Infoteca's E-Journal

An Electronic Compilation of Scientific and Cultural Information by
Sistema de Infotecas Centrales, Universidad Autónoma de Coahuila

CONTENTS

2000-year-old pills found in Greek shipwreck	3
Smoking, bad for your fertility and your child's	5
Ghostwriting probe into HRT articles	7
Grave soil whispers time of death tip-off	8
Junkie food: Tastes your brain can't resist	9
Losing weight may pollute the blood	14
Magic mushrooms reduce anxiety over cancer	15
What can deliver snakebite medicine where it's needed?	16
Caution urged over vitamin B dementia therapy	18
Extreme X-Ray Source Suggests New Class of Black Hole	20
Most Penguin Populations Continue to Decline, Biologists Warn	23
Researchers Hear Puzzling New Physics from Graphene Quartet's Quantum Harmonies	26
Woolly Mammoth Lived on Iberian Peninsula 150,000 Years Ago, Findings Show	28
Animal-Only Pigment, Bilirubin Now Confirmed in Bird of Paradise Flower	30
New Clue to How Last Ice Age Ended	32
Brain Cells -- Not Lack of Willpower -- Determine Obesity, Study Finds	34
Self-Administered Vaccine Patch May Protect Against Potentially Pandemic Flu Viruses	36
Big Bang Was Followed by Chaos, Mathematical Analysis Shows	37
Can We Spot Volcanoes on Alien Worlds? Astronomers Say Yes	39
More Weight Equals Longer Hospital Stays	41
Aging Reduces Centromere Cohesion, Disrupts Reproduction, Biologists Discover	43
These Dendritic Cells Are Fishy, but That's a Good Thing	46
Portable Laser Backpack Revolutionizes 3-D Mapping	47
Adults Demonstrate Modified Immune Response After Receiving Massage	49
Muscle Wasting in Cancer Does Not Spare the Heart	51
New Compound Safely Reduces Plaques in Mouse Model of Alzheimer's Disease	53
Molecular Gatekeeper of Arthritis: Removal of Key Protein Leads to Initiation of Disease	55
How Insulin Stimulates Fat Cells to Take in Glucose	57
Reading Food Labels, Combined With Exercise, Can Lead to Weight Loss, Study Finds	59
Micro-RNA Determines Malignancy of Lung Cancer	60
Decision-Making Deficits Related to Driving Under the Influence Are Often Undetected	62
Parents Report a Widely Prescribed Antibiotic Is Effective for Fragile X Treatment	64
Potential New Drug for Neurodegenerative Disease Identified	67
Personality Predicts Cheating More Than Academic Struggles, Study Shows	69
Compounds in Non-Stick Cookware Associated With Elevated Cholesterol in Children	71
Insight Offered Into Superstitious Behavior	73
Great apes protected as EU restricts animal testing	75
Fears of a Decline in Bee Pollination Confirmed	77
Melting Rate of Icecaps in Greenland and Western Antarctica Lower Than Expected	78
'Conan the Bacterium' Reveals Its Recipe for Success	80
Colorful Mix of Asteroids Discovered, May Aid Future Space Travel	82
Scientists create liver cells from patients' skin	84
Drugs protect monkeys from Ebola, U.S. study finds	86
Scientists use salmonella bug to kill cancer cells	88

The Brain Speaks: Scientists Decode Words from Brain Signals	90
Irrigation's Cooling Effects May Mask Warming in Some Regions -- For Now	94
Termites Foretell Climate Change in Africa's Savannas	96
B vitamins found to slow progression of dementia	98
Physicists Cross Hurdle in Quantum Manipulation of Matter	100
Foraging for Fat: Crafty Crows Use Tools to Fish for Nutritious Morsels	102
Structure of Prefrontal Cortex Helps Humans Think About One's Own Thinking	**105**
T. Rex Was More Than Just a Large Carnivore at Top of Food Chain	107
Scientists Document Fate of Deep Hydrocarbon Plumes in Gulf Oil Spill	109
Optical Chip Enables New Approach to Quantum Computing	111
Understanding Behavioral Patterns: Why Bird Flocks Move in Unison	113
3-D Computer Simulations Help Envision Supernovae Explosions	114
Findings Boost Hypothesis of Deep Magma Ocean	117
Pickle Spoilage Bacteria May Help Environment	119
Father Absence Linked to Earlier Puberty Among Certain Girls	120
Women With Diabetes Having More C-Sections and Fetal Complications	122
Teenagers Are More Sedentary on Weekends	124
Popular Supplements to Combat Joint Pain Do Not Work, Study Finds	125
Veterinarian Says Natural Foods Not Always Best for Pets	126
Tornado-Chasing Becomes Vacation Choice, Researchers Find	128
Researchers Identify Genetic Marker of Aggressive Alzheimer's Disease	129
Discovery of Key Pathway Interaction May Lead to Therapies That Aid Brain Growth	131
What's eating the stars out of our galaxy's heart?	132
Bad breath sniffer to hunt for life on Mars	135
Space junk: Hunting zombies in outer space	136
Did Jupiter and Saturn play pinball with Uranus?	140
Crater map rekindles debate over moon impacts	141
M-theory: Doubts linger over godless multiverse	143
New pi record exploits Yahoo's computers	144
Real spray-on clothes to hit the catwalk	146
Hendrix's soundman: How I invented Jimi's guitar sound	147
Autism drug aims to balance brain signals	149
Antibiotics play hell with gut flora	152
Chemical patterns on DNA mark out obesity genes	153
Graveyard DNA rewrites African American history	155
Receding gums: What ails Australia's iconic trees?	157
Transgenic fish swimming towards a plate near you	159
Ancient South American megabird had 6-metre wingspan	162
Light trapped on curved surfaces	164
Electron vortex could trap atoms	165
Do Egyptian mummies have a right to privacy?	166
Solar on the Cheap: Thanks Purple Pokeberry!	168
Ten Ways the Feds Are Leading the Green Charge	170
Roving Herds of Grazing Climate Helpers	172
Solar Power: America Hangs Its Head	175
Air Conditioning Using 90 Percent Less Power	177
Gauging the 'Yuck Factor' of Synthetic Biology	179
Young Artists, Scientists Think Logically, Creatively	181
The Scientist and the Journalist Can Be Friends	183
Volunteer Work Prolongs Lives of Frail Elderly	185
Do School Lunches Plump Up Poor Kids?	187
That Was No Accident. My Martini Told Me So.	189
Happiness Is on the Rise. Thanks, Freedom	191
Anti-Gay Attitudes Undeterred by Golden Rule	193
Busting Myths About Photovoltaics	195
Saving Sub-Sahara Africa a Drip at a Time	197
The Tree That Changed the World	199

2000-year-old pills found in Greek shipwreck

- 18:00 09 September 2010 by **Shanta Barley**

In 130 BC, a ship fashioned from the wood of walnut trees and bulging with medicines and Syrian glassware sank off the coast of Tuscany, Italy. Archaeologists found its precious load 20 years ago and now, for the first time, archaeobotanists have been able to examine and analyse pills that were prepared by the physicians of ancient Greece.

DNA analyses show that each millennia-old tablet is a mixture of more than 10 different plant extracts, from hibiscus to celery.

"For the first time, we have physical evidence of what we have in writing from the ancient Greek physicians Dioscorides and Galen," says Alain Touwaide of the Smithsonian Institution's National Museum of Natural History in Washington DC.

The box of pills was discovered on the wreck in 1989, with much of the medicine still completely dry, according to Robert Fleischer of the Smithsonian's National Zoological Park, also in Washington DC.

Herbal remedies

Fleischer analysed DNA fragments in two of the pills and compared the sequences to the GenBank genetic database maintained by the US National Institutes of Health. He was able to identify carrot, radish, celery, wild onion, oak, cabbage, alfalfa and yarrow. He also found hibiscus extract, probably imported from east Asia or the lands of present-day India or Ethiopia.

"Most of these plants are known to have been used by the ancients to treat sick people," says Fleischer. Yarrow staunched the flow of blood from wounds, and Pedanius Dioscorides, a physician and pharmacologist in Rome in the first century AD, described the carrot as a panacea for a number of problems. "They say that reptiles do not harm people who have taken it in advance; it also aids conception," he wrote around 60 AD.

The concoctions have also thrown archaeobotanists a few curve balls. Preliminary analyses of the ancient pills suggest they contain sunflower, a plant that is not thought to have existed in the Old World before Europeans discovered the Americas in the 1400s. If the finding is confirmed, botanists may need to revise the traditional history of the plant and its diffusion, says Touwaide – but it's impossible for now to be sure that the sunflower in the pills isn't simply from recent contamination.

Quacks no more

Drugs described by Dioscorides and another Greek physician known as Galen of Pergamon have often been dismissed as ineffectual quackery. "Scholars and scientists have often dismissed the literature on such medicines, and expressed doubt about their possible efficacy, which they attributed only to the presence of opium," says Touwaide. He hopes to resolve this debate by exploring whether the plant extracts in the pills are now known to treat illnesses effectively.

He also hopes to discover *therian* – a medicine described by Galen in the first century AD that contains more than 80 different plant extracts – and document the exact measurements ancient doctors used to manufacture

the pills. "Who knows, these ancient medicines could open new paths for pharmacological research," says Touwaide.

The team presented their findings yesterday at the Fourth International Symposium on Biomolecular Archaeology in Copenhagen, Denmark.

http://www.newscientist.com/article/dn19436-2000yearold-pills-found-in-greek-shipwreck.html

Smoking, bad for your fertility and your child's

- 17:32 09 September 2010 by **Miriam Frankel**

Yet another reason to give up smoking. Smoking may harm not just your fertility but that of the next generation.

Two separate studies show that men who smoke have a lower concentration of proteins in the testes that are essential for producing sperm, while women who smoke during pregnancy may be sowing the seeds of infertility in their unborn child.

In one of the studies researchers obtained 24 testes, from 37 to 68 day embryos after legally terminated pregnancies. They found that the number of germ cells – responsible for forming eggs and sperm – was reduced by 55 per cent in fetuses from women who'd been smoking while pregnant. They also found a 37 per cent reduction in the ordinary or somatic cells in the embryos.

"We were very surprised that smoking so early in pregnancy has such profound effect on the number of germ cells in the gonads," says co-author Claus Andersen from the University Hospital of Copenhagen in Denmark.

Exposed to cigarettes

Results from a previous study on female fetuses showed a slightly lower corresponding reduction of germ and somatic cells – of 41 and 29 per cent respectively. The authors believe the reason the male embryos they studied showed higher sensitivity was because they were, on average, exposed to more cigarettes per day.

The researchers do not known whether the reduction of germ cells is permanent – raising the question of whether women who smoke during pregnancy could harm the future fertility of their fetus.

Anderson says the next step is to expose cultured fetal testes to components of smoke thought to be harmful.

"We could expose the culture for a couple of weeks, and then continue [to develop] the culture without exposure and see if the cells are able to recover," he says.

Tina Kold Jensen from the University of Copenhagen Hospital, who was not involved in the study, says that while the link between smoking and fertility has been shown in previous studies, the new research is interesting because it provides an underlying mechanism.

Crucial for chromosomes

In a second study, Mohamed Hammadeh from the University of the Saarland in Germany, and colleagues, examined the concentrations of two proteins called protamines P1 and P2, which are crucial to the formation of chromosomes during cell division. Changes in the concentrations of these protamines can have negative effects on male fertility.

The study, which compared sperm samples from 53 men who smoked more than 20 cigarettes per day with sperm from 63 non-smokers, found that smokers have 14 per cent lower concentration of P2, and a higher ratio of P1 to P2 overall. They also found an increased level of "oxidative stress" in smokers – a chemical imbalance that is known to harm sperm DNA.

Since sperm can take months to develop before stored in the testes, the studies suggest that men hoping to reproduce may want to consider giving up smoking long before they try to conceive.

Journal references:

Claus Andersen: *Human Reproduction*, DOI: 10.1093/humrep/deq215

Mohamed Hammadeh: *Human Reproduction*, DOI: 10.1093/humrep/deq226

http://www.newscientist.com/article/dn19434-smoking-bad-for-your-fertility-and-your-childs.html

Ghostwriting probe into HRT articles

- 09 September 2010
- Magazine issue 2777.

"GHOSTWRITTEN" articles commissioned by drug company Wyeth may have led to hormone replacement therapy (HRT) being recommended to healthy menopausal women, despite evidence that it increases the risk of breast cancer.

So says Adriane Fugh-Berman of Georgetown University in Washington DC, an expert witness for thousands of women with breast cancer who are suing Pfizer - which acquired Wyeth in 2009 - for damages. She analysed 1500 documents made public through litigation and found controversial statements about the HRT Prempro in dozens of peer-reviewed articles drafted for Wyeth by communications firms. The articles were published under the names of doctors and scientists, who approved them, often with few changes (*PLoS Medicine*, DOI: 10.1371/journal.pmed.1000335).

