meyer, R. A. Cliff, C. Spotl. **Speleothems and mountain uplift**. *Geology*, 2011; DOI: 10.1130/G31881.1

http://www.sciencedaily.com/releases/2011/05/110502110618.htm

Sense of Justice Built Into the Brain, Imaging Study Shows



Functional magnetic resonance imaging (fMRI) data related to unfair proposals. (Credit: Katarina Gospic, Erik Mohlin, Peter Fransson, Predrag Petrovic, Magnus Johannesson, Martin Ingvar. Limbic Justice—Amygdala Involvement in Immediate Rejection in the Ultimatum Game. PLoS Biology, 2011; 9 (5): e1001054 DOI: 10.1371/journal.pbio.1001054)

ScienceDaily (May 3, 2011) — A new study from the Karolinska Institute and Stockholm School of Economics shows that the brain has built-in mechanisms that trigger an automatic reaction to someone who refuses to share.

In the study publishing in the online open access journal *PLoS Biology*, the subjects' sense of justice was challenged in a two-player monetary fairness game, and their brain activity was simultaneously measured using functional magnetic resonance imaging (fMRI). When bidders made unfair suggestions as to how to share the money, they were often punished by their partners even if it cost them. This reaction to unfairness could be reduced by targeting one specific brain region, the amygdala.

The study is based on the universal human behaviour to react with instant aggression when another person behaves unfairly and in a manner that is not in the best interest of the group. The researchers had 35 subjects play a money-based fairness game, in which one player suggests to another how a fixed sum of money is to be shared between them; the other player can then either accept the suggestion and take the money, or reject it, in which case neither player receives anything.

"If the sum to be shared is 100 SEK kronor and the suggestion is 50 each, everyone accepts it as it is seen as fair," says Dr Katarina Gospic. "But if the suggestion is that you get 20 and I take 80, it's seen as unfair. In roughly half the cases it ends up with the player receiving the smaller share rejecting the suggestion, even though it costs them 20 SEK."

Previous research has suggested that the area controlling the ability to analyse and make financial decisions is located in the prefrontal cortex and insula. Using fMRI, however, the researchers saw that the brain area controlling for fast financial decisions was actually located in the amygdala, an evolutionary old and therefore more primitive part of the brain that controls feelings of anger and fear.

To explore these results further, the subjects were either given the anti-anxiety tranquilliser Oxazepam or a placebo while playing the game. The researchers found that those who had received the drug showed lower amygdala activity and a stronger tendency to accept an unfair distribution of the money -despite the fact that when asked, they still considered the suggestion unfair. In the control group, the tendency to react aggressively and punish the player who had suggested the unfair distribution of money was directly linked to an increase in activity in the amygdala. A gender difference was also observed, with men responding more aggressively to unfair suggestions than women byshowing a correspondingly higher rate of amygdalic activity. This gender difference was not found in the group that received Oxazepam.

"This is an incredibly interesting result that shows that it isn't just processes in the prefrontal cortex and insula that determine this kind of decision about financial equitability, as was previously thought," says Professor Martin Ingvar. "Our findings, however, can also have ethical implications since the use of certain drugs can clearly affect our everyday decision-making processes."

This work was funded by the Swedish Research Council, The Barbro and Bernard Osher Foundation, The Swedish Agency for Innovation Systems
(VINNOVA), The Swedish Foundation for Strategic Research, The Jan Wallander and Tom Hedelius Foundation, The Swedish Council for Working Life and Social Research, The Knut and Alice Wallenberg Foundation and the Karolinska Institute.

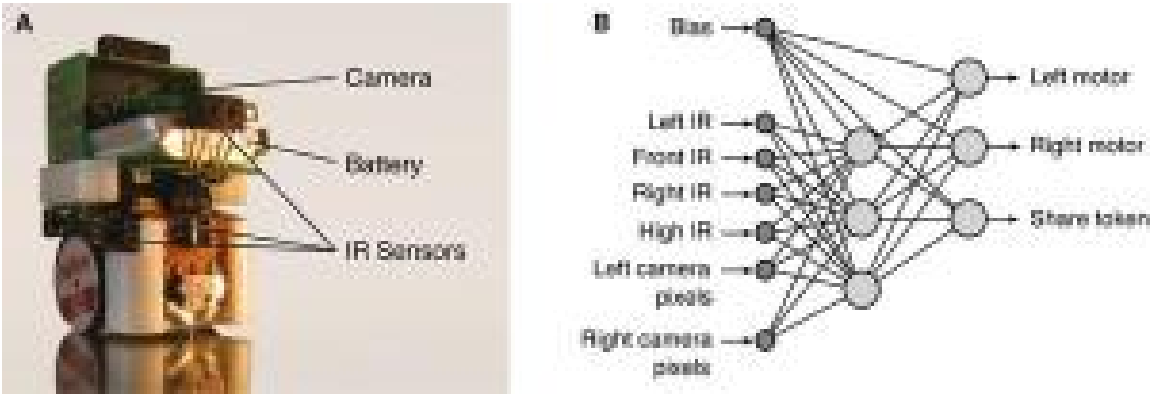
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Public Library of Science**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Katarina Gospic, Erik Mohlin, Peter Fransson, Predrag Petrovic, Magnus Johannesson, Martin Ingvar. **Limbic Justice—Amygdala Involvement in Immediate Rejection in the Ultimatum Game**. *PLoS Biology*, 2011; 9 (5): e1001054 DOI: 10.1371/journal.pbio.1001054

http://www.sciencedaily.com/releases/2011/05/110503171743.htm

Robots Learn to Share: Why We Go out of Our Way to Help One Another



Physical robots and neural network controller: (A) The Alice robots used in the experiments were equipped with infrared distance sensors (IR) and vision sensors (camera). (B) The input neurons (small circles) of the artificial neural network were connected to internal and output neurons (large circles) by 33 connection weights (lines connecting circles). (Credit: Markus Waibel, Dario Floreano, Laurent Keller. A Quantitative Test of Hamilton's Rule for the Evolution of Altruism. PLoS Biology, 2011; 9 (5): e1000615 DOI: 10.1371/journal.pbio.1000615)

ScienceDaily (May 3, 2011) — Using simple robots to simulate genetic evolution over hundreds of generations, Swiss scientists provide quantitative proof of kin selection and shed light on one of the most enduring puzzles in biology: Why do most social animals, including humans, go out of their way to help each other? In the online, open access journal *PLoS Biology,* EPFL robotics professor Dario Floreano teams up with University of Lausanne biologist Laurent Keller to weigh in on the oft-debated question of the evolution of altruism genes.

Altruism, the sacrificing of individual gains for the greater good, appears at first glance to go against the notion of "survival of the fittest." But altruistic gene expression is found in nature and is passed on from one generation to the next. Worker ants, for example, are sterile and make the ultimate altruistic sacrifice by not transmitting their genes at all in order to insure the survival of the queen's genetic makeup. The sacrifice of the individual in order to insure the survival of a relative's genetic code is known as kin selection. In 1964, biologist W.D. Hamilton proposed a precise set of conditions under which altruistic behavior may evolve, now known as Hamilton's rule of kin selection. Here's the gist: If an individual family member shares food with the rest of the family, it reduces his or her personal likelihood of survival but increases the chances of family members passing on their genes, many of which are common to the entire family. Hamilton's rule simply states that whether or not an organism shares its food with another depends on its genetic closeness (how many genes it shares) with the other organism.

Testing the evolution of altruism using quantitative studies in live organisms has been largely impossible because experiments need to span hundreds of generations and there are too many variables. However, Floreano's robots evolve rapidly using simulated gene and genome functions and allow scientists to measure the costs and benefits associated with the trait. Additionally, Hamilton's rule has long been a subject of much debate be-cause its equation seems too simple to be true. "This study mirrors Hamilton's rule re-markably well to explain when an altruistic gene is passed on from one generation to the next, and when it is not," says Keller.

Previous experiments by Floreano and Keller showed that foraging robots doing simple tasks, such as pushing seed-like objects across the floor to a destination, evolve over multiple generations. Those robots not able to push the seeds to the correct location are selected out and cannot pass on their code, while robots that perform comparatively better see their code reproduced, mutated, and recombined with that of other robots into the next generation -- a minimal model of natural selection. The new study by EPFL and UNIL researchers adds a novel dimension: once a foraging robot pushes a seed to the proper destination, it can decide whether it wants to share it or not. Evolutionary experiments lasting 500 generations were repeated for several scenarios of altruistic interaction -- how much is shared and to what cost for the individual -- and of genetic relatedness in the population. The researchers created groups of relatedness that, in the robot world, would be the equivalent

of complete clones, siblings, cousins and non-relatives. The groups that shared along the lines of Hamilton's rule foraged better and passed their code onto the next generation.
The quantitative results matched surprisingly well the predictions of Hamilton's rule even in the presence of multiple interactions. Hamilton's original theory takes a limited and isolated vision of gene interaction into account, whereas the genetic simulations run in the foraging robots integrate effects of one gene on multiple other genes with Hamilton's rule still holding true. The findings are already proving useful in swarm robotics. "We have been able to take this experiment and extract an algorithm that we can use to evolve cooperation in any type of robot," explains Floreano. "We are using this altruism algo-rithm to improve the control system of our flying robots and we see that it allows them to effectively collaborate and fly in swarm formation more successfully."
This research was funded by the Swiss National Science Foundation, the Euro-pean Commission ECAgents and Swarmanoids projects, and the European Research Council.

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

Journal Reference:

1. Markus Waibel, Dario Floreano, Laurent Keller. **A Quantitative Test of Hamilton's Rule for the Evolution of Altruism**. *PLoS Biology*, 2011; 9 (5): e1000615 DOI: 10.1371/journal.pbio.1000615

http://www.sciencedaily.com/releases/2011/05/110503171737.htm

First Rainforests Arose When Plants Solved Plumbing Problem

Fossil evidence indicates that vein density increased in the leaves of flowering plants. Scientists suggest that this permitted the plants to transport more water and conduct more photosynthesis, leading to the evolution of giant, rainforest trees and productive, biodiverse forests. (Credit: STRI Archives)

ScienceDaily (May 3, 2011) — A team of scientists, including several from the Smithsonian Institution, discovered that leaves of flowering plants in the world's first rainforests had more veins per unit area than leaves ever had before. They suggest that this increased the amount of water available to the leaves, making it possible for plants to capture more carbon and grow larger. A better plumbing system may also have radically altered water and carbon movement through forests, driving environmental change.

"It's fascinating that a simple leaf feature such as vein density allows one to study plant performance in the past," said Klaus Winter, staff scientist at the Smithsonian Tropical Research Institute in Panama, who was not an author, "Of course, you can't directly measure water flow through fossil leaves. When plants fix carbon, they lose water to the atmosphere. So to become highly productive, as many modern flowering plants are, requires that plants have a highly elaborate plumbing system."

A walk through a tropical forest more than 100 million years ago would have been different than a walk through a modern rainforest. Dinosaurs were shaded by flowerless plants like cycads and ferns. Fast-forward 40 million years. The dinosaurs have disappeared and the first modern rainforests have appeared: a realm of giant trees -- with flowers. By examining images of more than 300 hundred kinds of fossil leaves, the team, led by Taylor Feild from the University of Tennessee, Knoxville, counted how many veins there were in a given area of leaf. Flowerless plants then and now have relatively few veins. But their work shows that even after flowering plants evolved, it took some time before they developed the efficient plumbing systems that would allow them to develop into giant life-forms like tropical trees. The density of veins in the leaves of flowering plants increased at least two different times as the transition from ancient to modern rainforests took place, according to this research reported in the *Proceedings of the National Academy of Sciences*.