Controversial statements about the HRT pill Prempro were found in dozens of articles drafted for Wyeth

In 2002, a large trial showed conclusively that HRT did not reduce cardiovascular disease, and increased the risk of breast cancer. Yet ghostwritten articles published after this date downplayed the 2002 study, suggesting that there was no consensus on Prempro's breast cancer risk.

Pfizer says Fugh-Berman's study fails to acknowledge significant changes undertaken by drug companies to strengthen disclosure in connection with medical literature.

http://www.newscientist.com/article/mg20727773.300-ghostwriting-probe-into-hrt-articles.html

Grave soil whispers time of death tip-off

- 16:05 08 September 2010 by **Wendy Zukerman**

Crime scene investigators should take a closer look at the soil around a buried corpse to more accurately identify estimate when the person died.

So says soil researcher Mark Tibbett at the University of Western Australia in Crawley, who found that when muscle tissue decomposes in soil it creates a distinctive chemical signature.

Investigators can use signs of rigor mortis, ocular changes, blood pooling and food in stomach to very accurately estimate when a person died if they can examine the body within 24 hours of death. After that, they have to rely on evidence that doesn't allow such precise timings, such as identifying what kind of insect larvae, such as maggots, are at the scene.

Worse still, Tibbett says, insects lose their evidential value once they begin to pupate, as early as 10 days after death. He reckoned chemical changes in the soil reacting to decomposing bodies might be more useful for longer time scales.

Shallow graves

To investigate, Tibbett placed 1.5-gram samples of lamb muscle into pots of soil for six weeks. To see if soil type might affect the chemical signature of decay, he used soils that differed in pH. Each week, he measured the soils' pH and the carbon dioxide levels over the pots.

"After three weeks, muscle tissue in the acidic soil decomposed three times faster than that in the alkaline," says Tibbett. The concentration of CO_2 seeping from the pots changed at the same rate as the muscle tissue decomposed.

Tibbett says that CO_2 concentration could allow time of burial to be estimated for at least six weeks after the event.

Acid test

He also detected pH changes in the soil. After seven days, the pH of acidic soil rose by over 3 units, but the alkaline soil pH only slightly increased. Decomposing bodies release ammonium ions, which raise the pH in the acidic soil, but don't significantly affect soil that is already alkaline.

Rob Fitzpatrick, director of the Centre for Australian Forensic Soil Science in Adelaide, South Australia, says that soil is an important forensic tool, but that an investigator will always need to consider entomology and other aspects of body decomposition.

Tibbett presented his work at the World Congress of Soil Science in Brisbane, Australia, last month.

http://www.newscientist.com/article/dn19424-grave-soil-whispers-time-of-death-tipoff.html

Junkie food: Tastes your brain can't resist

- 08 September 2010 by **Bijal Trivedi**

A delicious indulgence, or your next desperate hit? (Image: Jonphotography.com)

Is that cupcake an innocent indulgence? Or your next hit? We're finding that a sweet tooth makes you just as much an addict as snorting cocaine

SETTLED on the sofa watching the usual rubbish on TV, I notice that predictable, uncontrollable, nightly craving. At first I sit there, fighting it. But the longer I fight, the worse it gets. After 20 minutes, I can't concentrate on anything, I feel anxious, and start fidgeting like crazy. Finally, admitting my addiction, I break. I go to the freezer - to my stash of white stuff - and take a hit. Almost instantly, I relax, my brain in a state of bliss as the chemical courses through my veins. Isn't it amazing what a few scoops of ice cream can do?

Before you dismiss my agitation as mere weakness, consider this: to my brain, sugar is akin to cocaine. There is now compelling evidence that foods high in sugar, fat and salt - as most junk foods are - can alter your brain chemistry in the same way as highly addictive drugs such as cocaine and heroin.

The idea, considered fringe just five years ago, is fast becoming a mainstream view among researchers as new studies in humans confirm initial animal findings, and the biological mechanisms that lead to "junk-food addiction" are being revealed. Some say there is now enough data to warrant government regulation of the fast food industry and public health warnings on products that have harmful levels of sugar and fat. One campaigning lawyer claims there could even be enough evidence to mount a legal fight against the fast food industry for knowingly peddling food that is harmful to our health, echoing the lawsuits against the tobacco industry in the 1980s and 90s.

"We have to educate people about how their brains get hijacked by fat, sugar and salt," says David Kessler, former commissioner of the US Food and Drug Administration and now a director of the Center for Science in the Public Interest, based in Washington DC. With obesity levels rocketing across the world, it is clear that I am not alone in my love of sweet things, but can it really be as bad as drug addiction?

We have to educate people about how their brains get hijacked by fat, sugar and salt

Arguably, it was the weight-loss industry that first introduced the idea to the public, long before there was any scientific evidence for it. For example, in her book *Lick the Sugar Habit*, published in 1988, the self-confessed "sugarholic" Nancy Appleton offered a checklist to determine whether you, too, are addicted to sugar. Since then, the notion has become commonplace.

In 2001, intrigued by this nascent cultural phenomenon, neuroscientists Nicole Avena, now at the University of Florida in Gainesville, and Bartley Hoebel at Princeton University, together began exploring whether the idea had a biological basis. They started by looking for signs of addiction in animals that had been eating junk food.

Hooked on sugar

Sugar is a key ingredient in most junk food, so they offered rats sugar syrup, similar to the sugar concentration in a typical soda beverage, for about 12 hours each day, alongside regular rat feed and water. After just a month on this diet, the rats developed behaviour and brain changes that Avena and Hoebel claimed were chemically identical to morphine-addicted rats. They binged on the syrup and showed anxious behaviour when it was removed - a sign of withdrawal. There were also changes in the neurotransmitters in the nucleus accumbens, a region associated with reward.

Crucially, the researchers noticed that the rats' brains released the neurotransmitter dopamine each time they binged on the sugar solution, even after having eaten it for weeks (*Neuroscience & Biobehavioral Reviews*, vol 32, p 20). That's not normal.

Dopamine drives the pursuit of pleasure - whether it is food, drugs or sex. It is a brain chemical vital for learning, memory, decision-making and sculpting the reward circuitry. You would expect it to be released when they eat a new food, says Avena, but not with one they are habituated to. "That's one of the hallmarks of drug addiction," she says. This was the first hard evidence of a biological basis for sugar addiction, and sparked a slew of animal studies.

Those results were among the most exciting news in obesity research in the last 20 years, says Mark Gold, an international authority on addiction research and chairman of the psychiatry department at the University of Florida College of Medicine.

Since Avena and Hoebel's landmark study, scores of other animal studies have confirmed the findings. But it is recent human studies that have finally tipped the balance of evidence in favour of labelling a love of junk food as a proper addiction.

Addicted brains

Addiction is commonly described as a dulling of the "reward circuits" triggered by the overuse of some drug. This is exactly what happens in the brains of obese individuals, says Gene-Jack Wang, chairman of the medical department at the US Department of Energy's Brookhaven National Laboratory in Upton, New York. In another landmark study published in 2001, he discovered a dopamine deficiency in the striatum of the brains of obese individuals that was virtually identical to those of drug addicts (*The Lancet*, vol 357, p 354).

In subsequent studies, Wang showed that even when (not obese) individuals are shown their favourite foods, an area of their brain called the orbital frontal cortex - involved in decision-making - experiences a surge of

dopamine. The same area is activated when cocaine addicts are shown a bag of white powder. It was a shocking discovery that showed you don't have to be obese for your brain to exhibit addictive behaviour. "I can tell they want it," says Wang.

Another critical leap in identifying junk food as addictive was made by Eric Stice, a neuroscientist at the Oregon Research Institute in Eugene. Stice has been trying to predict a person's propensity to junk food addiction. He has been watching how people's brains respond when they are fed a brief burst of creamy chocolate milkshake. He then compares the brain activity of lean and obese individuals, to see if it differs.

In an as-yet-unpublished study he found that when fed milkshakes, lean adolescents with obese parents experienced a greater surge of dopamine - indicating a greater sense of satisfaction - than those who had lean parents. Stice suspects that this is where the problem begins. "There are people born for whom eating is just more orgasmic," he says. It is this innate enjoyment of food that primes certain people to overeat.

There are people born for whom eating is just more orgasmic

Ironically, as they overeat, their reward circuitry dulls, which makes the food less satisfying and motivates them to eat more to compensate. They are essentially chasing the high of earlier heavenly eating experiences. This is precisely what we see with chronic alcohol or substance abuse, says Stice.

Stice has also shown that people with certain variants of the *DRD2* and *DRD4* genes are endowed with less active dopamine circuits, and as a result have a dulled dopamine response when eating appetising foods. Paradoxically, this places them at greater risk of obesity than a person without those gene variants because it means they have to eat more to get a sufficiently rewarding level of dopamine release (*Science*, vol 322, p 449; *NeuroImage*, vol 50, p 1618).

Together, these studies suggest there are two routes to food addiction corresponding to overactive or underactive dopamine systems, respectively: one if you find food more rewarding than the average person, and another if it isn't rewarding enough.

Of course, fast food is more than just a sugar rush, it is often a rich cocktail of sugars, fats and salt. Neuroscientist Paul Kenny at The Scripps Research Institute in Jupiter, Florida, is probing the impact of a junk food diet on rat behaviour and brain chemistry. One of his recent studies showed that these foods trigger the same changes in the brain as those caused by drug addiction in humans.

In animals, as in humans, repeated cocaine or heroin use dulls the brain's reward system. This leads to heavier use because the memory of a more pleasurable effect spurs the user to take more to get the same feeling, essentially chasing the high.

Kenny wondered whether rats that eat junk food would have a similar response to the cocaine-addicted rats he had already studied. He used three groups of rats. The first was a control group that only had access to standard rat feed. The second group could eat junk food - bacon, sausage, icing and chocolate - for only 1 hour each day with regular rat feed and water available for the rest of the time. The third group had an all-you-can-eat, around-the-clock buffet that included junk food and rat feed. After 40 days, Kenny stopped access to the junk food in both experimental groups. The rats with unlimited access to junk food essentially went on a hunger strike. "It was as if they had become averse to the healthy food," says Kenny. It took two weeks before the animals began eating as much as those in the control group.

Unlimited access to a powerfully addictive drug like cocaine has a big impact on the brain, says Kenny, so you might expect any addictive effect from food to be much less pronounced. But that is not the case. "Changes happened rapidly and we really saw very, very, striking effects. That's what surprised me."

The obese, unlimited junk food rats had dulled reward systems and were compulsive eaters. They would even tolerate electric shocks to their feet designed to deter them from eating junk food when the rat feed was still available shock-free. Cocaine-addicted rats behave the same way towards their drug.

When Kenny examined the brains of the obese rats with the unlimited junk food diet, they too had a dopamine deficiency in their striatum, similar to the obese individuals in Wang's study in humans. In the rats' brains, Kenny noticed there was a marked drop in a particular dopamine receptor, called D2. But it wasn't clear whether this drop affected a rat's propensity to become addicted to junk food.

To test the relevance of D2 receptors, he artificially reduced their number in the brains of a group of rats and then offered them only junk food for two weeks. The effect was dramatic. Compared to the control group offered the same diet, the reward circuitry in the brains of the modified rats showed a dulled response almost immediately. Unlike normal rats, they gorged on junk food even when eating it was penalised with an electric shock. Crucially, rats with reduced D2 receptors fed only regular rat food did not show the same change in their reward circuitry (*Nature Neuroscience*, vol 13, p 635). It seems there is an interaction between reduced D2 receptors and consumption of junk food that leads to addiction, says Kenny.

Taken together with Stice and Wang's results, this suggests that people who from birth have a low number of D2 receptors could also be prone to junk-food addiction. Kenny cautions that more studies in humans are needed before the conclusion can be generalised beyond rats.

Gold says there is plenty of evidence that food and drug addiction are so similar that treatments proven safe and effective for other addictions - such as alcohol, nicotine, cocaine and heroin - should be tested for food addiction too. "The real test of the 'hedonic eating' or food addiction hypothesis is if it can yield new and effective treatments," he says.

What some people claim is now beyond doubt is that junk foods rich in salt, sugar and fat switch on biological mechanisms that are just as powerful, and hard to fight, as drugs of abuse. Given that we regulate drugs because of the harms they can cause, is it time to begin tougher regulation of fast food too?