The first jump -- when the vein density in fossil leaves of flowering plants first exceeded vein density in the leaves of flowerless plants -- took place approximately one hundred million years ago. The second and more significant increase in vein density took place 35 million years later. Petrified tree trunks more than a meter in diameter were first found from this period, indicating another landmark -- the evolution of flowering trees. Soon the leaves of flowering plants had twice more veins per unit leaf area than the non-flowering plants. By the end of the Cretaceous period about 65 million years ago, the number of leaf veins per unit area was very similar to that of modern rainforest leaves.

As often happens, this study has seeded new questions. Did improvements in the plumbing system of flowering plants make giant rainforest trees possible? How important was this change in the plants to climate changes that were taking place at the time? Were these plants better able to take advantage of naturally occurring wet environments that were created by tectonic activity or changes in ocean circulation patterns, or did the trees themselves contribute to climate change by pumping more water into the atmosphere?

Story Source:

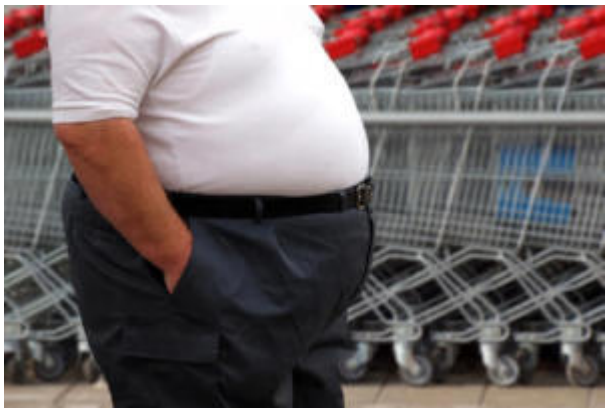
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Smithsonian Tropical Research Institute**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Taylor S. Feild, Timothy J. Brodribb, Ari Iglesias, David S. Chatelet, Andres Baresch, Gary Upchurch, Bernard Gomez, Barbara Mohr, Clement Coiffard, Jiri Kvacek and Carlos Jaramillo. **Fossil evidence for Cretaceous escalation in angiosperm leaf vein evolution**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1014455108

http://www.sciencedaily.com/releases/2011/05/110503133042.htm

Turning 'Bad' Fat Into 'Good': A Future Treatment for Obesity?



By knocking down the expression of a protein in rat brains known to stimulate eating, researchers say they not only reduced the animals' calorie intake and weight, but also transformed their fat into a type that burns off more energy. (Credit: © Otto Durst / Fotolia)

ScienceDaily (May 3, 2011) — By knocking down the expression of a protein in rat brains known to stimulate eating, Johns Hopkins researchers say they not only reduced the animals' calorie intake and weight, but also transformed their fat into a type that burns off more energy. The finding could lead to better obesity treatments for humans, the scientists report.

"If we could get the human body to turn 'bad fat' into 'good fat' that burns calories instead of storing them, we could add a serious new tool to tackle the obesity epidemic in the United States," says study leader Sheng Bi, M.D., an associate professor of psychiatry and behavioral sciences at the Johns Hopkins University School of Medicine.

More than two-thirds of adults in the United States are overweight, and more than one-third are obese, according to government estimates.

The Johns Hopkins study, published in the journal *Cell Metabolism*, looks at two types of fat made by the body: white and brown adipose tissue. White fat is the typical fat that ends up around your middle and other places, and is the storehouse for the extra calories we eat. White fat cells have a single large droplet of lipid, one of fat's building blocks, such as cholesterol and triglycerides.

Cells in brown fat, considered a "good fat" for its energy-burning qualities, contain many little droplets of lipid, each with its own power source, which enables heat generation. Babies have ample stores of brown fat at birth as a defense against the cold, but it mostly disappears, as adults have very little of this calorie-burning tissue.

Bi and his colleagues designed an experiment to see if suppressing the appetite-stimulating neuropeptide Y (NPY) protein in the dorsomedial hypothalamus of the brain would decrease body fat in rats. Located just above the brain stem, the hypothalamus helps regulate thirst, hunger, body temperature, water balance and blood pressure.

For five weeks, two groups of rats were fed a regular diet, with one group also treated with a virus to inhibit NPY expression and the other left as a control group. At the end of five weeks, the treated group weighed less than the control group, demonstrating that suppression of NPY reduced eating.

Then, researchers split each of the groups into two, creating four sets of rats. One of the treated groups of rats and one of the control groups were fed a regular diet while the other treated and control groups got a high-fat diet. Of the rats on the regular diet, the control group weighed more at the end of 11 weeks than those rats in which hypothalamic NPY expression was knocked down. In the high-fat group, the control group rats became obese; those rats in which NPY expression was silenced gained less weight.

Bi says the results "made sense," given that NPY has been shown to stimulate eating. The less NPY, the less the rats would eat, his team hypothesized. What was a surprise, however, was what they found after they checked the fat content of rats after death. In the groin area of the NPY rats, researchers discovered not the expected white fat found in adult rats, but the telltale signs of brown fat in its place. They confirmed this change by looking at levels of mitochondrial uncoupling protein-1, or UCP-1, through which brown fat burns

to produce heat. They used this protein as a marker to determine that the fat that should have been white was instead brown.
Bi says he believes that the transformation from white to brown fat resulting from NPY suppression may be due to activation of brown fat stem cells contained in white fat tissue. While brown fat seems to vanish in humans as they emerge from infancy, the brown fat stem cells may never disappear and may just become inactive as people age.
Bi says it may be possible to transplant or inject brown fat stem cells under the skin to burn white fat and stimulate weight loss. "Only future research will tell us if that is possible," he says.
This study also shows that low levels of hypothalamic NPY increase spontaneous physical activity, improve blood sugar levels and enhance insulin sensitivity in rats, but it remains undetermined whether this brown fat transformation also contributes to these effects.
The study was funded by the U.S. National Institute of Diabetes and Digestive and Kidney Diseases. Along with Bi, other Johns Hopkins researchers involved in the study include Pei-Ting Chao, Timothy H. Moran, Ph.D., and Susan Aja, Ph.D. Liang Yang, Ph.D., formerly of Johns Hopkins and now at the Massachusetts Institute of Technology, also contributed.

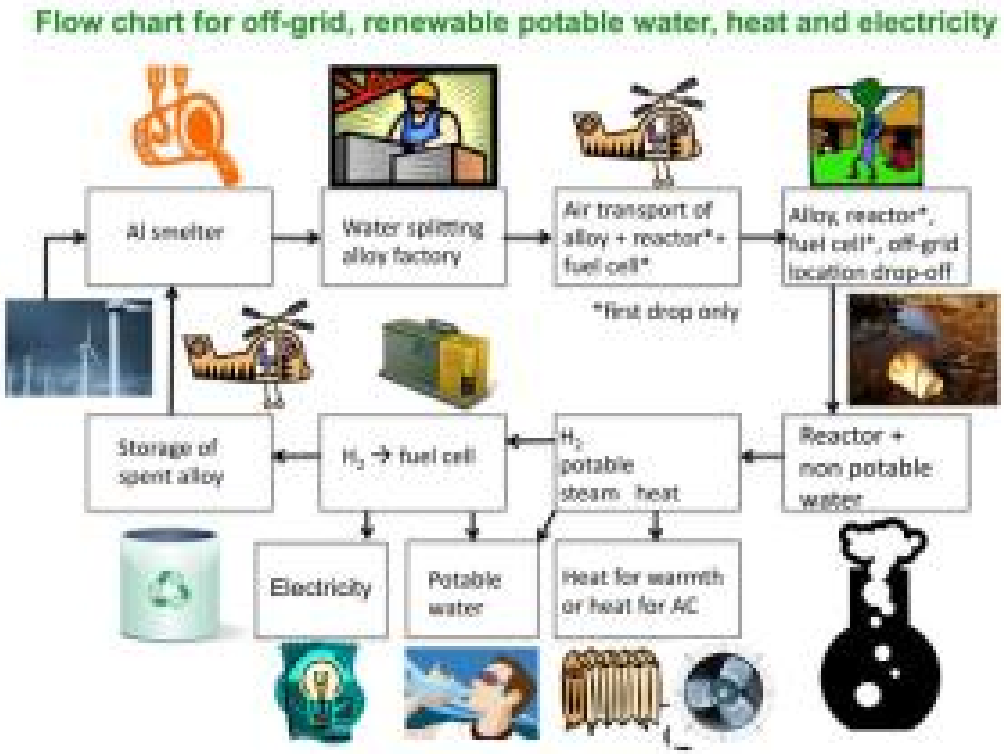
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Johns Hopkins Medical Institutions**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Pei-Ting Chao, Liang Yang, Susan Aja, Timothy H. Moran, Sheng Bi. **Knockdown of NPY Expression in the Dorsomedial Hypothalamus Promotes Development of Brown Adipocytes and Prevents Diet-Induced Obesity**. *Cell Metabolism*, 2011; 13 (5): 573-583 DOI: 10.1016/j.cmet.2011.02.019

http://www.sciencedaily.com/releases/2011/05/110503132704.htm

Portable Tech Might Provide Drinking Water, Power to Villages



A cartoon illustrates the potential uses of a new theoretical type of mobile technology that would use an aluminum alloy to convert non-potable water into drinking water while also extracting hydrogen to generate electricity. Such a lightweight, portable system might be used to provide power and drinking water to villages and also for military operations. (Credit: Jerry Woodall, Purdue University)

ScienceDaily (May 3, 2011) — Researchers have developed an aluminum alloy that could be used in a new type of mobile technology to convert non-potable water into drinking water while also extracting hydrogen to generate electricity.

Such a technology might be used to provide power and drinking water to villages and also for military operations, said Jerry Woodall, a Purdue University distinguished professor of electrical and computer engineering.

The alloy contains aluminum, gallium, indium and tin. Immersing the alloy in freshwater or saltwater causes a spontaneous reaction, splitting the water into hydrogen and oxygen molecules. The hydrogen could then be fed to a fuel cell to generate electricity, producing water in the form of steam as a byproduct, he said.

"The steam would kill any bacteria contained in the water, and then it would condense to purified water," Woodall said. "So, you are converting undrinkable water to drinking water."

Because the technology works with saltwater, it might have marine applications, such as powering boats and robotic underwater vehicles. The technology also might be used to desalinate water, said Woodall, who is working with doctoral student Go Choi.

A patent on the design is pending.

Woodall envisions a new portable technology for regions that aren't connected to a power grid, such as villages in Africa and other remote areas.

"There is a big need for this sort of technology in places lacking connectivity to a power grid and where potable water is in short supply," he said. "Because aluminum is a low-cost, non-hazardous metal that is the third-most abundant metal on Earth, this technology promises to enable a global-scale potable water and power technology, especially for off-grid and remote locations."