Junk foods switch on biological mechanisms that are just as hard to fight as recreational drugs

John Banzhaf, a lawyer who teaches public interest law at George Washington University Law School in Washington DC, has been following the research for the last decade. In the 1960s, he won a court ruling that forced radio and TV stations across the US to provide free airtime for anti-smoking messages and played a major role in crafting lawsuits against the tobacco industry. Now he is turning his attention to the fast food industry and its role in fuelling the obesity epidemic.

Banzhaf believes there is now enough research for the US Office of the Surgeon General to issue a report on food addiction, as it did for nicotine addiction in 1988. "The Health Consequences of Smoking: Nicotine Addiction", a report weighing in at over 600 pages, concluded that cigarettes were addictive, nicotine was the cause, and that the chemical and behavioural processes that define heroine and cocaine addiction were the same for tobacco. "At that point people began to accept it," Banzhaf says. But he acknowledges this is going to be a tricky fight. "Fast food isn't a [single] chemical so you can't meaningfully ask the question 'Is a triple

bacon cheeseburger addictive?' " he says. It would have to be something more specific about quantities of sugar, salt and fat.

Kelly Brownell, director of the Rudd Center for Food Policy and Obesity at Yale University, says that scientists would be likely to agree that low levels of addiction do occur. It is these low levels, Brownell argues, that are of real concern. It is easy to identify obese people who need help with their food addiction, what is more difficult to see is the slim people who are addicted and may eventually become obese because of their addiction. "Long term, that's what's effecting public health - it's the healthy-looking kid who needs three Cokes a day, not the person who already weighs 400 pounds [180 kilograms]."

Signs of things to come can already be seen across the US. For example, trans fats were recently banned in restaurants in New York City and throughout California, and fizzy drinks are being voluntarily taken out of some school vending machines in anticipation of a law that will mandate it.

Unsurprisingly, the food and drink industry is putting up a fight. These foods are only addictive to a "certain subset of consumers who don't exhibit the discipline required", says Hank Cardello, a former executive at food companies including Coca Cola and General Mills, and now a visiting fellow at the Hudson Institute, a think tank based in Washington DC. "People aren't going to change their behaviour. To me it's about getting calories off the streets."

Discounting waste, spoilage and returns, the food available to us today is about 30 per cent higher in calories compared with 1970, says Cardello. He believes tax relief for companies producing low-calorie foods is one way to reduce calories consumed without destroying the companies that sell fast food.

Cardello says food companies don't design food to be addictive, but admits many products are designed for "high hedonic value", with carefully balanced combinations of salt, sugar and fat that, experience has shown, induce people to eat more.

Kessler points out that, of course, the ultimate power is in the consumers' hands. Individuals have a responsibility to protect themselves, he says. I can vouch for the fact that it is possible to break the habit. After two weeks of going cold turkey, I can report I have successfully kicked my ice cream habit. Now, if only I could kick my junk TV addiction...

Bijal Trivedi is a writer based in Washington DC

http://www.newscientist.com/article/mg20727761.700-junkie-food-tastes-your-brain-cant-resist.html

Losing weight may pollute the blood

- 09:30 07 September 2010 by **Wendy Zukerman**
- Magazine issue 2777.

Weight loss has a serious downside: it leads to the release of persistent organic pollutants (POPs), which may have a significant impact on health.

POPs are man-made chemicals which enter the food chain from sources including pesticides and manufacturing. They have been linked to an increased risk of diabetes, cancer and dementia.

Once consumed, POPs collect in fatty tissue, where they are not thought to be harmful. Now, Duk-Hee Lee of Kyungpook National University in Daegu, South Korea, has shown that weight loss causes POPs to be freed, leading to their build up in the blood.

Lee compared weight changes in 1100 adults over 10 years with seven POPs in their blood. People who had lost 10 kilograms or more during the decade had the highest levels of blood-borne POPs, while those who gained 10 kilograms or more had the lowest.

The level of POPs needed to have an adverse affect in humans is unknown, so it should not stop obese people trying to lose weight, says Amanda Sainsbury-Salis at the Garvan Institute of Medical Research in Sydney, Australia.

Journal reference: *International Journal of Obesity*, DOI: 10.1038/ijo.2010.188

http://www.newscientist.com/article/dn19406-losing-weight-may-pollute-the-blood.html

Magic mushrooms reduce anxiety over cancer

- 21:00 06 September 2010 by **Jessica Griggs**
- Magazine issue 2777.

Psilocybe semilanceata's active ingredient may ease depression (Image: Dohduhdah/Wikipedia Commons)

The active ingredient of magic mushrooms, psilocybin, has been shown to reduce anxiety and improve mood in people with cancer. Charles Grob from Harbor-UCLA Medical Center in Torrance, California, and colleagues, recruited 12 people with advanced-stage cancer who also suffered from anxiety.

The volunteers received one dose of psilocybin or the vitamin niacin. Several weeks later they received the other treatment. The volunteers' heart rate, blood pressure and temperature were monitored throughout each treatment. They were also assessed for levels of depression, anxiety and mood.

Volunteers reported feeling less depressed and anxious two weeks after receiving psilocybin but not two weeks after niacin alone. Six months later, the level of depression was significantly lower in all volunteers than it had been before the treatments began.

Volunteers reported mildly altered states of consciousness after receiving psilocybin but noted no adverse physiological effects. With higher doses, the authors suggest the beneficial effects could become more pronounced, although further tests are needed to examine safety and efficacy.

Journal reference: *Archives of General Psychiatry*, DOI: 10.1001/archgenpsychiatry.2010.116

http://www.newscientist.com/article/dn19405-magic-mushrooms-reduce-anxiety-over-cancer.html

What can deliver snakebite medicine where it's needed?

- 06 September 2010 by **Nick Brown** and **Dev Kevat**
- Magazine issue 2776.

What happens if you get bitten? (Image: Jeremy Woodhouse/Getty)

*Snakebites kill hundreds of thousands, so the scarcity of proper treatment is a global tragedy. Time to bring in the law, say **Nick Brown** and **Dev Kevat***

SNAKEBITE is one of the world's most neglected health issues. In 2009, the World Health Organization (WHO) declared it a "neglected tropical disease". Yet this devastating problem is ignored by governments, research funders and public health organisations, leaving millions without adequate treatment.

In allowing this tragic situation to exist, governments are not only ignoring persuasive moral and economic reasons to improve treatment, but may also be in violation of legal obligations to provide access to antivenom.

The extent of the problem is difficult to quantify, but the WHO estimates there are 5 million cases annually worldwide, with up to half of victims experiencing effects from venom. Snakebites cause at least 100,000 deaths and up to 400,000 amputations each year. Millions more are bitten by spiders, scorpions and other venomous creatures, also without access to adequate medical care.

It is probable that snakebite causes more deaths and disability than many other tropical diseases, including dengue fever, Chagas' disease and leishmaniasis (*The Lancet*, vol 375, p 89). Despite this, snakebite treatment programmes receive little public health funding and struggle to attract the research effort and political resolve necessary to improve treatment options.

Antivenoms are a proven approach to reducing death and disability from snakebites, but safe and effective sources are in decline. In many parts of the developing world, access to antivenom is virtually impossible. Even where it is available it is sometimes not used, or used inappropriately, because of inadequate experience and a lack of equipment to administer it.

Moreover, a lack of investment and innovation has seen the proliferation of poorly manufactured, ineffective, expensive and sometimes dangerous antivenoms. Unscrupulous marketing of unsuitable and mislabelled antivenoms is not uncommon in some countries (*Transactions of the Royal Society of Tropical Medicine and Hygiene*, vol 102, p 397). Not surprisingly, these factors serve to undermine confidence in antivenoms.

There is no need for this. High quality antivenoms can be produced at reasonable cost. For example, funding from the UK's Engineering and Physical Sciences Research Council, the Biotechnology and Biological

Sciences Research Council, the Nigerian Ministry of Health and companies in Wales and Costa Rica led to the successful development of improved antivenoms against the West African carpet viper, *Echis ocellatus,* one of the world's deadliest snakes (*PLoS Neglected Tropical Diseases*, vol 4, p e767).

One such antivenom developed by the consortium is marketed for less than $40 per patient. At this price, more lives can be saved and disability averted per dollar spent on antivenom than with most other treatment programmes. Owing to its curative nature and relatively rapid effects, antivenom is one of the most cost-effective treatments available. Compared to HIV drugs, for example, it is at least 30 times more cost-effective in preventing death and disability (*Toxicon*, vol 55, p 1405).

There are also strong arguments that governments are legally obliged to provide access to antivenom. More than 160 countries are signatories to the UN's International Covenant on Economic, Social and Cultural Rights (ICESCR), which includes the right to health. This does not mean an individual has the "right" to be healthy, but that governments have an obligation to protect the health of their citizens.

All signatories must meet certain baseline obligations regardless of their economic status. One of these is to provide safe and effective essential drugs as defined by the WHO Action Programme on Essential Drugs, which since 2005 has included some antivenoms (*The Right to the Highest Attainable Standard of Health*, UN Economic and Social Council, E/C.12/2000/4). Under the ICESCR, when a country fails to meet a core obligation it must demonstrate that every effort has been made to use every resource at its disposal to satisfy this obligation as a matter of priority.

While the UN has a committee that monitors implementation of ICESCR obligations, international treaties can be difficult to enforce. However, more than 100 countries also have a "right to health" enshrined in their constitutions, which are usually the highest law of a country. Of the countries with a constitutional right to health, a number experience high rates of untreated snakebites, most notably in Asia, Africa and South America. The shortage of life-saving antivenom in these countries means that not only are governments contravening international laws to uphold the health of their people, but, depending on the rulings of national constitutional courts, they could also be found to be failing to meet national legal obligations.

The shortage of life-saving antivenom in many countries contravenes international law

Snakebites are terrifying ordeals with significant humanitarian consequences that outweigh those of many other tropical diseases. For millions of people, the inability to access antivenoms is an infringement of their right to health.

The arguments that support improved access to quality antivenoms give cause to ponder whether such a crisis would exist if snakebite was a problem affecting wealthy countries. It also makes one consider whether hitherto untried legal avenues may be more successful in improving the plight of the victims of snake venom.

Nick Brown is a fellow at the Australian Venom Research Unit, University of Melbourne, and is medical director of MicroPharm, a manufacturer of antivenoms and other antisera.

Dev Kevat is a researcher at the School of Public Health, Monash University, and has an interest in human rights law. Both are doctors at The Royal Brisbane and Women's Hospital

http://www.newscientist.com/article/mg20727760.100-what-can-deliver-snakebite-medicine-where-its-needed.html

Caution urged over vitamin B dementia therapy

16:12 9 September 2010
Health
Science In Society

Jessica Hamzelou, reporter

Can cheap vitamin supplements really defend you from Alzheimer's? In a paper published today, David Smith and colleagues at the University of Oxford have claimed that dosing up on B vitamins can protect an ageing brain from shrinking.

The team instructed a group of 168 people over the age of 70 with mild cognitive impairment (MCI) to take a 2 year course of either daily vitamin B supplements or placebo pills. The vitamins included folic acid, B6 and B12. Each person had an fMRI brain scan at the start and end of the study, in order to compare how their brains had atrophied or shrunk over the period.

While the brains of the placebo group shrunk by an average of 1.08 per cent per year, those taking vitamin B supplements experienced an average atrophy of "only" 0.76 per cent per year.

Smith's team only looked at brain scans, and didn't carry out cognitive tests on the study participants, but the authors reckon that B vitamins might slow the onset of Alzheimer's disease.

Rebecca Wood of the Alzheimer's Research Trust - which co-funded the study - agrees:

These are very important results, with B vitamins now showing a prospect of protecting some people from Alzheimer's in old age.

The results certainly sound dramatic when you consider that vitamin B supplements reduced the rate of atrophy by 30 per cent. But in absolute terms this was only an average difference of 0.32 per cent. On top of this, the sample was small - only 85 people received the treatment.

John Hardy, a neuroscientist at University College London, tells the UK's Science Media Centre that while the data is "interesting", "it is important to note that the study is rather small and needs replicating in a larger study."

Let's say the results end up holding true in a larger sample. You'd be forgiven for thinking that eating a little more of the right foods - such as beans, leafy vegetables and meat - could protect your mind from early decline.

However, according to the dietary reference intakes recommended by the US National Academy of Sciences, the doses of folic acid, vitamin B6 and vitamin B12 used in the study were twice, thirteen times and over 200 times over the recommended intakes of each, respectively.

The UK's *Daily Telegraph* explains how readers can replicate the treatment:

It is possible to copy the dose [used in the study] by buying three separate supplements from health food shops in Britain for as little as 10 pence per day

However, Clive Ballard, director of research at the Alzheimer's Society, is a little more cautious:

Previous studies looking at B vitamins have been very disappointing and we wouldn't want to raise people's expectations yet

Chris Kennard, chair of the Medical Research Council's Neurosciences and Mental Health Board, told the BBC:

We must be cautious when recommending supplements like vitamin B as there are separate health risks if taken in too high doses

It's unlikely that the extreme doses would be dangerous, though. According to the medical website eMedicine, the doses used in the study are at most a tenth of the tolerable upper limit.