The potable water could be produced for about $1 per gallon, and electricity could be generated for about 35 cents per kilowatt hour of energy.
"There is no other technology to compare it against, economically, but it's obvious that 34 cents per kilowatt hour is cheap compared to building a power plant and installing power lines, especially in remote areas," Woodall said.
The unit, including the alloy, the reactor and fuel cell might weigh less than 100 pounds.
"You could drop the alloy, a small reaction vessel and a fuel cell into a remote area via parachute," Woodall said. "Then the reactor could be assembled along with the fuel cell. The polluted water or the seawater would be added to the reactor and the reaction converts the aluminum and water into aluminum hydroxide, heat and hydrogen gas on demand."
The aluminum hydroxide waste is non-toxic and could be disposed of in a landfill.
The researchers have a design but haven't built a prototype.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Purdue University**. The original article was written by Emil Venere.

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http://www.sciencedaily.com/releases/2011/05/110503161411.htm

Gender Bias Uncovered in Children's Books With Male Characters

This is a book from 1916 featuring a female central character. (Credit: Public Domain)

ScienceDaily (May 3, 2011) — The most comprehensive study of 20th century children's books ever undertaken in the United States has found a bias towards tales that feature men and boys as lead characters. Surprisingly, researchers found that even when the characters are animals, they tend to be male.

The findings, published in the April issue of *Gender & Society*, are based on a study of nearly 6,000 books published from 1900 to 2000. While previous studies have looked at the representation of male and female characters in children's books, they were often limited in scope. "We looked at a full century of books," says lead author Prof. Janice McCabe, Assistant Professor of Sociology at Florida State University. "One thing that surprised us is that females' representations did not consistently improve from 1900 to 2000; in the mid part of the century it was actually more unequal. Books became more male-dominated."

The study also found that:

- Males are central characters in 57 percent of children's books published per year, while only 31 percent have female central characters.
- No more than 33 percent of children's books published in any given year contain central characters that are adult women or female animals, but adult men and male animals appear in up to 100 percent of books.
- Male animals are central characters in more than 23 percent of books per year, while female animals are in only 7.5 percent.
- On average, 36.5 percent of books in each year studied include a male in the title, compared to 17.5 percent that include a female.
- Although books published in the 1990s came close to parity for human characters (with a ratio of 0.9:1 for child characters; 1.2:1 for adult characters), a significant disparity of nearly 2 to 1 remains for male animal characters versus female.

Since children's books are a "dominant blueprint of shared cultural values, meanings, and expectations," the authors say the disparity between male and female characters is sending children a message that "women and girls occupy a less important role in society than men or boys." Books contribute to how children understand what is expected of women and men, and shape the way children will think about their own place in the world.

The authors collected information from the full series of three sources: Caldecott award-winning books, (1938-2000); Little Golden Books, (1942-1993) and the Children's Catalog, (1900-2000). They found that Golden Books tended to have the most unbalanced representations.

A closer look at the types of characters with the greatest disparity reveals that only one Caldecott winner has a female animal as a central character without any male central characters. The 1985 book Have You Seen My Duckling? follows Mother Duck asking other pond animals this question as she searches for a missing duckling.

In seeking to answer why there is such persistent inequality among animal characters in books for kids, the authors say some publishers -- under pressure to release books that are more gender balanced -- use "animal characters in an attempt to avoid the problem of gender representation." However, their findings show that most animal characters are gendered and that inequality among animals is greater -- not less -- than that among humans.

The tendency of readers to interpret even gender-neutral animal characters as male exaggerates the pattern of female underrepresentation. The authors note that mothers frequently label gender-neutral animal characters as male when reading with their children, and that children assign gender to gender-neutral animal characters. "Together with research on reader interpretations, our findings regarding imbalanced representations among animal characters suggest that these characters could be particularly powerful, and potentially overlooked, conduits for gendered messages…The persistent pattern of disparity among animal characters may reveal a subtle kind of symbolic annihilation of women disguised through animal imagery."

Story Source:

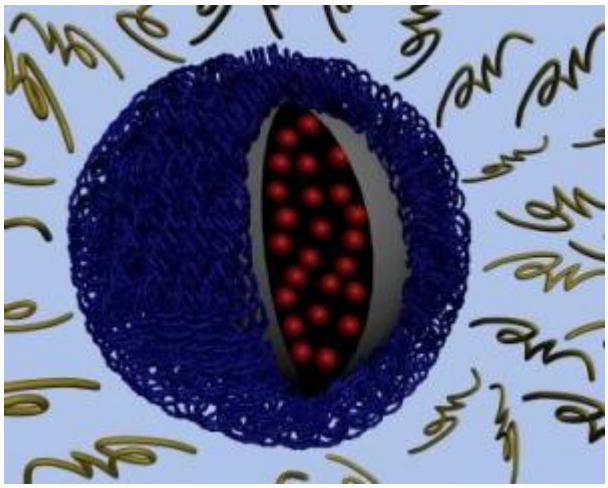
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Sociologists for Women in Society**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. J. McCabe, E. Fairchild, L. Grauerholz, B. A. Pescosolido, D. Tope. **Gender in Twentieth-Century Children's Books: Patterns of Disparity in Titles and Central Characters**. *Gender & Society*, 2011; 25 (2): 197 DOI: 10.1177/0891243211398358

http://www.sciencedaily.com/releases/2011/05/110503151607.htm

Removable 'Cloak' for Nanoparticles Helps Them Target Tumors



The outer layer of this nanoparticle (in yellow) falls off in an acidic environment. (Credit: Stephen Morton)

ScienceDaily (May 3, 2011) — MIT chemical engineers have designed a new type of drug-delivery nanoparticle that exploits a trait shared by almost all tumors: They are more acidic than healthy tissues. Such particles could target nearly any type of tumor, and can be designed to carry virtually any type of drug, says Paula Hammond, a member of the David H. Koch Institute for Integrative Cancer Research at MIT and senior author of a paper describing the particles in the journal *ACS Nano*.

Like most other drug-delivering nanoparticles, the new MIT particles are cloaked in a polymer layer that protects them from being degraded by the bloodstream. However, the MIT team, including lead author and postdoctoral associate Zhiyong Poon, designed this outer layer to fall off after entering the slightly more acidic environment near a tumor. That reveals another layer that is able to penetrate individual tumor cells. In the *ACS Nano* paper, which went online April 23, the researchers reported that, in mice, their particles can survive in the bloodstream for up to 24 hours, accumulate at tumor sites and enter tumor cells.

A new target

The new MIT approach differs from that taken by most nanoparticle designers. Typically, researchers try to target their particles to a tumor by decorating them with molecules that bind specifically to proteins found on the surface of cancer cells. The problem with that strategy is that it's difficult to find the right target -- a molecule found on all of the cancer cells in a particular tumor, but not on healthy cells. Also, a target that works for one type of cancer might not work for another.

Hammond and her colleagues decided to take advantage of tumor acidity, which is a byproduct of its revved-up metabolism. Tumor cells grow and divide much more rapidly than normal cells, and that metabolic activity uses up a lot of oxygen, which increases acidity. As the tumor grows, the tissue becomes more and more acidic.

To build their targeted particles, the researchers used a technique called "layer-by-layer assembly." This means each layer can be tailored to perform a specific function.

When the outer layer (made of polyethylene glycol, or PEG) breaks down in the tumor's acidic environment, a positively charged middle layer is revealed. That positive charge helps to overcome another obstacle to nanoparticle drug delivery: Once the particles reach a tumor, it's difficult to get them to enter the cells. Particles with a positive charge can penetrate the negatively charged cell membrane, but such particles can't be injected into the body without a "cloak" of some kind because they would also destroy healthy tissues.

The nanoparticles' innermost layer can be a polymer that carries a cancer drug, or a quantum dot that could be used for imaging, or virtually anything else that the designer might want to deliver, says Hammond, who is the Bayer Professor of Chemical Engineering at MIT.

Layer by layer

Other researchers have tried to design nanoparticles that take advantage of tumors' acidity, but Hammond's particles are the first that have been successfully tested in living animals.

Jinming Gao, professor of oncology and pharmacology at the University of Texas Southwestern Medical Center, says it is "quite clever" to use layer-by-layer assembly to create particles with a protective layer that can be shed when the particles reach their targets. "It is a nice proof of concept," says Gao, who was not part of the research team. "This could serve as a general strategy to target acidic tumor microenvironment for improved drug delivery."
The researchers are planning to further develop these particles and test their ability to deliver drugs in animals. Hammond says she expects it could take five to 10 years of development before human clinical trials could begin.
Hammond's team is also working on nanoparticles that can carry multiple payloads. For example, the outer PEG layer might carry a drug or a gene that would "prime" the tumor cells to be susceptible to another drug carried in the particle's core.

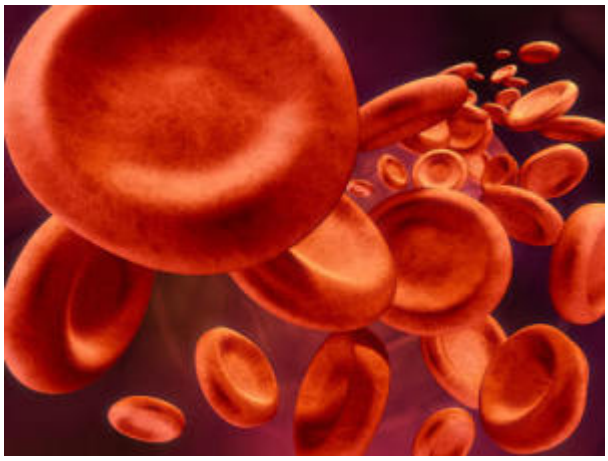
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Massachusetts Institute of Technology**. The original article was written by Anne Trafton, MIT News Office.

Journal Reference:

1. Zhiyong Poon, Dongsook Chang, Xiaoyong Zhao, Paula T. Hammond. **Layer-by-Layer Nanoparticles with a pH Sheddable Layer for In Vivo Targeting of Tumor Hypoxia**. *ACS Nano*, 2011; : 110423130803069 DOI: 10.1021/nn200876f

http://www.sciencedaily.com/releases/2011/05/110503133228.htm

Technique Developed for Measuring Stressed Molecules in Cells



Rendering of red blood cells. Biophysicists at the University of Pennsylvania have helped develop a new technique for studying how proteins respond to physical stress and have applied it to better understand the stability-granting structures in normal and mutated red blood cells. (Credit: © tom / Fotolia)

ScienceDaily (May 3, 2011) — Biophysicists at the University of Pennsylvania have helped develop a new technique for studying how proteins respond to physical stress and have applied it to better understand the stability-granting structures in normal and mutated red blood cells.

The research was conducted by Dennis Discher and Christine Krieger in the Molecular and Cell Biophysics Lab in Penn's School of Engineering and Applied Science, along with researchers from the New York Blood Center and the Wistar Institute.

Discher's research was published online in the journal *Proceedings of the National Academy of Sciences*.

In stark contrast with much of the architecture people interact with every day, the internal architecture of the human body is predominantly soft. Other than bones, all of the organs, tissues and structures in the body are pliable and flexible and need to be that way in order to work.

The Discher lab's research aims to understand what keeps these flexible structures stable, especially when they are under constant physical stress. Discher selected red blood cells as a model for this stress, as they make a complete lap of the turbulent circulatory system every few minutes but survive for months.

"Red blood cells are disks, and they have proteins right below the membrane that give it resilience, like a car tire," Discher said. "The cells are filled with hemoglobin like the tires are filled with air, but where the rubber meets the road is the exterior."

To measure stress in that membrane on an atomic level, the Discher team needed a way to track changes to the shape of those supporting proteins. They found an ideal proxy for that stress in the amino acid cysteine.

Proteins are long chain of amino acids that are tightly folded in on themselves. The order and chemical properties of the acids determine the locations of the folds, which in turn determine the function of the protein. Cysteine is "hydrophobic"; it interacts poorly with water and so it is usually on the inside of a protein. And because stress changes the shape of these folded proteins, Discher reasoned that measuring the degree to which cysteine is exposed would in effect measure how stressed the protein and cells containing it are.

Discher's team simulated the shear forces originating from the beating heart, which forcefully pumps blood and ultimately pulls apart the folds that keep cysteine on the inside of proteins at the red blood cell membrane, allowing it to bind with a fluorescent marker dye. The team could visually confirm that more stressed cells were more fluorescent under the microscope but actually tested the levels of marked cysteine using mass spectrometry.

"Just like a polymer engineer designing a tire, we're looking at the relationship between the chemical makeup and the physical stability of the structure and how it performs," Discher said. "We can use this technique to look at the relationship between structure, flexibility and function."

Investigating the structural elements of blood cells could pave the way to breakthroughs for human health.

"How long can blood be stored? Why are there no good blood substitutes? There are a lot of things we don't understand about the forces cells can sustain before fragmenting and falling apart, especially when we consider age and mutations," he said.

The Discher team studied the mutated blood cells that result in disorders known as elliptocytosis; cells are elliptical, rather than round, and therefore have shorter functional lifespans. These elliptical cells are often missing a chemical "rivet" that anchors the support proteins to the outer membrane, which means that stress causes them to "disassociate," or disconnect, rather than unfold.

That kind of structural change is crippling to the function of anatomical structures like blood cells. The flexibility provided by unfolding is therefore key to their overall stability.

"At least for this cell, the first mechanism of response is to unfold proteins and keep the interactions between proteins the same," Discher said. "That constant back and forth with unfolding within these cells as the cells flow and distort while in the blood stream, allows their architecture to be maintained."

Discher and his colleagues plan to use their cysteine-mass-spectometry technique to investigate the role of softness and flexibility in responding to stress in other biological systems, particularly stem cells, and to better understand why those traits are intrinsic to life on this planet.

Along with Discher and Krieger, the research was conducted by Xiuli An and Narla Mohandas of the New York Blood Center and Hsin-Yao Tang and David W. Speicher of the Wistar Institute.

The research was supported by the National Institutes of Health.

Story Source:

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

Journal Reference:

1. C. C. Krieger, X. An, H.-Y. Tang, N. Mohandas, D. W. Speicher, D. E. Discher. **Cysteine shotgun-mass spectrometry (CS-MS) reveals dynamic sequence of protein structure changes within mutant and stressed cells**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1018887108

http://www.sciencedaily.com/releases/2011/05/110503133209.htm

Using Solar Power to Sterilize Medical Instruments

For their senior capstone design project, the members of Team Sterilize refitted the Capteur Soleil at Rice's Oshman Engineering Design Kitchen to sterilize medical instruments and supplies with the power of the sun. From left, David Luker, William Dunk, professor and team adviser Doug Schuler, Daniel Rist and Sam Major. (Credit: Jeff Fitlow/Rice University)

ScienceDaily (May 3, 2011) — Rice University senior engineering students are using the sun to power an autoclave that sterilizes medical instruments and help solve a long-standing health issue for developing countries.

The student's used Capteur Soleil, a device created decades ago by French inventor Jean Boubour to capture the energy of the sun in places where electricity -- or fuel of any kind -- is hard to get. In attaching an insulated box containing the autoclave, the students transform the device into a potential lifesaver.

The Capteur Soleil, which sits outside Rice's Oshman Engineering Design Kitchen, looks something like an ultramodern lawn swing. Its spine is a steel A-frame, and a bed of curved mirrors beneath the frame produces steam by focusing sunlight along a steel tube at the frame's apex. Rather than pump steam directly into the autoclave, the Rice team's big idea was to use the steam to heat a custom-designed conductive hotplate.

"It basically becomes a stovetop, and you can heat anything you need to," said Sam Major, a member of the team with seniors Daniel Rist, David Luker and William Dunk, all mechanical engineering students. "As long as the autoclave reaches 121 Celsius for 30 minutes (the standard set by the Centers for Disease Control and Prevention), everything should be sterile, and we've found we're able to do that pretty easily."

He said one person could easily adjust the Capteur Soleil by ratcheting up the back leg to align the mirrors with the sun. Within half an hour of receiving strong sunlight, the Capteur Soleil will begin to produce steam, which will in turn heat the patterned hotplate and then the standard-issue, FDA-approved autoclave. With good midday sun, Major said, it takes 40 minutes to an hour to begin significant heating of the autoclave.

The autoclave, which looks like a tricked-out pressure cooker, has a steamer basket inside. "We put about an inch of water inside, followed by the basket with the tools and syringes," Major said. "We've used some biological spores from a test kit, steamed them, and then incubated them for 24 hours and they came back negative for biological growth. That means we killed whatever was in there."
The autoclave, tucked inside a plywood frame, is wrapped in silicon-based Thermablok insulation, which has the highest R-value of any known material and is a spinoff from NASA research into thermal protection for the space shuttle. "This thin layer does most of the work," Major said. "We used standard pink insulation around the inside just to make the box stronger."
"This is really the latest iteration of a much larger project," said Doug Schuler, the team's faculty adviser and an associate professor of business and public policy at Rice's Jones Graduate School of Business. "We already have a version of the Capteur Soleil being used in Haiti for cooking, but we felt it could do more."

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

http://www.sciencedaily.com/releases/2011/05/110503133205.htm

Revolution in Wound Care? Cotton Candy-Like Glass Fibers Appear to Speed Healing in Initial Venous Stasis Wound Trial

When applied to venous stasis wounds, borate glass nanofibers (above) developed at Missouri S&T and produced by the Mo-Sci Corporation appear to speed the healing process in a recent 12-person human trial. (Credit: Peter Wray; ACerS)

ScienceDaily (May 3, 2011) — Imagine a battlefield medic or emergency medical technician providing first aid with a special wad of cottony glass fibers that simultaneously slows bleeding, fights bacteria (and other sources of infection), stimulates the body's natural healing mechanisms, resists scarring, and-because it is quickly absorbed by surrounding tissue -- may never have to be removed in follow-up care.

Or, imagine diabetics with hard-to-heal wounds finding a source of relief from the battle against infections and limb amputation.

Those scenarios are the hope of the developers of a revolutionary borate glass nanofiber material, which appears have sped and helped the final of healing long-term wounds in eight out of 12 venous stasis wound sufferers in a recent clinical trial held at a medical center in Rolla, Mo.

Details about the trials and the glass fiber material were published in the May issue of the American Ceramic Society's *Bulletin* magazine.

The story reports on the discovery of the fibers and on an empirical study that began late in the fall of 2010 supervised by the internal review board of the Phelps County Regional Medical Center. The trial groups originally had 13 volunteer members, but one dropped out during the early stages.

According to Peggy Taylor, the PCRMC registered nurse who administered the treatments, all of the volunteers in the trial are enthusiastic about the use of the glass fiber product, which she says "looks like cotton candy."

"All of the participants had diabetes and several of them had wounds that had been unhealed for more than a year," says Taylor, a specialist in wound care. "One patient had the same wound for three years. After using the glass fiber product for a few months, we were able to repair the skin in eight of the patients. Remarkably, the other four have made a lot of progress and all of their wounds should be healed soon, too."

All of the patients suffered from problems associated with venous stasis, a condition where blood circulation in extremities is poor. As the blood pools, typically in lower legs, fluids accumulate causing unusual pressure on skin tissues. Sores and wounds can then develop when the fluid "weeps" from skin cracks, cuts or abrasions.

Because of an enzyme in the weeping fluid, the skin surrounding small venous stasis injuries can quickly erode and turn into large and deep wounds. Even small bruises can eventually develop into bone-deep openings.

The goal of the PCRMC trial was to provide an initial evaluation of the effects of the novel fibrous glass material produced by the Mo-Sci Corporation, a Rolla company already known for creating glass-based materials for medical applications.

"Bioglass" materials aren't particularly new to the medical field, but thus far all bioglass has been formed from a silica-based glass composition, and these primarily have been used in hard-tissue regeneration, such as bone repair.

Glass scientist Steve Jung, who helped develop the new material, says he and co-developer Delbert Day had wondered whether a different type of bioactive glass material could be used for soft-tissue regeneration. "We felt from our in-vitro studies that bioactive glasses containing boron would react to body fluids much faster than silicate glasses," says Jung, who obtained his Ph.D from Missouri University of Science and Technology, where he conducted his research with Day, a professor at the university. "We also knew that an in-vitro study of lithium borate glasses had showed it to have beneficial effects against bacteria, such as E. coli, salmonella and staphylococcus microbes."

Lastly, Jung and Day recall they were interested in a composition that was rich in calcium. "Previously, investigators have reported that calcium is important for wound healing. It appears to assist the migration of epidermal cells and help the body regulate the healing process of open wounds," says Jung.

Besides composition, Jung and Day thought the structure of the material may be important to consider, too, and suspected that providing a healing "scaffold" might be beneficial. "We thought it might be advantageous to have a material that could mimic the microstructure of fibrin that forms the basis of a blood clot. We reasoned that if the structure could imitate fibrin, it might trap blood platelets and allow the formation of a wound cover that could support the healing process."

Jung and Day finally settled on a particular borate glass composition -- called 13-93B3 glass -- one that Mo-Sci, a company founded by Day, already knew how to form into cottony glass fibers, 300 nanometers to 5 micrometers in diameter.

After animal tests showed no adverse effects, Mo-Sci obtained a license to the material from Missouri S&T, named the borate glass material "DermaFuse," and approached PCRMC about starting the small-scale human test.

PCRMC approved the trial in July 2010, and nurse Taylor saw her first patient one month later. Once the study was underway, the company provided Taylor with individual, foil-sealed packets containing pads made of the glass fibers. She says the material is easy to apply. "It gets kind of squished in the packs, but you can form it, pick it, make it into any kind of shape you need out of it. I used tweezers to pack the material up into all of the recesses before filling the rest of the wound. I didn't pack it hard, but enough to fill all the crevices. Once it was in place, I covered it with a secondary covering or compression wrap." One thing that surprised Taylor was that the glass fibers seem to disappear over time, a phenomenon that has been observed with other bioglasses. "Does it dissolve? Does it become part of the tissue? We don't quite know, but it is just such a neat thing to watch that process."

Taylor acknowledges that under her care, the wounds would have probably healed without the glass material, but they would have required expensive vacuum-assisted healing systems that must be carried by patient at all times.

Besides low cost and ease of use, Taylor says the glass fibers seem to offer another stunning benefit: low scarring. "All but one of the patients in the trial were elderly and had a lot of skin discoloration, but we healed wounds that show nothing or negligible scarring," she says.