Despite the headlines, it's still too early to recommend vitamin B supplements to people with MCI. It might also be worth mentioning that Smith has a patent on the use of folic acid to treat Alzheimer's disease.

Journal reference: *PLoS One*, DOI: 10.1371/journal.pone.0012244

http://www.newscientist.com/blogs/shortsharpscience/2010/09/vitamin-b-dementia.html

Extreme X-Ray Source Suggests New Class of Black Hole

This is an artist's impression of the source HLX-1 (represented by the light blue object to the top left of the galactic bulge) in the periphery of the edge-on spiral galaxy ESO 243-49. This is the first strong evidence for the existence of intermediate mass black holes. (Credit: Heidi Sagerud)

ScienceDaily (Sep. 8, 2010) — A group of international astronomers in the UK, France and the USA, led by the University of Leicester, have found proof to confirm the distance and brightness of the most extreme ultra-luminous X-ray source, which may herald a new type of Black Hole.

The X-ray source, HLX-1, is the most extreme member of an extraordinary class of objects -- the ultra-luminous X-ray sources -- and is located in the galaxy ESO 243-49 at a distance of ~300 million light years from the Earth.

The astronomers' findings confirm that the extreme luminosity (which is a factor of ~100 above most other objects in its class, and a factor of ~10 higher than the next brightest ultra-luminous X-ray source) is correct.

This is forcing scientists to rethink their theories on the maximum brightness of ultra-luminous X-ray sources, and provides support to the idea that HLX-1 may contain an intermediate mass black hole.

This latest result will be reported September 8 in the scientific journal, The *Astrophysical Journal*.

Using the European Southern Observatory's (ESO's) Very Large Telescope (VLT) in Chile, the team have obtained an optical spectrum of their record breaking ultra-luminous X-ray source (HLX-1) in the distant galaxy ESO 243-49.

Their findings enable them to show conclusively that HLX-1 is indeed located within this galaxy, and is neither a foreground star nor a background galaxy. The main implication of this discovery is that ultra-luminous X-ray sources such as HLX-1 can be brighter than was originally thought, which is consistent with at least the brightest of them hosting intermediate mass black holes.

A black hole is an ultra-dense object with such a powerful gravitational field that it absorbs all the light that passes near it and reflects nothing.

While astrophysicists have suspected that an intermediate class of black hole might exist, with masses between a hundred and several hundred thousand times that of the Sun, such black holes had not previously been reliably detected and their existence has been fiercely debated among the astronomical community.

The VLT enabled the team of researchers to confirm the detection of HLX-1 in optical wavelengths and to measure a precise distance to it.

The lead author of the paper reporting this result, Dr Klaas Wiersema of Leicester's Department of Physics and Astronomy, commented: "After our earlier discovery of the very bright X-ray source, we were very keen to find out just how far away it really is, so that we can work out how much radiation this black hole produces.

"We could see on images taken with big telescopes that a faint optical source was present at the location of the X-ray source, located near the core of a large and bright galaxy.

"We suspected that this faint optical source was directly associated with the X-ray source, but to be sure we had to study the light of this source in detail, using the Very Large Telescope in Chile.

"The data we got from the VLT were of a very high quality, and allowed us to separate the light of the big, bright galaxy from that of the faint optical source.

"Much to our delight we saw in the resulting measurements exactly what we were hoping for: the characteristic light of hydrogen atoms was detected allowing us to accurately measure the distance to this object. This provided conclusive proof that the black hole was indeed located inside the big, bright galaxy, and that HLX-1 is the brightest ultra-luminous X-ray source known.

"Now that we have established the distance to this black hole and now we know where it lives, we would like to find out what makes this source so bright, and how it ended up in this big galaxy."

This is a very important result as it is consistent with the idea that HLX-1 contains an intermediate mass black hole. Ultra-luminous X-ray sources are among the most promising candidates for intermediate mass black holes, with masses between stellar mass black holes (around ~3-20 times the mass of the Sun) and the super-massive black holes found in the centres of most galaxies (around 1 million -- 1 billion times the mass of the Sun).

The research team can now conclusively prove that HLX-1 is not in our own Galaxy, nor is it a super-massive black hole in the centre of a distant background galaxy. This result also confirms that it really is as bright as they thought it was.

Dr Didier Barret, of the Centre d'Etude Spatiale des Rayonnements in France, commented: "The XMM-Newton and Swift X-ray observatories are keeping a close eye on this source. The latest data, which was obtained while HLX-1 was very faint, indicates that it is behaving in a very similar way to stellar mass black holes in our own Galaxy, but at a level ~100 -- 1,000 times brighter."

Dr Sean Farrell, also in the Leicester Department of Physics and Astronomy, commented: "This is very difficult to explain without the presence of an intermediate mass black hole of between ~500 and 10,000 times the mass of the Sun. HLX-1 is therefore (so far!) weathering the scrutiny of the international astronomy community."The centres of most galaxies are thought to contain super-massive black holes, and these powerhouses have an enormous impact on the surrounding galaxy. Super-massive black holes deposit an immense amount of energy into their host galaxies, which has dramatic consequences for the formation of stars and the growth of the galaxy as a whole. Intermediate mass black holes may be the building blocks of super-massive black holes.

"Understanding how super-massive black holes form and grow is thus crucial to our comprehension of the formation and evolution of galaxies, which in turn goes part of the way to answering one of the really big questions: How did our own Galaxy form and evolve?"We are very pleased with this result, as it confirms our original discovery of the record breaking ultra-luminous X-ray source. In order to ensure the success of this project, we carefully prepared the VLT observations using data from the US-operated Magellan Telescopes. The VLT data analysis was especially complicated on this project, as it is very difficult to disentangle the signature in optical wavelengths of HLX-1 from the bright galaxy in which it lies.

"This work relied heavily on the expertise of researchers at the University of Leicester, and is testament to the high level of skills that are concentrated in our department, which works on some of the biggest questions in astronomy today. This is fitting as we are currently celebrating the 50th anniversary of the founding of the astronomy group here at Leicester."

Whether all ultra-luminous X-ray sources contain intermediate mass black holes is still quite uncertain. Dr Farrell's research team will continue studying HLX-1 in order to understand how it formed, where it is located, and what is feeding it.

In order to do this they have been granted time on the Hubble Space Telescope to take the highest ever resolution images of this host galaxy, which will allow them to investigate in detail the nature of the environment around HLX-1 and the galaxy which hosts it. Once the Hubble observations are performed, most of the great observatories would have been used to study this source.

The next step will be to find out if there are more objects as extreme as this one, and to compare what they know about HLX-1 with the larger population of ultra-luminous X-ray sources. This will help them understand how many intermediate mass black holes might be out there, and where they are likely to find them.The research team, their institutions and their funding bodies are: Sean Farrell, University of Leicester, Science and Technology Facilities Council (STFC) Klaas Wiersema, University of Leicester, STFC Natalie Webb, Centre d'Etude Spatiale des Rayonnements (CESR), Centre National de la Recherche Scientifique (CNRS) Mathieu Servillat, Harvard-Smithsonian Center for Astrophysics, NASA Thomas Maccarone, University of Southampton, STFC Didier Barret, CESR, CNRS Olivier Godet, CESR, CNRS.

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

http://www.sciencedaily.com/releases/2010/09/100908101925.htm

Most Penguin Populations Continue to Decline, Biologists Warn

Adele penguins jumping off of iceberg. Antarctica. (Credit: iStockphoto/Keith Szafranski)

ScienceDaily (Sep. 9, 2010) — Penguin biologists from around the world, who are gathered in Boston the week of September 6, warn that ten of the planet's eighteen penguin species have experienced further serious population declines. The effects of climate change, overfishing, chronic oil pollution and predation by introduced mammals are among the major factors cited repeatedly by penguin scientists as contributing to these population drops. Prior to the conference, thirteen of these penguin species were already classified as endangered or threatened. Some penguin species may face extinction in this century.

More than 180 penguin biologists, government officials, conservation advocates, and zoo and aquarium professionals from 22 nations have convened in Boston for the five day International Penguin Conference, which is being hosted this year by the New England Aquarium. The conference is held every three to four years, and this is the first time that it has been held in the Northern Hemisphere.

Penguins are found exclusively in the Southern Hemisphere with a single species on the Galapagos Islands at the Equator to four Antarctic penguin species that are most well known to the public, yet 13 other species also live in South America, southern Africa, Australia, New Zealand, and on the many sub-Antarctic islands. Throughout their ranges, nearly all of penguin species are in significant decline or under duress due to a host of common factors.

Climate Change Concerns

The effects of climate change on different penguin species has been the topic of many of the scientists's papers and presentations. Many penguin species are highly dependent on small schooling fish for food. These masses of anchovies, sardines and other small finfish are seasonally brought to many penguin habitats by cold water currents. In years with El Nino events in the Pacific, there has been a dramatic warming of sea surface temperatures which effectively blocked cold water currents coming up the western coast of South America.

Consequently, Galapagos penguins and Humboldt penguins, which are found on the coasts of Peru and Chile, have suffered due to reduced food availability, which principally affects the survival of the young. Galapagos penguins stand a 30% probability of becoming extinct in this century and Humboldt penguins have been classified by the Peruvian government as endangered.

Earlier this year, African penguins, found in Namibia and South Africa, were reclassified internationally as endangered as many breeding colonies in the western part of their range have disappeared. Important food bearing cold water currents have shifted and are now routinely found much further offshore. The increased roundtrip commuting distance for African penguins to obtain food has been devastating to their population.

Scientists are closely watching the potential effects on several Antarctic penguin species that are highly dependent on the presence of sea ice for breeding, foraging and molting. Emperor penguins, which were the subject of "March of the Penguins," could see major population declines by 2100, if they do not adapt, migrate and change the timing of their growth stages.

Adelie penguin colonies in the Antarctic's Ross Sea have coped for several years with two super-sized icebergs that have grounded there and created an enormous physical barrier. It has resulted in lower breeding rates and the migration of many animals out of the area.

Sea ice also creates an important nursey cover for juvenile krill which feed on ice algae. Krill is the primary fuel at the base the Antarctic food chain. Reduced sea ice cover has led to a dramtic decline in krill and will likely lead to a decline in many wildlife populations further up the food chain that relies on krill as its foundation food source.

The effects of climate change on penguins are very real. Many environmental conditions are changing and much less predictable. For penguins living in harsh conditions, the ability to properly time when to migrate, nest, mate and seek food are critical decisions often with a very small margin for error, both for both individual animals and entire species.

Overfishing and Bycatch

As fishing efforts around the globe have multipled several fold over the last few decades, penguins are now competing with people for enough food. The large scale harvesting of anchovy and sardine stocks have directly reduced the prey available to many penguin species including Macaroni and Chinstrap penguins in the South Atlantic. Combined with the effects of climate change on the locations of fish stocks, reduced food availability leads to higher starvation rates, increased vulnerabilty to disease and lower breeding success.

Thousands of penguins are also killed annually when caught in fixed fishing nets.

Chronic Oiling

Large scale oil spills make worlwide headlines, but chronic petroleum pollution has killed thousands of penguins particularly off the coasts of South America and South Africa. The most common sources are illegal operational dumping from ships, long term leaks from sunken ships and some land-based discharges. Better legislation and law enforcement efforts can yield positive results. The incidence of oiling of Magellanic penguins off the coast of Argentina has decline signficantly in recent years due to increased public awareness and enforcement.

Introduced Mammalian Predators

Many penguin species evolved in extremely remote settings devoid of any mammal predators.. Prior to the arrival of humans, New Zealand's only mammals were bats. Now, introduced weasels have had a large impact on the the small populations of Yellow-Eyed and Fiordland penguins. In Australia and Argentina, the arrival of foxes have had impacts while feral cats in the Galapagos have reduced penguin populations there.