Jung, who now works as a senior researcher for Mo-Sci, says that the next step is expanded human trials, which will be conducted in partnership with the Center for Wound Healing and Tissue Regeneration at the University of Illinois at Chicago. He says the center has agreed to begin testing the material this summer. In the meantime, Jung says he and Day are optimistic about a new era in wound treatment. "We are really hoping the properties of these fibers can help with more extensive wounds, such as burns, and we easily foresee the day when soldiers or EMT workers carry packets of these glass fibers to provide healing protective covers that don't have to be removed."

The story, "Cotton candy that heals? Borate glass fibers look promising", is available online at http://americanceramicsociety.org/bulletin/2011_pdf_files/may_11/#/27/

Story Source:

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

http://www.sciencedaily.com/releases/2011/05/110503133056.htm

Market Lighting Affects Nutrients in Salad Greens, Researchers Find

ARS researchers have found that spinach leaves exposed to light similar to the 24-hour fluorescent light received by packages of fresh salad greens on display in grocery stores had higher levels of some nutrients than did leaves exposed to continuous dark. (Credit: Photo by Keith Weller)

ScienceDaily (May 3, 2011) — Many people reach toward the back of the fresh-produce shelf to find the freshest salad greens with the latest expiration dates. But a study led by U.S. Department of Agriculture (USDA) scientists may prompt consumers to instead look for packages that receive the greatest exposure to light--usually those found closest to the front.

The study was led by postharvest plant physiologist Gene Lester while at the Agricultural Research Service (ARS) Crop Quality and Fruit Insects Research Unit in Weslaco, Texas. ARS is USDA's chief intramural scientific research agency.

Lester and colleagues Donald Makus and Mark Hodges found that spinach leaves exposed to continuous light during storage were, overall, more nutritionally dense than leaves exposed to continuous dark. Lester now works at the ARS Food Quality Laboratory in Beltsville, Md.

For the study, the researchers exposed spinach leaves to light similar to the 24-hour artificial fluorescent light received by spinach in packages located at the front of the display case. A second group was enclosed in two-layer-thick, brown-grocery-bag paper to represent the "dark treatment."

Both experimental groups were housed in market-type, light-transmissible polymer tubs with snap-tight lids and were kept in walk-in storage chambers at 4 degrees Celsius, the same temperature at which markets

currently display packaged spinach. The light reaction of photosynthesis is not temperature-dependent and can occur at 4 degrees C in the right type of light.
The researchers found that the continuous light affected the leaves' photosynthetic system-resulting in a significant increase in levels of carotenoids and vitamins C, E, K, and B9, or folate.
While the simulated retail light conditions actually helped the stored leaves gain in content of several human-healthy vitamins, some wilting occurred after three days of storage in flat-leaf spinach, but not crinkled-leaf types.
Results from this work were published in the *Journal of Agricultural and Food Chemistry*.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **USDA/Agricultural Research Service**. The original article was written by Rosalie Marion Bliss.

Journal Reference:

1. Gene E. Lester, Donald J. Makus, D. Mark Hodges. **Relationship between Fresh-Packaged Spinach Leaves Exposed to Continuous Light or Dark and Bioactive Contents: Effects of Cultivar, Leaf Size, and Storage Duration**. *Journal of Agricultural and Food Chemistry*, 2010; 58 (5): 2980 DOI: 10.1021/jf903596v

http://www.sciencedaily.com/releases/2011/05/110503133054.htm

World's Smallest Atomic Clock: Tiny Laser Reduces Power Consumption 1,000-Fold

Darwin Serkland measures the wavelength of a tiny laser called a VCSEL, or vertical-cavity surface-emitting laser. The image on the monitor (left) shows a bright circle of light emitted from a VCSEL operating at the wavelength of 894 nanometers needed to drive the atomic clock. The objects that look like black baseball bats are tiny wire needles carrying milliampere currents. The round white plastic containers on Serkland's workbench each contain about 5,000 VCSELs fabricated from one-quarter of a 3-inch diameter gallium arsenide wafer. Each wafer is designed differently to yield a unique type of laser. (Credit: Image courtesy of DOE/Sandia National Laboratories)

ScienceDaily (May 3, 2011) — A matchbook-sized atomic clock 100 times smaller than its commercial predecessors has been created by a team of researchers at Symmetricom Inc. Draper Laboratory and Sandia National Laboratories. The portable Chip Scale Atomic Clock (CSAC) -- only about 1.5 inches on a side and less than a half-inch in depth -- also requires 100 times less power than its predecessors. Instead of 10 watts, it uses only 100 milliwatts. "It's the difference between lugging around a device powered by a car battery and one powered by two AA batteries," said Sandia lead investigator Darwin Serkland.

Despite common implications of the word "atomic," the clock does not use radioactivity as an energy source. Instead, where an old-fashioned alarm clock uses a spring-powered series of gears to tick off seconds, a CSAC counts the frequency of electromagnetic waves emitted by cesium atoms struck by a tiny laser beam to determine the passage of time.

Still, given that the CSAC does not actually display the time of day -- measured in millionths of a second, its passage would defy the ability of human eyes to read it -- why would anyone want it?

The clock's uses are, indeed, specialized. Miners far underground or divers engaged in deep-sea explorations, blocked by natural barriers from GPS signals, could plan precise operations with remote colleagues who also had atomic clocks, because their timing would deviate from each other by less than one millionth of a second in a day.

A CSAC timekeeper would be invaluable to experts using electromagnetic interference to prevent telephone signals from detonating improvised explosive devices, or IEDs. Though GPS signals also would be blocked, a CSAC timekeeper would still function.

On a nationwide scale, relay stations for cross-country phone and data lines, which routinely break up messages into packets of information and send them by a variety of routes before reconstituting them correctly at the end of their voyages, would continue functioning during GPS outages.

The clock's many uses, both military and commercial, are why the Defense Advanced Research Projects Agency (DARPA) funded the work from 2001 until the CSA Clock hit the commercial market in January. "Because few DARPA technologies make it to full industrial commercialization for dual-use applications, this is a very big deal," said Gil Herrera, director of Sandia's Microsystems and Engineering Sciences Application (MESA) center. "CSAC now is a product with a data sheet and a price."

Cesium atoms are housed in a container the size of a grain of rice developed by Cambridge, Mass.-based Draper Lab. The cesium atoms are interrogated by a light beam from a vertical-cavity surface-emitting laser, or VCSEL, contributed by Sandia. Symmetricom, an atomic clock manufacturer, designed the electronic circuits and assembled the components into a complete functioning clock at its Beverly, Mass., location.

The reduced power consumption that was key to creating the smaller unit required, in addition to a completely new architecture, a VCSEL rather than the previous tool of choice, a rubidium-based atomic vapor lamp. "It took a few watts to excite the rubidium lamp into a plasmalike state," Serkland said. "Use of the VCSEL reduced that power consumption by more than a thousand times to just two milliwatts." (Serkland's success in attaining this huge power reduction caused some in the clock business to refer to him as "the VCSEL wizard.")

The way the clock keeps time may best be imagined by considering two tuning forks. If the forks vary only slightly in size, a series of regular beats are produced when both forks vibrate. The same principle works in the new clock.

The VCSEL -- in addition to being efficient, inexpensive, stable and low-power -- is able to produce a very fine, single-frequency beam. The laser frequency, at 335 terahertz (894.6 nanometers), is midway between two hyperfine emission levels of the cesium atom, separated in terms of energy like the two differently sized tuning forks. One level is 4.6 gigahertz above and the other 4.6 gigahertz below the laser frequency. (Hyperfine lines are the energy signatures of atoms.) A tiny microwave generator sends an oscillating frequency that alternates adding and subtracting energy from the incoming laser carrier frequency. Thus, the laser's single beam produces two waves at both hyperfine emission energies. When they interact, the emitted waves produce (like two tuning forks of different sizes) a series of 'beats' through a process known as interference.

A photodiode monitors the slight increase in light transmission through the cesium vapor cell when the microwave oscillator is tuned to resonance. According to the international definition of the second (since 1967) the clock indicates that one second has elapsed after counting exactly 4,596,315,885 cycles (nearly 4.6 gigacycles) of the microwave oscillator signal.

Because magnetism has an influence on cesium atoms, they are shielded from Earth's magnetic field by two layers of steel sheathing.

While this sounds cumbersome, atomic clocks are simpler to maintain than timepieces of a century ago, when a pendulum clock in Paris was the source of the world's exact time. Kept in a room that was temperature- and humidity-controlled, not only would a change of one degree affect the pendulum's swing, but the difficulty of bringing accurate time to the U.S. was extreme: one synchronized a portable clock in Paris and then had to transport it across the ocean by ship, during which time the mechanical clock would inevitably drift from the time of the Paris clock.

A description of the technical details of the clock, available for approximately $1,500, can be found at Symmetricom's website at: http://www.symmetricom.com/products/frequency-references/chip-scale-atomic-clock-csac/SA.45s-CSAC/

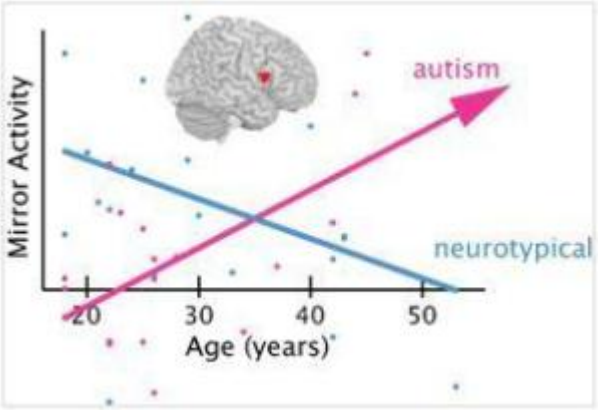
Sandia is developing a follow-on technology for DARPA: a trapped-ion-based clock. It will improve timing accuracy at similar size, weight and power to the CSAC. Researches are working on the first compact prototype.

Story Source:

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

http://www.sciencedaily.com/releases/2011/05/110503132707.htm

Mirror Neuron System in Autism: Broken or Just Slowly Developing?



This graph shows the relationship between age and mirror activity for a normal brain and one with autism. (Credit: Image courtesy of Elsevier)

ScienceDaily (May 3, 2011) — Developmental abnormalities in the mirror neuron system may contribute to social deficits in autism.

The mirror neuron system is a brain circuit that enables us to better understand and anticipate the actions of others. These circuits activate in similar ways when we perform actions or watch other people perform the same actions.

Now, a new study published in *Biological Psychiatry* reports that the mirror system in individuals with autism is not actually broken, but simply delayed.

Dr. Christian Keysers, lead author on the project, detailed their findings, "While most of us have their strongest mirror activity while they are young, autistic individuals seem to have a weak mirror system in their youth, but their mirror activity increases with age, is normal by about age 30 and unusually high thereafter." This increase in function of mirror neuron systems may be related to increased capacity for social function or responsiveness to rehabilitative treatments among individuals with autism.

"The finding of late developing circuit functions could be very important. One wonders whether the recent breakthroughs in the genetics of autism could help to identify causes for the developmental delays. This type of bridge might help to identify novel treatment mechanisms for autism," said Dr. John Krystal, Editor of *Biological Psychiatry*.

One of the next steps in this line of research will be for researchers to examine how individuals with autism accomplish this improvement over time, and how therapeutic interventions targeting the same mechanism can help to support this important process.