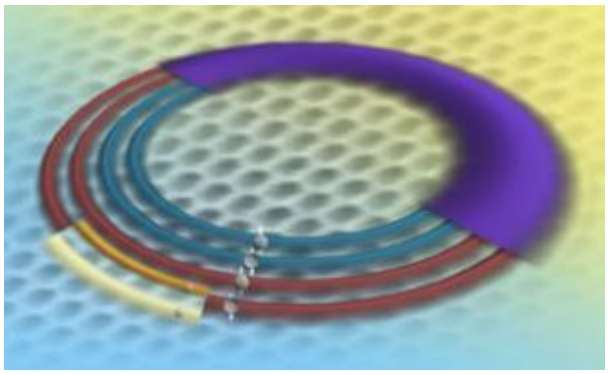
The goal of the 7th International Penguin Conference is to present ongoing research, identify current and emerging conservations issues and create action plans that will help create a strategic global effort on behalf of these threatened species.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **New England Aquarium**, via Newswise.

http://www.sciencedaily.com/releases/2010/09/100906145115.htm

Researchers Hear Puzzling New Physics from Graphene Quartet's Quantum Harmonies



This artist's rendition illustrates the electron energy levels in graphene as revealed by a unique NIST instrument. Because of graphene's properties, an electron in any given energy level (the wide, purple band) comprises four quantum states (the four rings), called a "quartet." This quartet of levels split into different energies when immersed in a magnetic field. The two smaller bands on the outermost ring represent the further splitting of a graphene electronic state. (Credit: T. Schindler and K. Talbott/NIST)

ScienceDaily (Sep. 9, 2010) — Using a one-of-a-kind instrument designed and built at the National Institute of Standards and Technology (NIST), an international team of researchers have "unveiled" a quartet of graphene's electron states and discovered that electrons in graphene can split up into an unexpected and tantalizing set of energy levels when exposed to extremely low temperatures and extremely high magnetic fields. Published in this week's issue of *Nature*, the new research raises several intriguing questions about the fundamental physics of this exciting material and reveals new effects that may make graphene even more powerful than previously expected for practical applications.

Graphene is one of the simplest materials -- a single-atom-thick sheet of carbon atoms arranged in a honeycomb-like lattice -- yet it has many remarkable and surprisingly complex properties. Measuring and understanding how electrons carry current through the sheet is important to realizing its technological promise in wide-ranging applications, including high speed electronics and sensors. For example, the electrons in graphene act as if they have no mass and are almost 100 times more mobile than in silicon. Moreover, the speed with which electrons move through graphene is not related to their energy, unlike materials such as silicon where more voltage must be applied to increase their speed, which creates heat that is detrimental to most applications.

To fully understand the behavior of graphene's electrons, scientists must study the material under an extreme environment of ultra-high vacuum, ultra-low temperatures and large magnetic fields. Under these conditions, the graphene sheet remains pristine for weeks, and the energy levels and interactions between the electrons can be observed with precision.

NIST recently constructed the world's most powerful and stable scanning-probe microscope, with an unprecedented combination of low temperature (as low as 10 millikelvin, or 10 thousandths of a degree above absolute zero), ultra-high vacuum and high magnetic field. In the first measurements made with this instrument, the team has used its power to resolve the finest differences in the electron energies in graphene, atom-by-atom.

"Going to this resolution allows you to see new physics," said Young Jae Song, a postdoctoral researcher who helped develop the instrument at NIST and make these first measurements.

And the new physics the team saw raises a few more questions about how the electrons behave in graphene than it answers.

Because of the geometry and electromagnetic properties of graphene's structure, an electron in any given energy level populates four possible sublevels, called a "quartet." Theorists have predicted that this quartet of levels would split into different energies when immersed in a magnetic field, but until recently there had not been an instrument sensitive enough to resolve these differences.

"When we increased the magnetic field at extreme low temperatures, we observed unexpectedly complex quantum behavior of the electrons," said NIST Fellow Joseph Stroscio.

What is happening, according to Stroscio, appears to be a "many-body effect" in which electrons interact strongly with one another in ways that affect their energy levels.

One possible explanation for this behavior is that the electrons have formed a "condensate" in which they cease moving independently of one another and act as a single coordinated unit.

"If our hypothesis proves to be correct, it could point the way to the creation of smaller, very-low-heat producing, highly energy efficient electronic devices based upon graphene," said Shaffique Adam, a postdoctoral researcher who assisted with theoretical analysis othe measurements.

The research team, led by Joseph Stroscio, includes collaborators from NIST, the University of Maryland, Seoul National University, the Georgia Institute of Technology, and the University of Texas at Austin.

The group's work was also recently featured in *Nature Physics*, in which they describe how the energy levels of graphene's electrons vary with position as they move along the material's crystal structure. The way in which the energy varies suggests that interactions between electrons in neighboring layers may play a role.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Institute of Standards and Technology (NIST)**.

Journal References:

1. David L. Miller, Kevin D. Kubista, Gregory M. Rutter, Ming Ruan, Walt A. de Heer, Markus Kindermann, Phillip N. First, Joseph A. Stroscio. **Real-space mapping of magnetically quantized graphene states**. *Nature Physics*, 2010; DOI: 10.1038/nphys1736
2. Young Jae Song, Alexander F. Otte, Young Kuk, Yike Hu, David B. Torrance, Phillip N. First, Walt A. de Heer, Hongki Min, Shaffique Adam, Mark D. Stiles, Allan H. MacDonald, Joseph A. Stroscio. **High-resolution tunnelling spectroscopy of a graphene quartet**. *Nature*, 2010; 467 (7312): 185 DOI: 10.1038/nature09330

http://www.sciencedaily.com/releases/2010/09/100908132218.htm

Woolly Mammoth, Woolly Rhinoceros and Reindeer Lived on Iberian Peninsula 150,000 Years Ago, Findings Show

Spanish researchers found the fossil remains of fauna of glacial climate in 72 Iberian sites, mostly in the north of the peninsula. (Credit: Peter Novák)

ScienceDaily (Sep. 9, 2010) — A team made up of members of the University of Oviedo (UO) and the Complutense University of Madrid (UCM) have gathered together all findings of the woolly mammoth, the woolly rhinoceros and the reindeer in the Iberian Peninsula to show that, although in small numbers, these big mammals -- prehistoric indicators of cold climates -- already lived in this territory some 150,000 years ago.

The presence of the woolly mammoth (*Mammuthus primigenius*), the woolly rhinoceros (*Coelodonta antiquitatis*), the reindeer (*Rangifer tarandus*), and to a lesser extent the wolverine (*Gulo gulo*), the arctic fox (*Alopex lagopus*), the musk-ox (*Ovibos moschatus*) and the Saiga antelope (*Saiga tatarica*), has been linked to the paleoclimatic scale created on the basis of the isotopic composition of oxygen in the ice of Greenland.

"The findings of cold climate fauna in the Iberian Peninsula coincide with the periods of greatest global cooling recorded in the ice of Greenland," Diego Álvarez-Lao, main author of the work and researcher in the Palaeontology Department of the UO explains.

The study, which has been published in the journal *Quaternary International*, reveals that the oldest remains of mammals adapted to cold climates found in the Iberian Peninsula belong to great prehistoric mammals which lived isolated in Spain 150,000 years ago.

The "glacial fauna" entered the Peninsula at that time because "the environmental conditions in central and northern Europe were so extreme that the animals were obliged to migrate to the south, where the climate was less severe," Álvarez-Lao explains.

44,000 years ago these animals became more common in the Iberian Peninsula but only for periods. "The cold periods (with the presence of glacial fauna) alternated with milder periods," adds the researcher.

The increase in temperatures caused a biological crisis

According to the team, the last findings of these cold species date back some 10,000 years, and coincide with the end of the glaciations. At that time, the climate became warmer in the whole northern hemisphere and the favourable habitat for these faunae was reduced to increasingly more northern latitudes and to smaller spaces.

"The increase in temperatures caused a genuine biological crisis for these animals from extremely cold climates. Some species such as the reindeer and the arctic fox found their new habitat in the arctic regions of the planet, where they still survive today. Others, such as the woolly mammoth and the woolly rhinoceros weren't so lucky," specifies the paleontologist.

According to the studies of pollen remains associated with these findings, the landscape of the period in which the great mammals lived in the Iberian Peninsula comprised mainly of steppes, or herbaceous vegetation. "Trees would have been very scarce in these times of extreme cold and environmental aridity," Álvarez-Lao points out.

More than 72 sites with remains of mammals

The Spanish researchers found the fossil remains of glacial climate fauna in 72 Iberian sites, the majority of which are in the north of the peninsula (Cornisa Cantabrica and Catalonia). There are also some traces in inland areas of the peninsula and even in the south, where the site of the woolly mammoths of Padul (Granada) lies.

"These species lived alongside different human cultures. There is evidence in some sites of the Basque country, Navarra and Catalonia that the Neanderthals coexisted with the mammoths and the reindeer at specific times. However, the majority of evidence of these faunae coincides with the periods of the Gravettian, Solutrean and Magdalenian cultures (during the Upper Paleolithic era in West Europe)," states Álvarez-Lao.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Plataforma SINC**, via AlphaGalileo.

Journal Reference:

1. Diego J. Álvarez-Lao, Nuria García. **Chronological distribution of Pleistocene cold-adapted large mammal faunas in the Iberian Peninsula**. *Quaternary International*, 2010; 212 (2): 120 DOI: 10.1016/j.quaint.2009.02.029

http://www.sciencedaily.com/releases/2010/09/100907081643.htm

Previously Known as Animal-Only Pigment, Bilirubin Now Confirmed in Bird of Paradise Flower

Bilirubin has been discovered in the beautiful and iconic Bird of Paradise flower. (Credit: Photo by David Lee)

ScienceDaily (Sep. 8, 2010) — A research team led by Cary Pirone from the Department of Biological Sciences at Florida International University has identified bilirubin in the popular Bird of Paradise plant. The breakthrough study, published in the September 2010 issue of the American Society for Horticultural Science's journal *HortScience*, provides new insights into color production in this iconic tropical plant.

Previously thought to be an "animal-only" pigment, bilirubin is best known as the yellowish hue associated with bruises and jaundice sufferers. In 2009 the FIU researchers found bilirubin in the arils of Strelitzia nicolai, the white Bird of Paradise tree. The incredible discovery -- that bilirubin exists in both plants and animals -- put Pirone's research on the scientific map. The current study expands the original research and reveals new insights into the presence of animal pigment in flowers. Advisor David Lee credits Pirone for her persistence and scientific acumen. "Cary has made a remarkable discovery," he noted, adding that it was Pirone's persistence and curiosity that persuaded colleagues that she was on the right track.

Strelitzia reginae Aiton, the Bird of Paradise plant, is known for its vibrant orange and blue inflorescences. Native to South Africa, it is widely cultivated in warm temperate and tropical regions. Aside from the widely recognized shape of its flower, which resembles the head of a bird, Strelitzia reginae is also admired for its brilliant floral coloration. In contrast to its showy flowers, the fruit of the Bird of Paradise is pale and partially obscured by the bract during development. When it matures, however, the capsule breaks open to reveal intensely colored orange arillate seeds. Remarkably, the distinct aril color can remain unchanged for decades after the plant dies.

Using high-performance liquid chromatography (HPLC) and HPLC/electrospray ionization-tandem mass spectrometry, the research team discovered bilirubin to be the primary aril pigment of Strelitzia reginae and found low concentrations of bilirubin in the plant's sepals. In mature aril tissue, bilirubin was present as

granular bodies irregularly distributed throughout the cell. In mature sepal tissue, the researchers observed elongate structures that were previously identified as containing carotenoids.

"This research is the first discovery of bilirubin in a flower; it verifies the presence of bilirubin in a plant species other than Strelitzia nicolai. With further research on the function, distribution, and synthesis of bilirubin in plants, the information may be useful for practical applications such as the manipulation of color through breeding and genetics," the researchers concluded.

The findings will likely have broad appeal among flower lovers, observed Lee. "When you discover something this significant about something this familiar (the Bird of Paradise flower), the story has power."

Story Source:

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

Journal Reference:

1. Pirone, Cary, Johnson, Jodie V., Quirke, J. Martin E., Priestap, Horacio A., Lee, David. **The Animal Pigment Bilirubin Identified in Strelitzia reginae, the Bird of Paradise Flower**. *HortScience*, 2010; 45: 1411-1415 [link]

http://www.sciencedaily.com/releases/2010/09/100908160356.htm

New Clue to How Last Ice Age Ended

Thick ice once filled New Zealand's Irishman Basin. (Credit: Aaron Putnam, University of Maine)

ScienceDaily (Sep. 8, 2010) — As the last ice age was ending, about 13,000 years ago, a final blast of cold hit Europe, and for a thousand years or more, it felt like the ice age had returned. But oddly, despite bitter cold winters in the north, Antarctica was heating up. For the two decades since ice core records revealed that Europe was cooling at the same time Antarctica was warming over this thousand-year period, scientists have looked for an explanation.

A new study in *Nature* brings them a step closer by establishing that New Zealand was also warming, indicating that the deep freeze up north, called the Younger Dryas for the white flower that grows near glaciers, bypassed much of the southern hemisphere.

"Glaciers in New Zealand receded dramatically at this time, suggesting that much of the southern hemisphere was warming with Antarctica," said study lead author, Michael Kaplan, a geochemist at Columbia University's Lamont-Doherty Earth Observatory. "Knowing that the Younger Dryas cooling in the northern hemisphere was not a global event brings us closer to understanding how Earth finally came out of the ice age."

Ice core records show that warming of the southern hemisphere, starting 13,000 years ago, coincided with rising levels of the heat-trapping gas, carbon dioxide. The study in *Nature* is the first to link this spike in CO_2 to the impressive shrinking of glaciers in New Zealand. The scientists estimate that glaciers lost more than half of their extent over a thousand years, and that their creep to higher elevations was a response to the local climate warming as much as 1 degree C.

To reconstruct New Zealand's past climate, the study's authors tracked one glacier's retreat on South Island's Irishman Basin. When glaciers advance, they drag mounds of rock and dirt with them. When they retreat, cosmic rays bombard these newly exposed ridges of rock and dirt, called moraines. By crushing this material and measuring the build-up of the cosmogenic isotope beryllium 10, scientists can pinpoint when the glacier receded. The beryllium-10 method allowed the researchers to track the glacier's retreat upslope through time and indirectly calculate how much the climate warmed.

The overall trigger for the end of the last ice age came as Earth's orientation toward the sun shifted, about 20,000 years ago, melting the northern hemisphere's large ice sheets. As fresh melt water flooded the North Atlantic Ocean, the Gulf Stream weakened, driving the north back into the ice age. During this time, temperatures in Greenland dropped by about 15 degrees C. For years, scientists have tried to explain how the so-called Younger Dryas cooling fit with the simultaneous warming of Antarctica that eventually spread across the globe.

The *Nature* paper discusses the two dominant explanations without taking sides. In one, the weakening of the Gulf Stream reconfigures the planet's wind belts, pushing warm air and seawater south, and pulling carbon dioxide from the deep ocean into the air, causing further warming. In the other, the weakened Gulf Stream triggers a global change in ocean currents, allowing warm water to pool in the south, heating up the climate.

Bob Anderson, a geochemist at Lamont-Doherty who argues the winds played the dominant role, says the *Nature* paper adds another piece to the puzzle. "This is one of the most pressing problems in paleoclimatology because it tells us about the fundamental processes linking climate changes in the northern and southern hemispheres," he said. "Understanding how regional changes influence global climate will allow scientists to more accurately predict regional variations in rain and snowfall."

Other researchers involved in the study: Joerg Schaefer and Roseanne Schwartz, also of Lamont-Doherty; George Denton and Aaron Putnam, University of Maine; David Barrell, GNS Science, New Zealand; Trevor Chinn, Alpine and Polar Processes Consultancy, New Zealand; Bjørn Andersen, University of Oslo; Robert Finkel, University of California, Berkeley; Alice Doughty, Victoria University of Wellington.

Story Source:

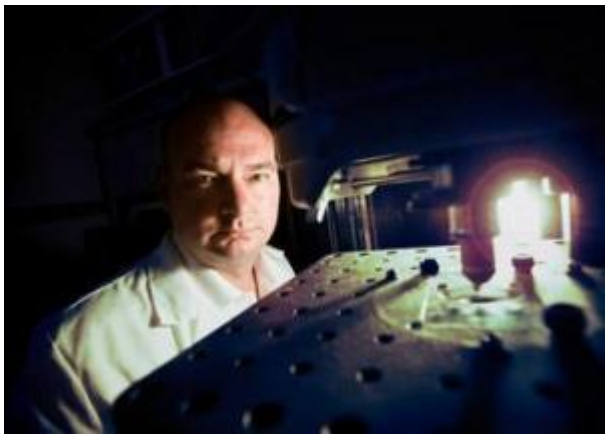
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **The Earth Institute at Columbia University**.

Journal Reference:

1. Michael R. Kaplan, Joerg M. Schaefer, George H. Denton, David J. A. Barrell, Trevor J. H. Chinn, Aaron E. Putnam, Bjørn G. Andersen, Robert C. Finkel, Roseanne Schwartz, Alice M. Doughty. **Glacier retreat in New Zealand during the Younger Dryas stadial**. *Nature*, 2010; 467 (7312): 194 DOI: 10.1038/nature09313

http://www.sciencedaily.com/releases/2010/09/100908132214.htm

Brain Cells -- Not Lack of Willpower -- Determine Obesity, Study Finds



Professor Michael Cowley discovered that a high-fat diet caused brain cells to become insulated from the body, rendering the cells unable to detect signals of fullness to stop eating. (Credit: Image courtesy of Monash University)

ScienceDaily (Sep. 8, 2010) — An international study has discovered the reason why some people who eat a high-fat diet remain slim, yet others pile on the weight.

The study, led in Australia by the Monash Obesity and Diabetes Institute (MODI) at Monash University, found a high-fat diet causes brain cells to become insulated from the body preventing vital signals, which tell the body to stop eating and to burn energy, from reaching the brain efficiently.

MODI director and Australian Life Scientist of the Year Professor Michael Cowley said there were two clear outcomes from the findings.

'We discovered that a high-fat diet caused brain cells to become insulated from the body, rendering the cells unable to detect signals of fullness to stop eating," Professor Cowley said.

"Secondly, the insulation also created a further complication in that the body was unable to detect signals to increase energy use and burn off calories/kilojoules."

The research showed that support cells in the brain developed overgrowth in a high-fat diet. This prevented the regular brain cells (the melanocortin system or POMC neurons) from connecting with other neural mechanisms, which determine appetite and energy expenditure.

Professor Cowley said the study findings provide a critical link in addressing the obesity epidemic.

"These neuronal circuits regulate eating behaviours and energy expenditure and are a naturally occurring process in the brain. The circuits begin to form early in life so that people may have a tendency towards obesity even before they eat their first meal," Professor Cowley said.

Eating a high fat diet causes more "insulation" in the nerve cells, and makes it even harder for the brain to help a person lose weight.

"Obese people are not necessarily lacking willpower. Their brains do not know how full or how much fat they have stored, so the brain does not tell the body to stop refuelling. Subsequently, their body's ability to lose weight is significantly reduced."

Professor Cowley and fellow MODI researcher Dr Pablo Enriori collaborated with Research Chair and Professor of Comparative Medicine and Professor of Neurobiology Tamas Horvath and his team at the Yale School of Medicine in the United States, together with teams of scientists in Cincinnati, New Jersey, Mexico and Spain.

For a period of four months, the researchers monitored the eating and body composition of groups of mice and rats and found that those with a neural predisposition to obesity gained 30 per cent more weight compared to six per cent of the group with obesity-resistant cells.

Story Source:

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

Journal Reference:

1. T. L. Horvath, B. Sarman, C. Garcia-Caceres, P. J. Enriori, P. Sotonyi, M. Shanabrough, E. Borok, J. Argente, J. A. Chowen, D. Perez-Tilve, P. T. Pfluger, H. S. Bronneke, B. E. Levin, S. Diano, M. A. Cowley, M. H. Tschop. **Synaptic input organization of the melanocortin system predicts diet-induced hypothalamic reactive gliosis and obesity**. *Proceedings of the National Academy of Sciences*, 2010; 107 (33): 14875 DOI: 10.1073/pnas.1004282107

http://www.sciencedaily.com/releases/2010/09/100908094807.htm

Self-Administered Vaccine Patch May Protect Against Potentially Pandemic Flu Viruses

ScienceDaily (Sep. 9, 2010) — A self-administered patch containing tiny microneedles may effectively deliver influenza virus-like particles through the skin and protect against potentially pandemic flu viruses such as H5N1.

Researchers from the U.S. and abroad report their findings in the September 2010 issue of the journal *Clinical Vaccine and Immunology*.

In the United States, seasonal flu epidemics often result in over 200,000 hospitalizations and 36,000 deaths each year. New pandemic flu strains continue to emerge, such as the 2009 H1N1 virus that resulted in the first pandemic influenza outbreak in the 21st century. Conventional vaccination programs require a painful injection administered by medical personnel and can take months to develop, emphasizing the need for vaccines that can be rapidly produced at low cost and distributed within weeks.

Influenza virus-like particles (VLPs) are potentially promising vaccine candidates as they are non-infectious and have been shown to induce long-lasting immunity against pandemic influenza viruses. An abundance of dermal dendritic cells, important members of the skins' immune system, make the skin an appealing route for vaccine delivery.

In the study researchers vaccinated mice with microneedle patches containing influenza H5 VLPs derived from the H5N1 virus and found the resulting protective immunity to be equal to or higher than that induced from intramuscular inoculation. Significantly, human skin cells also responded to the influenza VLP vaccine delivered by the microneedle patch.

"Microneedle vaccination in the skin with H5 VLPs represents a promising approach for a self-administered vaccine against viruses with pandemic potential," say the researchers.

Story Source:

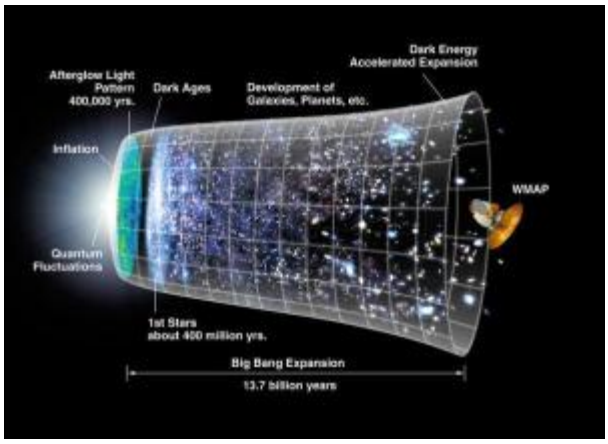
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Society for Microbiology**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. J.-M. Song, Y.-C. Kim, A. S. Lipatov, M. Pearton, C. T. Davis, D.-G. Yoo, K.-M. Park, L.-M. Chen, F.-S. Quan, J. C. Birchall, R. O. Donis, M. R. Prausnitz, R. W. Compans, S.-M. Kang. **Microneedle Delivery of H5N1 Influenza Virus-Like Particles to the Skin Induces Long-Lasting B- and T-Cell Responses in Mice**. *Clinical and Vaccine Immunology*, 2010; 17 (9): 1381 DOI: 10.1128/CVI.00100-10

http://www.sciencedaily.com/releases/2010/09/100908104340.htm

Big Bang Was Followed by Chaos, Mathematical Analysis Shows



Time line of the Universe. (Credit: NASA)

ScienceDaily (Sep. 8, 2010) — Seven years ago Northwestern University physicist Adilson E. Motter conjectured that the expansion of the universe at the time of the big bang was highly chaotic. Now he and a colleague have proven it using rigorous mathematical arguments.

The study, published by the journal *Communications in Mathematical Physics*, reports not only that chaos is absolute but also the mathematical tools that can be used to detect it. When applied to the most accepted model for the evolution of the universe, these tools demonstrate that the early universe was chaotic.

Certain things are absolute. The speed of light, for example, is the same with respect to any observer in the empty space. Others are relative. Think of the pitch of a siren on an ambulance, which goes from high to low as it passes the observer. A longstanding problem in physics has been to determine whether chaos -- the phenomenon by which tiny events lead to very large changes in the time evolution of a system, such as the universe -- is absolute or relative in systems governed by general relativity, where the time itself is relative.

A concrete aspect of this conundrum concerns one's ability to determine unambiguously whether the universe as a whole has ever behaved chaotically. If chaos is relative, as suggested by some previous studies, this question simply cannot be answered because different observers, moving with respect to each other, could reach opposite conclusions based on the ticks of their own clocks.

"A competing interpretation has been that chaos could be a property of the observer rather than a property of the system being observed," said Motter, an author of the paper and an assistant professor of physics and astronomy at Northwestern's Weinberg College of Arts and Sciences. "Our study shows that different physical observers will necessarily agree on the chaotic nature of the system."

The work has direct implications for cosmology and shows in particular that the erratic changes between red- and blue-shift directions in the early universe were in fact chaotic.

Motter worked with colleague Katrin Gelfert, a mathematician from the Federal University of Rio de Janeiro, Brazil, and a former visiting faculty member at Northwestern, who says that the mathematical aspects of the problem are inspiring and likely to lead to other mathematical developments.

An important open question in cosmology is to explain why distant parts of the visible universe -- including those that are too distant to have ever interacted with each other -- are so similar.

"One might suggest 'Because the large-scale universe was created uniform,'" Motter said, "but this is not the type of answer physicists would take for granted."Fifty years ago, physicists believed that the true answer could be in what happened a fraction of a second after the big bang. Though the initial studies failed to show that an arbitrary initial state of the universe would eventually converge to its current form, researchers found something potentially even more interesting: the possibility that the universe as a whole was born inherently chaotic.