Story Source:

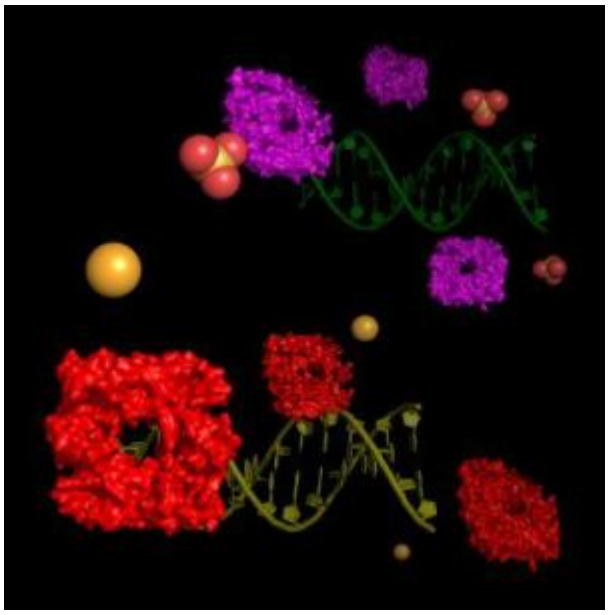
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Elsevier**, via AlphaGalileo.

Journal Reference:

1. Jojanneke A. Bastiaansen, Marc Thioux, Luca Nanetti, Christiaan van der Gaag, Cees Ketelaars, Ruud Minderaa, Christian Keysers. **Age-Related Increase in Inferior Frontal Gyrus Activity and Social Functioning in Autism Spectrum Disorder**. *Biological Psychiatry*, 2011; 69 (9): 832 DOI: 10.1016/j.biopsych.2010.11.007

http://www.sciencedaily.com/releases/2011/05/110503081159.htm

Discovery of Two New Genes Provides Hope for Stemming Staph Infections



Staphylococcus aureus encodes a DNA binding copper-sensitive operon repressor (CsoR, bottom) and a CsoR-like sulfur transferase repressor (CstR, top), which are very similar to one another. Unlike CsoR, the repressor CstR does not form a stable complex with copper, Cu(I). Instead, operator binding is inhibited by attaching a second repressor to the first, possibly via a disulfide or even trisulfide bridge. (Credit: David Giedroc)

ScienceDaily (May 2, 2011) — The discovery of two genes that encode copper- and sulfur-binding repressors in the hospital terror *Staphylococcus aureus* means two new potential avenues for controlling the increasingly drug-resistant bacterium, scientists say in the April 15, 2011 issue of the *Journal of Biological Chemistry*.

"We need to come up with new targets for antibacterial agents," said Indiana University Bloomington biochemist David Giedroc, who led the project. "Staph is becoming more and more multi-drug resistant, and both of the systems we discovered are promising."

The work was a collaboration of members of Giedroc's laboratory, and that of Vanderbilt University School of Medicine infectious disease specialist Eric Skaar, and University of Georgia chemist Robert Scott.

MRSA, or multidrug-resistant *Staphylococcus aureus*, is the primary cause of nosocomial infections in the United States. About 350,000 infections were reported last year, about 20 percent of which resulted in fatalities, according to the Centers for Disease Control. One to two percent of the U.S. population has MRSA in their noses, a preferred colonization spot.

One of the repressors the scientists discovered, CsoR (Copper-sensitive operon Repressor), regulates the expression of copper resistance genes, and is related to a CsoR previously discovered by the Giedroc group in Mycobacterium tuberculosis, the bacterium that causes tuberculosis in humans. When the bacterium is exposed to excess copper, the repressor binds copper (I) and falls away from the bacterial genome to which it is bound, making it possible for the copper resistance genes to be turned on. This makes sense, since in the presence of a lot of copper -- a metal commonly used to kill bacteria -- a bacterium is well served by expressing genes that help the bacterium sequester and export extra copper before the metal can do any real damage.

The other repressor, CstR (CsoR-like sulfurtransferase Repressor), which the scientists found can react with various forms of sulfur, appears to prevent the transcription of a series of sulfur assimilation genes based on their homology with similar genes in other bacterial species. One of the genes in this system encodes a well known enzyme, sulfurtransferase, which interconverts sulfite (SO3 2-) and thiosulfate, (S2O3 2-).

The scientists have yet to confirm the functions of the other genes controlled by CstR, but a new four-year, $1.1 million grant from the National Institutes of Health to principal investigator Giedroc will fund crucial investigations into Staph's utilization of sulfur, an important element that bacteria -- and all organisms for that matter -- use to make protein.

The two repressors -- and the gene systems they regulate -- are possible new drug targets for controlling Staph growth. A drug could hypothetically target either of the repressors, causing bacteria to become unresponsive to toxic copper levels or incapable of properly integrating sulfur into their cell physiologies, respectively.

"One thing you could do is prevent the repressors from coming off the DNA in the first place," Giedroc said "although I think that's probably a long shot. I think the repressors are one step removed from where you'd like to have the action. At this point I think the better targets are going to be the genes they are regulating."

Among those genes, Giedroc says he's hopeful one of the sulfur utilization genes controlled by CstR turns out to be an effective drug target. And he wouldn't be surprised if that was the case.

"The metabolic process by which sulfur is assimilated is a proven drug target in Mycobacterium tuberculosis," Giedroc said. "We see no reason why this can't be the case for *Staphylococcus aureus*. Finding out will be one of the goals of this new NIH-funded project."

Nicholas Grossoehme and Zhen Ma of IU Bloomington, Thomas Kehl-Fie and Keith Adams of Vanderbilt, and Darin Cowart of Georgia also contributed to the report. The project was funded by grants from the National Institutes of Health, the Southeastern Regional Center of Excellence for Emerging Infections and Biodefense, and the American Heart Association.

Story Source:

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

Journal Reference:

1. N. Grossoehme, T. E. Kehl-Fie, Z. Ma, K. W. Adams, D. M. Cowart, R. A. Scott, E. P. Skaar, D. P. Giedroc. **Control of Copper Resistance and Inorganic Sulfur Metabolism by Paralogous Regulators in Staphylococcus aureus**. *Journal of Biological Chemistry*, 2011; 286 (15): 13522 DOI: 10.1074/jbc.M111.220012

http://www.sciencedaily.com/releases/2011/04/110412121249.htm

New Mineral Discovered: One of Earliest Minerals Formed in Solar System

The "Cracked Egg" grain, in which krotite was discovered, is contained in the NWA 1934 Meteorite. (Credit: Image by Chi Ma)

ScienceDaily (May 6, 2011) — In the May-June issue of the journal *American Mineralogist*, a team of scientists announced the discovery of the new mineral krotite, one of the earliest minerals formed in our solar system. It is the main component of an unusual inclusion embedded in a meteorite (NWA 1934), found in northwest Africa. These objects, known as refractory inclusions, are thought to be the first planetary materials formed in our solar system, dating back to before the formation of Earth and the other planets.

This particular grain is known affectionately as "Cracked Egg" for its distinctive appearance. Dr. Harold C. Connolly, Jr. and student Stuart A. Sweeney Smith at the City University of New York (CUNY) and the American Museum of Natural History (AMNH) first recognized the grain to be of a very special type, known as a calcium-aluminum-rich refractory inclusion. ("Refractory" refers to the fact that these grains contain minerals that are stable at very high temperature, which attests to their likely formation as very primitive, high-temperature condensates from the solar nebula.)

Cracked Egg refractory inclusion was sent to Dr. Chi Ma at California Institute of Technology (Caltech) for very detailed nano-mineralogy investigation. Dr. Ma then sent it to Dr. Anthony Kampf, Curator of Mineral Sciences at the Natural History Museum of Los Angeles County (NHM), for X- ray diffraction study. Kampf's findings, confirmed by Ma, showed the main component of the grain was a low-pressure calcium aluminum oxide ($CaAl_2O_4$) never before found in nature. Kampf's determination of the atomic arrangement in the mineral showed it to be the same as that of a human-made component of some types of refractory (high-temperature) concrete.

What insight can we get from knowing that a common human-made component of modern concrete is found in nature only as a very rare component of a grain formed more than 4.5 billion years ago? Such investigations are essential in deciphering the origins of our solar system. The creation of the human-made compound requires temperature of at least 1,500°C (2,732°F). This, coupled with the fact that the compound forms at low pressure, is consistent with krotite forming as a refractory phase from the solar nebula. Therefore, the likelihood is that krotite is one of the first minerals formed in our solar system.

Studies of the unique Cracked Egg refractory inclusion are continuing, in an effort to learn more about the conditions under which it formed and subsequently evolved. In addition to krotite, the Cracked Egg contains at least eight other minerals, including one other mineral new to science.

The *American Mineralogist* paper is authored by Chi Ma (Caltech), Anthony R. Kampf (NHM), Harold C. Connolly Jr. (CUNY and AMNH), John R. Beckett (Caltech), George R. Rossman (Caltech), Stuart A. Sweeney Smith (who was a NSF funded Research for Undergraduate (REU) student at CUNY/AMNH) and Devin L. Schrader (University of Arizona). Krotite is named for Alexander N. Krot, a cosmochemist at the University of Hawaii, in recognition of his significant contributions to the understanding of early solar system processes.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Natural History Museum of Los Angeles County**.

Journal Reference:

1. Chi Ma, Anthony R. Kampf, Harold C. Connolly Jr., John R. Beckett, George R. Rossman, Stuart A. Sweeney Smith, and Devin L. Schrader. **Krotite, $CaAl_2O_4$, a new refractory mineral from the NWA 1934 meteorite**. *American Mineralogist*, 2011; 96: 709-715 [link]

http://www.sciencedaily.com/releases/2011/05/110506165310.htm

Malaria Mosquitoes Accurately Find Their Way to Smelly Feet

This Anopheles gambiae mosquito is obtaining a blood meal as it feeds on a human host. (Credit: CDC/Jim Gathany)

ScienceDaily (May 6, 2011) — Malaria mosquitoes utilize CO_2 from exhaled air to localize humans from afar. In the vicinity of their preferred host, they alter their course towards the human feet. Researcher Remco Suer discovered how female malaria mosquitoes use foot odors in the last meters to guide them to their favoured biting place. Suer, who is defending his doctoral thesis May 9 at Wageningen University, part of Wageningen UR, sees possibilities to disrupt the host seeking behaviour of the malaria mosquito.

African malaria mosquitoes, *Anopheles gambiae*, use their olfactory organs, two antennae, two mouthparts (maxillary palps) and the proboscis, to search for their hosts to obtain a bloodmeal. From a distance of several tens of meters mosquitoes detect CO_2 which forms part of exhaled air by humans. However, a malaria mosquito does not follow the CO_2 trail to its source, the mouth, but at a certain point close to the source is diverted toward the feet, which is the preferred biting place for this mosquito species.

PhD candidate Remco Suer from the chair group Entomology of Wageningen University has uncovered a mechanism for this behavior. Previous research within this project, funded by the Bill and Melinda Gates foundation, showed that bacteria living on the human foot produce various odors and identified ten bacterial foot odors that, when offered as a blend, were attractive to malaria mosquitoes. Remco Suer now shows that nine out of these ten foot odors are detected by olfactory neurons present underneath hair-like structures on the mouthparts of the malaria mosquito. More importantly, he discovered that 5 of the 10 microbial odors are capable of blocking the response to CO_2. By blocking the CO_2 signal the mosquito stops orienting towards CO_2 and diverts its attention to close range foot odors.