The present-day universe is expanding and does so in all directions, Motter explained, leading to red shift of distant light sources in all three dimensions -- the optical analog of the low pitch in a moving siren. The early universe, on the other hand, expanded in only two dimensions and contracted in the third dimension.

This led to red shift in two directions and blue shift in one. The contracting direction, however, was not always the same in this system. Instead, it alternated erratically between x, y and z."According to the classical theory of general relativity, the early universe experienced infinitely many oscillations between contracting and expanding directions," Motter said.

"This could mean that the early evolution of the universe, though not necessarily its current state, depended very sensitively on the initial conditions set by the big bang."This problem gained a new dimension 22 years ago when two other researchers, Gerson Francisco and George Matsas, found that different descriptions of the same events were leading to different conclusions about the chaotic nature of the early universe. Because different descriptions can represent the perspectives of different observers, this challenged the hypothesis that there would be an agreement among different observers. Within the theory of general relativity, such an agreement goes by the name of a "relativistic invariant."

"Technically, we have established the conditions under which the indicators of chaos are relativistic invariants," Motter said. "Our mathematical characterization also explains existing controversial results. They were generated by singularities induced by the choice of the time coordinate, which are not present for physically admissible observables."Motter also is an assistant professor of engineering sciences and applied mathematics at the McCormick School of Engineering and Applied Science, a member of the executive committee of the Northwestern Institute on Complex Systems (NICO) and a member of the Center for Interdisciplinary Exploration and Research in Astrophysics (CIERA).

Story Source:

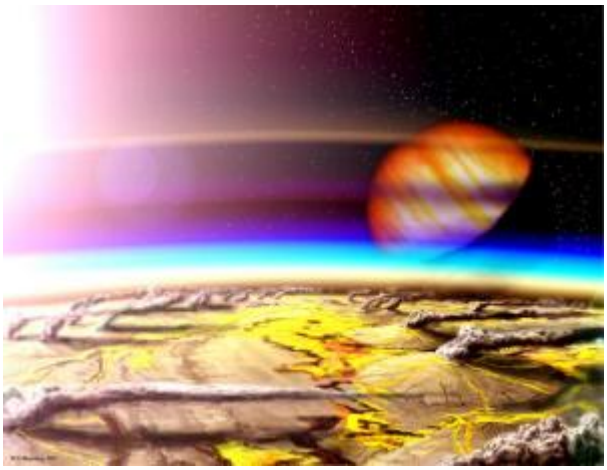
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Northwestern University**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Katrin Gelfert, Adilson E. Motter. **(Non)Invariance of Dynamical Quantities for Orbit Equivalent Flows**. *Communications in Mathematical Physics*, 2010; DOI: 10.1007/s00220-010-1120-x

http://www.sciencedaily.com/releases/2010/09/100907171642.htm

Can We Spot Volcanoes on Alien Worlds? Astronomers Say Yes



This artist's conception shows an extremely volcanic moon orbiting a gas giant planet in another star system. New research suggests that astronomers using the James Webb Space Telescope could potentially detect volcanic activity on a distant Earth-sized planet by measuring volcanic gases in its atmosphere. Credit: (Credit: Wade Henning)

ScienceDaily (Sep. 7, 2010) — Volcanoes display the awesome power of Nature like few other events. Earlier this year, ash from an Icelandic volcano disrupted air travel throughout much of northern Europe. Yet this recent eruption pales next to the fury of Jupiter's moon Io, the most volcanic body in our solar system.

Now that astronomers are finding rocky worlds orbiting distant stars, they're asking the next logical questions: Do any of those worlds have volcanoes? And if so, could we detect them? Work by theorists at the Harvard-Smithsonian Center for Astrophysics suggests that the answer to the latter is a qualified "Yes."

"You would need something truly earthshaking, an eruption that dumped a lot of gases into the atmosphere," said Smithsonian astronomer Lisa Kaltenegger. "Using the James Webb Space Telescope, we could spot an eruption 10 to 100 times the size of Pinatubo for the closest stars," she added.

Astronomers are decades away from being able to image the surface of an alien world, or exoplanet. However, in a few cases they have been able to detect exoplanet atmospheres for gas giants known as "hot Jupiters." An eruption sends out fumes and various gases, so volcanic activity on a rocky exoplanet might leave a telltale atmospheric signature.

To examine which volcanic gases might be detectable, Kaltenegger and her Harvard colleagues, Wade Henning and Dimitar Sasselov, developed a model for eruptions on an Earth-like exoplanet based on the present-day Earth. They found that sulfur dioxide from a very large, explosive eruption is potentially measurable because a lot is produced and it is slow to wash out of the air.

"Our first sniffs of volcanoes from an alien Earth might be pretty rank!" Kaltenegger said. "Seeing a volcanic eruption on an exoplanet will show us similarities or differences among rocky worlds."

The 1991 eruption of Mount Pinatubo in the Philippines spewed about 17 million tons of sulfur dioxide into the stratosphere -- a layer of air 6 to 30 miles above Earth's surface. The largest volcanic eruption in recorded history, the 1815 Tambora event, was about 10 times more powerful.

Such gigantic eruptions are infrequent, so astronomers would have to monitor many Earth-sized planets for years to catch one in the act. However, if alien worlds are more volcanically active than Earth, success might be more likely.

"A Tambora-sized eruption doesn't happen often here, but could be more common on a younger planet, or a strongly tidally active planet -- analogous to Io," said Henning. "Once you detected one eruption, you could keep watch for further ones, to learn if frequent eruptions are common on other planets."

To look for volcanic sulfur dioxide, astronomers would rely on a technique known as the secondary eclipse, which requires the exoplanet to cross behind its star as seen from Earth. By collecting light from the star and planet, then subtracting the light from the star (while the planet is hidden), astronomers are left with the signal from the planet alone. They can search that signal for signs of particular chemical molecules.

Due to its proximity, a hypothetical Earth or super-Earth orbiting Alpha Centauri would offer a best-case scenario for a sun-like star. A super-Earth orbiting a smaller host star close to our own Sun would show the biggest signal. But any Earth-like planet less than 30 light-years away could show faint signs of volcanism when studied with the James Webb Space Telescope.

This research will be published in *The Astrophysical Journal.*

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Harvard-Smithsonian Center for Astrophysics**.

---

http://www.sciencedaily.com/releases/2010/09/100907113048.htm

More Weight Equals Longer Hospital Stays

Sociologists Weigh In On Obesity Increasing The Length Of Hospital Stays
January 1, 2009 — Sociologists found a direct relationship between obesity and duration and frequency of hospital stays. Researchers found that, on average, obese persons stayed one and a half days longer than those with normal weight. Sociologists attribute the connection to disease--46 percent of obese adults have high blood pressure. Obesity is also linked to an increased risk of heart disease, diabetes, stroke and other illnesses. The researchers also note that the longer a person has been obese, the more likely their hospital stay is lengthened.

The numbers on our nation's scales are going up. A recent study puts Mississippi at the top of the list with the highest rate of adult obesity in the country. New research shows how extra weight is adding up to longer hospital stays.

Annette Armstead knows what it takes to stay healthy. Before she started exercising, she weighed 225 pounds.

"I was tired of people telling fat jokes," said Armstead. "I was in pain all the time. I was so heavy that my knees would give out on me, and I was always falling down."

Obesity is linked with increased risk of heart disease, stroke, diabetes and other illnesses.

"I had problems with arthritis and different health problems, and everything they were saying [indicated] I was too heavy and I needed to lose weight," Armstead said. A new study by sociologists at Purdue University found obesity also leads to more frequent and longer hospital stays.

"Obese people, on average, stay at least one to one and a half days longer than a normal-weight individual," said Ken Ferraro, Ph.D., a sociologist at Purdue University in West Lafayette, Ind.

The main reason for extra hospitalizations is disease. Forty-six percent of obese adults in the study had high blood pressure, and obese adults who have been overweight since childhood and carried extra weight into adulthood pay the highest price for being heavy.

"The longer the person is obese, the longer their stay in the hospital," Dr. Ferraro said.

Tackling obesity at a young age is crucial to staying out of the hospital later on.

"If you can tell other people that you're on a diet, a lot of them actually might help you to stay on that diet, but if you're silent to your friends, then obviously they can't support you," Dr. Ferraro advised.

Armstead credits her weight loss to diet and exercise and has never felt better.

"I feel healthier at 55 than I did at 25," she said.

ABOUT TYPE II DIABETES: Type II diabetes is the most common form of diabetes. In this form of the disease, either the body does not produce enough insulin, or the cells in the body ignore insulin. This can stop glucose from moving out of the bloodstream and into cells. Cells need the energy that glucose provides, and too much sugar in the blood can cause damage to the eyes, nerves, kidneys, or heart. These complications are

very similar to the threats from type I diabetes, though type II can sometimes be treated with medications and diet instead of insulin (obtained through injections or in an inhaled form).

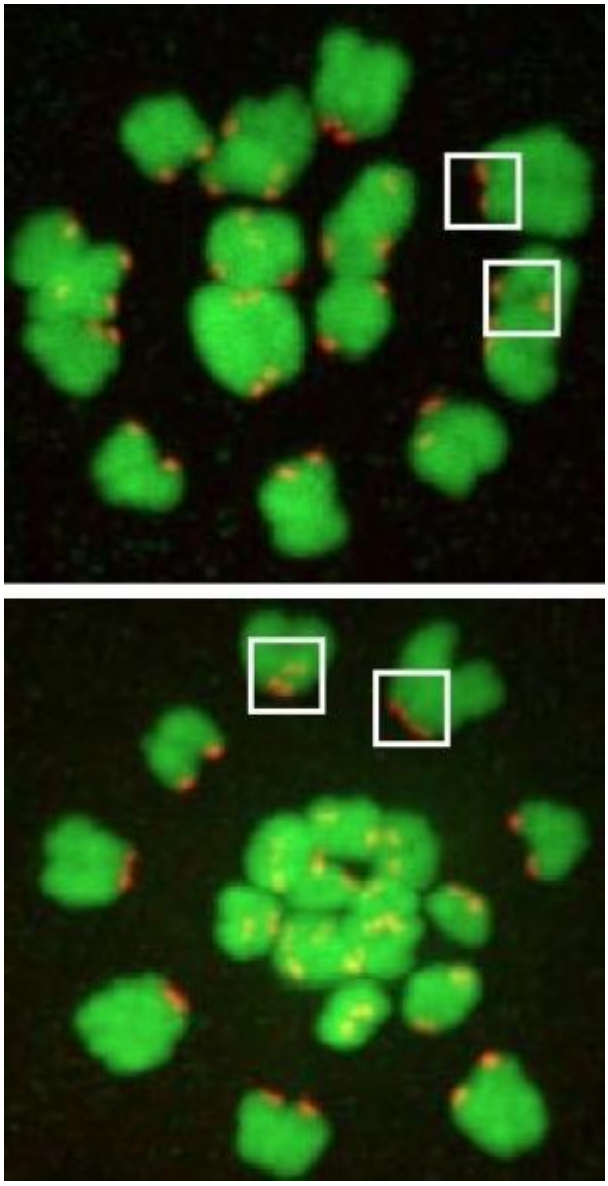
WHAT IS BLOOD PRESSURE: Blood pressure is the force in the arteries when the heart beats, and when the heart is at rest. When blood pressure is high, there is an increased risk of heart disease (which leads to heart attack) and stroke. It is most common in adults over age 35, and is especially prevalent in African Americans, the middle-aged and elderly, obese people, heavy drinkers, and women who are taking birth control pills. Those with diabetes, gout or kidney disease are also prone to suffer from high blood pressure.

WHAT CAUSES HEART ATTACKS: Heart attack is the leading cause of death in North and South America and in Europe. It is usually the result of prolonged hardening and narrowing of the arteries that direct blood into the heart. When blood vessels are healthy, oxygen-rich blood flows easily to all the muscles and organs of the body. But if they become clogged by the buildup of fatty deposits on vessel walls, blood can be cut off, killing heart muscle cells. This is called coronary heart disease, and it can lead to heart attacks or strokes.

The American Sociological Association contributed to the information contained in the TV portion of this report.

http://www.sciencedaily.com/videos/2009/0108-more_weight_equals_longer_hospital_stays.htm

Why the Biological Clock? Aging Reduces Centromere Cohesion, Disrupts Reproduction, Biologists Discover



Green DNA with red kinetichore protein structures increasing in separation between young mice (top) and old. (Credit: Image courtesy of University of Pennsylvania)

ScienceDaily (Sep. 9, 2010) — University of Pennsylvania biologists studying human reproduction have identified what is likely the major contributing factor to the maternal age-associated increase in aneuploidy, the term for an abnormal number of chromosomes during reproductive cell division.