The researcher added additional CO_2 to the experiments to simulate exhaled air. A short stimulation of 1 second with the highest concentration of the five foot odors separately resulted in complete inhibition of the CO_2 response for multiple seconds.

From dozens of olfactory neurons, only one type of olfactory neuron is capable detecting CO_2. This olfactory neuron is co-compartmentalized together with two other olfactory neurons underneath the capitate peg sensilla, hair-like structures, present on the mouthparts of the mosquito. By registering the responses of these olfactory neurons, Suer was able to determine which human odors the female malaria mosquito detects. From the ten microbial odors previously discovered nine elicited responses from all three olfactory receptors on the mouthparts and 5 of them inhibited the CO_2 response.

By inhibiting the perception of CO_2, it is possible to disrupt the host seeking behavior of the malaria mosquito. Because these bacterial foot odors block the CO_2 response and at the same time activate other olfactory neurons, it is very plausible that these odors cause the switch from the long distance CO_2 signal to the preferred biting place, the feet. Behavioral experiments show that at short range these odors block the CO_2 effect and even enhance the attractiveness of an attractive basic odor blend. This implies that these CO_2 inhibitors cannot be used as repellents and even divert the orientation of the mosquito to short-range human odors.

Odors that block the CO_2 receptor but activate other olfactory neurons, thereby diverting the orientation of the malaria mosquito to other odor sources, have potential applications in odor trapping systems as a barrier. By

placing a barrier releasing these CO_2 inhibitors, it might be possible to lure malaria mosquitoes towards odor traps containing a mixture of other attractive human odors.

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

http://www.sciencedaily.com/releases/2011/05/110506073756.htm

Mars Express Sees Deep Fractures on Mars

Deep fractures on Mars. (Credit: ESA/DLR/FU Berlin (G. Neukum))

ScienceDaily (May 6, 2011) — Newly released images from the European Space Agency's Mars Express show Nili Fossae, a system of deep fractures around the giant Isidis impact basin. Some of these incisions into the martian crust are up to 500 m deep and probably formed at the same time as the basin.

Nili Fossae is a 'graben' system on Mars, northeast of the Syrtis Major volcanic province, on the northwestern edge of the giant Isidis impact basin. Graben refers to the lowered terrain between two parallel faults or fractures in the rocks that collapses when tectonic forces pull the area apart. The Nili Fossae system contains numerous graben concentrically oriented around the edges of the basin.

It is thought that flooding of the basin with basaltic lava after the impact that created it resulted in subsidence of the basin floor, adding stress to the planet's crust, which was released by the formation of the fractures.

A strongly eroded impact crater is visible to the bottom right of the image. It measures about 12 km across and exhibits an ejecta blanket, usually formed by material thrown out during the impact. Two landslides have taken place to the west of the crater. Whether they were a direct result of the impact or occurred later is unknown.

A smaller crater, measuring only 3.5 km across, can be seen to the left of centre in the image and this one does not exhibit any ejecta blanket material. It has either been eroded or may have been buried.

The surface material to the top left of the image is much darker than the rest of the area. It is most likely formed of basaltic rock or volcanic ash originating from the Syrtis Major region. Such lava blankets form when large amounts of low-viscosity basaltic magma flow across long distances before cooling and solidifying. On Earth, the same phenomenon can be seen in the Deccan Traps in India.

Nili Fossae interests planetary scientists because observations taken with telescopes on Earth and published in 2009 have shown that there is a significant enhancement in Mars' atmospheric methane over this area, suggesting that methane may be being produced there. Its origin remains mysterious, however, and could be geological or perhaps even biological.

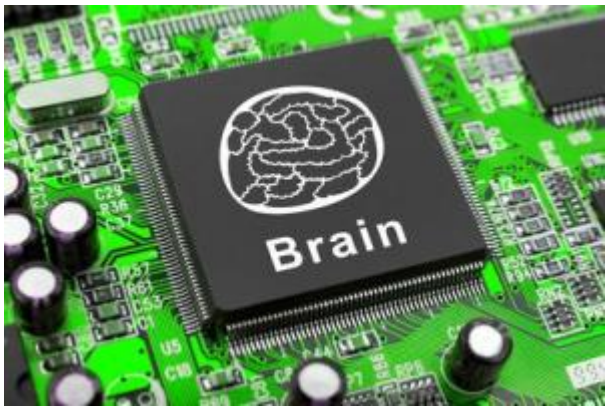
As a result, understanding the origin of methane on Mars is high on the priority list and in 2016, ESA and NASA plan to launch the ExoMars Trace Gas Orbiter to investigate further. Nili Fossae will be observed with great interest.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **European Space Agency**.

http://www.sciencedaily.com/releases/2011/05/110506100931.htm

Scientists Afflict Computers With 'Schizophrenia' to Better Understand the Human Brain



Computer networks that can't forget fast enough can show symptoms of a kind of virtual schizophrenia, giving researchers further clues to the inner workings of schizophrenic brains, researchers have found. (Credit: © Nikolai Sorokin / Fotolia)

ScienceDaily (May 6, 2011) — Computer networks that can't forget fast enough can show symptoms of a kind of virtual schizophrenia, giving researchers further clues to the inner workings of schizophrenic brains, researchers at The University of Texas at Austin and Yale University have found.

The researchers used a virtual computer model, or "neural network," to simulate the excessive release of dopamine in the brain. They found that the network recalled memories in a distinctly schizophrenic-like fashion.

Their results were published in April in *Biological Psychiatry*.

"The hypothesis is that dopamine encodes the importance-the salience-of experience," says Uli Grasemann, a graduate student in the Department of Computer Science at The University of Texas at Austin. "When there's too much dopamine, it leads to exaggerated salience, and the brain ends up learning from things that it shouldn't be learning from."

The results bolster a hypothesis known in schizophrenia circles as the hyperlearning hypothesis, which posits that people suffering from schizophrenia have brains that lose the ability to forget or ignore as much as they normally would. Without forgetting, they lose the ability to extract what's meaningful out of the immensity of stimuli the brain encounters. They start making connections that aren't real, or drowning in a sea of so many connections they lose the ability to stitch together any kind of coherent story.

The neural network used by Grasemann and his adviser, Professor Risto Miikkulainen, is called DISCERN. Designed by Miikkulainen, DISCERN is able to learn natural language. In this study it was used to simulate what happens to language as the result of eight different types of neurological dysfunction. The results of the simulations were compared by Ralph Hoffman, professor of psychiatry at the Yale School of Medicine, to what he saw when studying human schizophrenics.

In order to model the process, Grasemann and Miikkulainen began by teaching a series of simple stories to DISCERN. The stories were assimilated into DISCERN's memory in much the way the human brain stores information-not as distinct units, but as statistical relationships of words, sentences, scripts and stories.

"With neural networks, you basically train them by showing them examples, over and over and over again," says Grasemann. "Every time you show it an example, you say, if this is the input, then this should be your output, and if this is the input, then that should be your output. You do it again and again thousands of times, and every time it adjusts a little bit more towards doing what you want. In the end, if you do it enough, the network has learned."

In order to model hyperlearning, Grasemann and Miikkulainen ran the system through its paces again, but with one key parameter altered. They simulated an excessive release of dopamine by increasing the system's learning rate-essentially telling it to stop forgetting so much.

"It's an important mechanism to be able to ignore things," says Grasemann. "What we found is that if you crank up the learning rate in DISCERN high enough, it produces language abnormalities that suggest schizophrenia."

After being re-trained with the elevated learning rate, DISCERN began putting itself at the center of fantastical, delusional stories that incorporated elements from other stories it had been told to recall. In one answer, for instance, DISCERN claimed responsibility for a terrorist bombing.
In another instance, DISCERN began showing evidence of "derailment"-replying to requests for a specific memory with a jumble of dissociated sentences, abrupt digressions and constant leaps from the first- to the third-person and back again.
"Information processing in neural networks tends to be like information processing in the human brain in many ways," says Grasemann. "So the hope was that it would also break down in similar ways. And it did."
The parallel between their modified neural network and human schizophrenia isn't absolute proof the hyperlearning hypothesis is correct, says Grasemann. It is, however, support for the hypothesis, and also evidence of how useful neural networks can be in understanding the human brain.
"We have so much more control over neural networks than we could ever have over human subjects," he says. "The hope is that this kind of modeling will help clinical research."

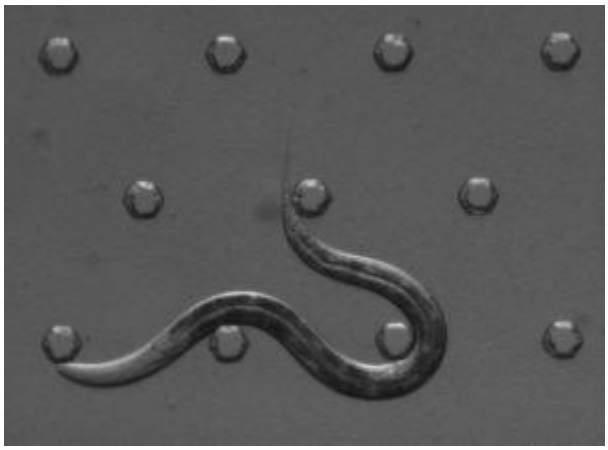
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Texas at Austin**.

Journal Reference:

1. Ralph E. Hoffman, Uli Grasemann, Ralitza Gueorguieva, Donald Quinlan, Douglas Lane, Risto Miikkulainen. **Using Computational Patients to Evaluate Illness Mechanisms in Schizophrenia**. *Biological Psychiatry*, 2011; DOI: 10.1016/j.biopsych.2010.12.036

http://www.sciencedaily.com/releases/2011/05/110505124002.htm

Universal Signaling Pathway Found to Regulate Sleep



While conducting aversion studies with the C. elegans nematode, researchers noticed something strange. Although nematodes are usually in almost constant motion, the ones with an overexpressed osm-11 gene started taking naps. (Credit: Hart Lab/Brown University)

ScienceDaily (May 6, 2011) — Sleeping worms have much to teach people, a notion famously applied by the children's show "Sesame Street," in which Oscar the Grouch often reads bedtime stories to his pet worm Slimy. Based on research with their own worms, a team of neurobiologists at Brown University and several other institutions has now found that "Notch," a fundamental signaling pathway found in all animals, is directly involved in sleep in the nematode *C. elegans*.

"This pathway is a major player in development across all animal species," said Anne Hart, associate professor of neuroscience at Brown. "The fact that this highly conserved pathway regulates how much these little animals sleep strongly suggests that it's going to play a critical role in other animals, including humans. The genes in this pathway are expressed in the human brain."

The work, to be published May 24 in the journal *Current Biology*, offers new insights into what controls sleep. The lead authors are Komudi Singh, a postdoctoral fellow in the Department of Neuroscience at Brown University, and Michael Chao, a previous member of the Hart laboratory, who is now an associate professor at California State University-San Bernardino.

"We understand sleep as little as we understand consciousness," said Hart, the paper's senior author. "We're not clear why sleep is required, how animals enter into a sleep state, how sleep is maintained, or how animals wake up. We're still trying to figure out what is critical at the cellular level and the molecular level."

Ultimately, Hart added, researchers could use that knowledge to develop more precise and safer sleep aids. "We only have some really blunt tools that we can use to change sleep patterns," she said. "But there are definite side effects to manipulating sleep the way we do now."

Mysterious napping

Hart first realized that Notch pathway genes might be important for sleep when her group was investigating an entirely different behavior. She was studying the effect of this pathway on the nematodes' revulsion to an odious-smelling substance called octanol. What she found, and also reports in the *Current Biology* paper, is that adult nematodes without Notch pathway genes (like osm-11) have their Notch receptors turned off and, therefore, they do not avoid octanol as normal worms do.

But she was shocked to find that the adult nematodes in which the osm-11 gene was overexpressed were doing something quite bizarre. "Normally, adult nematodes spend all of their time moving" she said. "But, these animals suddenly start taking spontaneous 'naps.' It was the oddest thing I'd seen in my career."

Nematode sleep is not exactly the same as sleep in larger animals, but these worms do go into a quiescent sleep-like state when molting. The worms with too much osm-11 were dozing when they were not supposed to.

Other experiments showed that worms lacking osm-11 and the related osm-7 genes were hyperactive, exhibiting twice as many body bends each minute as normal nematodes.

The story became clear. The more Notch signaling was turned on, the sleepier the worms would be. When it is suppressed, they go into overdrive and become too active.
In humans, the gene that is most similar to osm-11 is called Deltalike1 (abbreviated DLK1). It is expressed in regions of the brain associated with the sleep-wake cycle.

Beyond Notch

That result alone is not enough to lead directly to the development of a new sleep drug, even for worms. Notch signaling is implicated in a lot of different activities in the body, Hart said, some of which should not be encouraged.
"Too much Notch signaling can cause cancer, so we would have to be very targeted in how we manipulate it," she said. "One of the next steps we're going to take is to look at the specific steps in Notch signaling that are pertinent to arousal and quiescence."
Focusing on those steps could minimize side effects, Hart said.
In addition to Hart, Singh, and Chao, other authors from Brown were Mark Corkins, Melissa Walsh, and Emma Beaumont, an intern from University of Bath. Authors who worked at Massachusetts General Hospital were Gerard Somers, Hidetoshi Komatsu, Jonah Larkins-Ford, Tim Tucey, and Heather Dionne. Author Douglas Hart is from the Massachusetts Institute of Technology and author Shawn Lockery is from the University of Oregon.
The National Institutes of Health and Massachusetts General Hospital funded the research.

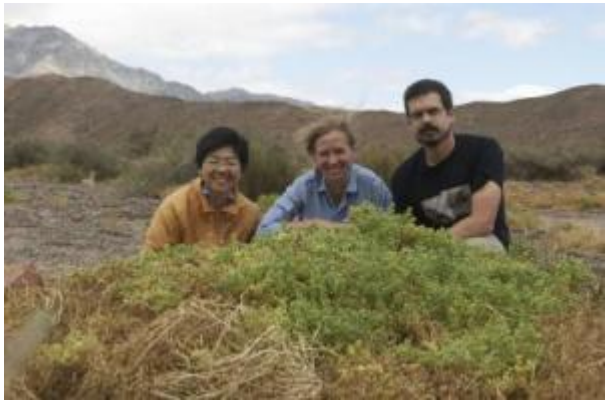
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Brown University**.

Journal Reference:

1. Komudi Singh, Michael Y. Chao, Gerard A. Somers, Hidetoshi Komatsu, Mark E. Corkins, Jonah Larkins-Ford, Tim Tucey, Heather M. Dionne, Melissa B. Walsh, Emma K. Beaumont, Douglas P. Hart, Shawn R. Lockery, and Anne C. Hart. **C. elegans Notch Signaling Regulates Adult Chemosensory Response and Larval Molting Quiescence**. *Current Biology*, 2011; DOI: 10.1016/j.cub.2011.04.010

http://www.sciencedaily.com/releases/2011/05/110505123941.htm

Succulent Plants Waited for Cool, Dry Earth to Make Their Mark



Researchers Monica Arakaki, Erika Edwards and Matt Obgurn were hunting for succulent plants in Argentina last February. Finding Halophytum amenghinoi, foreground, an extremely rare succulent relative of cacti, was a major goal of that field trip. (Credit: Brown University)

ScienceDaily (May 6, 2011) — The cactus, stalwart of the desert, has quite a story to tell about the evolution of plant communities found the world over.

In a paper published in the early edition of the *Proceedings of the National Academy of Sciences*, Brown University biologists and colleagues have discovered that the rapid speciation of cacti occurred between 5 and 10 million years ago and coincided with species explosions by other succulent plant groups around the world. The researchers propose that a prolonged dry spell and possibly lower levels of atmospheric carbon dioxide during that time, known as the late Miocene, opened habitat that contributed to the rise of these plants and a broad vegetative makeover on Earth.

"The cacti, as a group, have been around for a while, but most of the species diversity that we see today was generated really recently," said Monica Arakaki, a postdoctoral researcher at Brown and the paper's lead author.

The Brown team and colleagues from Oberlin College and the University of Zurich, Switzerland, were interested primarily in dating the origins of the cacti (scientific name *Cactaceae*). The team sequenced the chloroplast genomes (the organelles inside plant leaves that engineer photosynthesis) for a dozen cacti and their relatives and combined their new genomic data with existing genomes to build a phylogeny, or evolutionary tree, for angiosperms, the genealogical line of flowering plants that represents roughly 90 percent of all plants worldwide. From there, the scientists deduced that Cactaceae first diverged from its angiosperm relatives roughly 35 million years ago but didn't engage in rapid speciation for at least another 25 million years.

"Cacti were actually present on the landscape for millions of years -- looking like cacti and acting like cacti -- before they began their major diversification," said Erika Edwards, assistant professor of biology in the Department of Ecology and Evolutionary Biology at Brown and corresponding author on the paper.

The team then sifted through the literature on the timing of diversification in other succulents from regions around the globe. Succulents include aloes, the agaves of North America, the ice plants of South Africa and other lineages. Their comfort zone is in water-limited climates, and they have adapted physical characteristics to cope in those locales, such as shallow root systems, specialized water-storing tissue and exchanging gas at night, when it is cooler and less humid and so less water is lost. What struck the researchers was that all the succulent lineages, across habitats and continents, underwent major speciation between 5 and 10 million years ago, during roughly the same time period as the cacti.

C4 grasses, the tropical grasses that are now up to 20 percent of our planet's vegetative covering, burst onto the scene as well during this same window of time.

This must be more than a coincidence, the researchers thought. "It isn't overly surprising that most of the standing cactus diversity is relatively young. But when you put these species radiations in the context of all the other changes in plant communities that were happening at that very moment, all over the world, it begs some sort of global environmental driver," Edwards said.

The most plausible causes, the scientists thought, were a drying out of the planet and lowering of atmospheric carbon-dioxide levels. A wealth of research involving oxygen isotopes from a deep-sea organism showed Earth underwent a drop in temperature, which the researchers believe led to reduced rainfall and increased aridity worldwide.

The carbon-dioxide link is more nuanced and controversial. The authors highlight one study that inferred atmospheric CO_2 levels spiraled downward beginning roughly 15 million years ago. Combined with global cooling, "a drop in CO_2 concentration would therefore immediately expand the ecological space in which drought-adapted succulent plants, with their high photosynthetic water use efficiency, would be competitive," the authors write.

"We suggest that a rapid expansion of available habitat (rather than any particular new 'key' innovation) during the late Miocene was a primary driver of the global diversification of plant lineages already possessing a preadapted succulent syndrome," the researchers write. "Against a backdrop of increasing global aridity, a sharp CO_2 decline is a plausible driver of the simultaneous expansion of C4 grasslands, the clustering of new C4 origins, and the diversification of succulent lineages."

Contributing authors include postdoctoral research associate Pascal-Antoine Christin, graduate student R. Matthew Ogburn, and undergraduate student Elizabeth Spriggs, all of Brown; Reto Nyffeler and Anita Lendel from the University of Zurich; Urs Eggli from the Succulent Plant Collection in Zurich; and Michael Moore from Oberlin.

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Story Source:

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

Journal Reference:

1. M. Arakaki, P.-A. Christin, R. Nyffeler, A. Lendel, U. Eggli, R. M. Ogburn, E. Spriggs, M. J. Moore, E. J. Edwards. **Contemporaneous and recent radiations of the world's major succulent plant lineages**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1100628108

http://www.sciencedaily.com/releases/2011/05/110503133050.htm

Why More Species Live in Amazon Rainforests: Evolution of Treefrogs Sheds Light on the Mystery

A treefrog (Osteocephalus heyeri) from the Amazonian rainforest. (Credit: Photo by Dan Moen)

ScienceDaily (May 6, 2011) — For more than two hundred years, the question of why there are more species in the tropics has been a biological enigma. A particularly perplexing aspect is why so many species live together in a small area in the tropics, especially at some sites in the rainforests of the Amazon Basin in South America.

New research on the evolution and ecology of treefrogs, published online in the journal *Ecology Letters*, sheds new light on the puzzle. The patterns found in treefrogs may also help to explain the high species richness of other groups of organisms -- such as trees, birds and insects -- in the Amazon rainforests.

"Treefrogs are a particularly important group to study for understanding amphibian diversity, because they can make up nearly half of all amphibian species in some rainforest sites," says lead author John J. Wiens, an Associate Professor in the Department of Ecology and Evolution at Stony Brook University. "Treefrogs also offer a striking example of the high local-scale biodiversity in the Amazon. At some sites in the Amazon rainforest, there are more treefrog species in a small area than there are across all of North America or Europe."

The researchers compiled data on the number of treefrog species at 123 sites around the world and analyzed the data with a new evolutionary tree (based on DNA sequence data) for 360 treefrog species. They discovered that the richness of treefrog species in the Amazon rainforest sites is not explained by wet, tropical climatic conditions alone.

"In fact, we found that many tropical rainforest sites that are outside the Amazon Basin have no more species than do some sites in temperate North America," explains Dr. Wiens.

Instead, the researchers discovered that the high biodiversity of Amazonian sites is related to different groups of treefrogs occurring together in the Amazon Basin for more than 60 million years -- since before most dinosaurs became extinct. In contrast, those sites in tropical rainforests that have relatively few treefrog species are in areas that were colonized by treefrogs much more recently.

These results also have important implications for humans. "The results suggest that the incredible biodiversity of amphibians in some sites in the Amazon Basin took more than 50 million years to develop," says Dr. Wiens. "If the Amazon rainforests are destroyed and the amphibian species are driven to extinction by human activities in the next few decades, it may take tens of millions of years for this incredible level of biodiversity to ever return."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stony Brook University**.

Journal Reference:

1. John J. Wiens, R. Alexander Pyron, Daniel S. Moen. **Phylogenetic origins of local-scale diversity patterns and the causes of Amazonian megadiversity**. *Ecology Letters*, 2011; DOI: 10.1111/j.1461-0248.2011.01625.x

http://www.sciencedaily.com/releases/2011/05/110505165623.htm