Using naturally aging mouse models, researchers showed that this basic fact of reproductive life is most likely caused by weakened chromosome cohesion. Older oocytes, or egg cells, have dramatically reduced amounts of a protein, REC8, that is essential for chromosomes to segregate correctly during the process that forms an egg. Mistakes in this process can create chromosomal abnormalities like Down syndrome.

Richard Schultz, associate dean for the natural sciences and the Charles and William L. Day Distinguished Professor of Biology in Penn's School of Arts and Sciences, and Michael Lampson, assistant professor of biology, found that kinetochores -- the protein structures that mark the site where a chromosome pair is split during cell division -- are farther apart in eggs obtained from aged mice, resulting in reduced centromere cohesion. Because cohesion in these cells is established during fetal development, and must remain functional until meiotic resumption in adult life (up to ~50 years later in humans or 15 months in mice), defective cohesion is a good candidate for a process that might fail with increasing maternal age.

Researchers demonstrated that about 90 percent of age-related aneuploidies are best explained by weakened centromere cohesion. Together, these results show that the maternal age-associated increase in aneuploidy is often due to a failure to effectively replace cohesin proteins lost during aging.

"Despite the well understood nature of the issue -- popularly called the biological clock -- the molecular mechanisms that underpin this phenomenon have never been fully understood," Schultz said. "Even now at

the molecular level, there is no clear explanation for the loss of cohesion, in large part because almost nothing is known about how cohesion is normally maintained during the long prophase arrest in mammalian oocytes. Outstanding questions, such as the stability of cohesin complexes on chromosomes during arrest and whether new cohesins load and mature during the arrest, are now under investigation."

To test whether cohesion defects led to the observed aneuploidies, scientists monitored chromosome segregation during the initial stages of separation, called the anaphase, in live mouse oocytes, counting the chromosomes in the resulting metaphase II eggs.

Researchers arrived at this hypothesis by identifying mRNAs that differed in oocytes of old and young mice, which suggested the spindle assembly checkpoint, kinetochore function and spindle assembly as processes that might become defective with age. Results of experiments addressed to test these possibilities suggested that they were unlikely causes. During these studies, however, the scientists noticed that sister kinetochores are farther apart in metaphase II eggs from older mice at 16 to 19 months of age compared to eggs from young mice of 6 to 14 weeks of age, a finding that drew their attention to explore reduced cohesion as a primary source for age-related aneuploidy.

The study, appearing in the journal *Current Biology*, was conducted by Schultz, Lampson, Teresa Chiang, Francesca E. Duncan and Karen Schindler of the Department of Biology in Penn's School of Arts and Sciences.

The study was funded by the National Institutes of Health and a Searle Scholar Award to Lampson.

Story Source:

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

Journal Reference:

1. Teresa Chiang, Francesca E. Duncan, Karen Schindler, Richard M. Schultz, Michael A. Lampson. **Evidence that Weakened Centromere Cohesion Is a Leading Cause of Age-Related Aneuploidy in Oocytes**. *Current Biology*, 2010; DOI: 10.1016/j.cub.2010.06.069

http://www.sciencedaily.com/releases/2010/09/100908142741.htm

These Dendritic Cells Are Fishy, but That's a Good Thing

ScienceDaily (Sep. 7, 2010) — Scientists from the University of California, San Diego School of Medicine have identified dendritic antigen-presenting cells in zebrafish, opening the possibility that the tiny fish could become a new model for studying the complexities of the human immune system.

The study, reported in the online edition of the *Proceedings of the National Academy of Sciences*, was headed by David Traver, an associate professor in UCSD's Department of Cellular and Molecular Medicine, with colleagues in UCSD's Division of Biological Sciences and at the Brazilian National Cancer Institute.

Dendritic cells (DCs) form a crucial link between the innate and adaptive immune systems in mammals. Innate immunity is present in all organisms, providing immediate but short-lived and relatively non-specific defense against infection. Adaptive immunity is evolutionarily younger and more complex. It produces long-lasting protection against specific pathogens after initial exposure. Mammalian DCs act as sentries that bridge the innate and adaptive systems, confronting and engulfing newly discovered pathogens, then recruiting and activating antigen-specific T lymphocytes.

While DCs and the adaptive response have been well-documented in mammals, it was not clear whether these cells existed in non-mammalian vertebrates. Scientists knew that zebrafish -- an increasingly popular animal model -- exhibited many of the cellular elements of the adaptive system, including T and B lymphocytes, but no one had documented the presence of dendritic cells.

Traver and colleagues inventoried hematopoietic cells that could engulf labeled bacteria, looking for cells that appeared and behaved like mammalian DCs. They found multiple suspects, but finally zeroed in on one rare cell type that appears to fit all of the criteria for being a dendritic cell.

"All signs point to these cells being the fish version of dendritic cells," said Traver. "They have all of the major characteristics."

The discovery of DCs in zebrafish provides researchers with another model for investigating the mammalian immune system, particular with regard to humans. "The cool thing is that the more we learn, the more we realize that our immune systems are highly conserved," said Traver. "Of course, there are differences. These differences, however, are variations on a theme, with the major themes of immune cell function being quite similar. Likewise, there are differences and variations in the dendritic cells of mice compared to humans, but the basics are the same."

Zebrafish do offer some practical research advantages over other models.

First, the fish are translucent. "You can track individual cells and systems directly in the whole animal," said Traver. "Very little is known about the initial immune response in mammals because we can't see it happening. In these fish, we can visualize what happens in real time."

Second, zebrafish are easy to handle and reproduce rapidly, making it easier to engineer and study mutations. "We can quickly grow generations of fish, letting the genetics tell us what's important," Traver said.

Co-authors with Traver are Geanncarlo Lugo-Villarino, Keir M. Balla and David L. Stachura of the Section of Cell and Developmental Biology, Division of Biological Sciences, UC San Diego and Miriam B.F. Werneck of the Division of Cellular Biology, Brazilian National Cancer Institute.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - San Diego**. The original article was written by Scott LaFee.

Journal Reference:

1. Geanncarlo Lugo-Villarino, Keir M. Balla, David L. Stachura, Karina Bañuelos, Miriam B. F. Werneck, David Traver. **Identification of dendritic antigen-presenting cells in the zebrafish**. *Proceedings of the National Academy of Sciences*, 2010; 107 (36): 15850-15855 DOI: 10.1073/pnas.1000494107

http://www.sciencedaily.com/releases/2010/09/100908094920.htm

Portable Laser Backpack Revolutionizes 3-D Mapping

A portable, laser backpack for 3D mapping has been developed at the University of California, Berkeley where it is being hailed as a breakthrough technology capable of producing fast, automatic and realistic 3D mapping of even difficult interior environments. (Credit: John Kua, University of California, Berkeley)

ScienceDaily (Sep. 8, 2010) — A portable, laser backpack for 3-D mapping has been developed at the University of California, Berkeley, where it is being hailed as a breakthrough technology capable of producing fast, automatic and realistic 3-D mapping of difficult interior environments.

Research leading to the development of the reconnoitering backpack, was funded by the Air Force Office of Scientific Research and the Army Research Office under the guidance of program managers, Dr. Jon Sjogren (AFOSR) and Dr. John Lavery (ARO).

The backpack is the first of a series of similar systems to work without being strapped to a robot or attached to a cart. At the same time, its data acquisition speed is very fast, as it collects the data while the human operator is walking; this is in contrast with existing systems in which the data is painstakingly collected in a stop and go fashion, resulting in days and weeks of data acquisition time.

Using this technology, Air Force personnel will be able to collectively view the interior of modeled buildings and interact over a network in order to achieve military goals like mission planning.

Under the direction of Dr. Avideh Zakhor, lead researcher and UC Berkeley professor of electrical engineering, the scientists have been able to use this more portable method of mapping by way of sensors or lightweight (less than eight ounces) laser scanners.

"We have also developed novel sensor fusion algorithms that use cameras, lasers range finders and inertial measurement units to generate a textured, photo-realistic, 3-D model that can operate without GPS input and that is a big challenge," said Zakhor.

There are many basic research issues to achieve a working system, including calibration, sensor registration and localization. Using multiple sensors facilitates the modeling process, though the data from various sensors do need to be registered and precisely fused with each other in order to result in coherent, aligned, and textured 3-D models. Localization is another technical challenge since without it; it is not possible to line up scans from laser scanners in order to build the 3-D point cloud, which is the first step in the modeling process.

"It is fair to say that embarking on such a hands-on project, to make indoor 3-D modeling a matter of routine, a number of research questions of a fundamental nature came up," said Sjogren. "It is typical of the work that Prof. Zakhor has done for AFOSR/Air Force Research Laboratory over the years, that she meets these challenges head-on, and in most cases solves the problem sufficient to demonstrate a prototype system."

Sjogren noted that what is left for others is to examine the approach that was taken, and extend the techniques that were brought in, to a wider context.

"We are gratified to see how technology can drive science in a domain of critical relevance to practical defense implementations," he said.

Even though they don't have all the answers yet, the scientists are boldly looking ahead to how this technology can be used in the future when they plan to model entire buildings and develop interactive viewers that allow users to virtually walk through buildings before they are there in person.

In the meantime, the cutting-edge technology is being successfully implemented on campus.

"We have already generated 3-D models of two stories of the electrical engineering building at UC Berkeley, including the stairway and that is a first," said Zakhor.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Air Force Office of Scientific Research**. The original article was written by Maria Callier.

http://www.sciencedaily.com/releases/2010/09/100908171128.htm

Adults Demonstrate Modified Immune Response After Receiving Massage, Researchers Show

ScienceDaily (Sep. 9, 2010) — Researchers in Cedars-Sinai's Department of Psychiatry and Behavioral Neurosciences have reported people who undergo massage experience measureable changes in their body's immune and endocrine response.

Although there have been previous, smaller studies about the health benefits of massage, the Cedars-Sinai study is widely believed to be the first systematic study of a larger group of healthy adults.

The study is published in the October printed edition of the *Journal of Alternative and Complementary Medicine*.

"Massage is popular in America, with almost 9 percent of adults receiving at least one massage within the past year," said Mark Rapaport, M.D., chairman of the Department of Psychiatry and Behavioral Neurosciences. "People often seek out massage as part of a healthy lifestyle but there hasn't been much physiological proof of the body's heightened immune response following massage until now."

In the study, 29 subjects received 45 minutes of Swedish massage and 24 received 45 minutes of light touch massage. Each participant underwent informed consent, a physical and mental evaluation and was deemed to be physically healthy and free of any mental disorder. Massage therapists were trained in how to deliver both Swedish and light touch using specific and identical protocols.

Prior to the massage, study participants were fitted with intravenous catheters in order to take blood samples during the study session. Then participants were asked to rest quietly for 30 minutes. Following the rest period, blood samples were collected from each person five minutes and one minute before the massage began. At the end of the 45-minute massage session, blood samples were collected at one, five, 10, 15, 30, and 60 minutes after the massage.

"This research indicates that massage doesn't only feel good, it also may be good for you," said Rapaport, the principal investigator of the study and the Polier Family Chair in Schizophrenia and Related Disorders. "More research is ahead of us but it appears that a single massage may deliver a measurable benefit."

Among the study's results:

- People in the Swedish massage group experienced significant changes in lymphocytes ,(lymphocyte numbers and percentages white blood cells that play a large role in defending the body from disease.
- Swedish massage caused a large decrease (effect size -.74) in Arginine Vasopressin (AVP) a hormone believed to play a role in aggressive behavior and linked to helping cause increases in the stress hormone cortisol.
- Swedish massage caused a decrease in levels of the stress hormone cortisol.
- Swedish massage caused a notable decrease in most cytokines produced by stimulated white blood cells.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Cedars-Sinai Medical Center**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Rapaport et al. **A Preliminary Study of the Effects of a Single Session of Swedish Massage on Hypothalamic–Pituitary–Adrenal and Immune Function in Normal Individuals**. *The Journal of Alternative and Complementary Medicine*, 2010; 100901121319046 DOI: 10.1089/acm.2009.0634

http://www.sciencedaily.com/releases/2010/09/100908094809.htm

Muscle Wasting in Cancer Does Not Spare the Heart

ScienceDaily (Sep. 9, 2010) — The wasting disease associated with some cancers that is typically seen affecting skeletal muscles can also cause significant damage to the heart, new research in mice suggests.

Before now, cachexia, characterized by muscle wasting and dramatic weight loss, was believed to spare the heart. But an Ohio State University study showed that the condition reduces heart function and changes the heart muscle structure in mice with colon cancer.

Previous studies have suggested that cachexia is responsible for between one-fifth and one-third of all cancer deaths. But many aspects of the condition remain misunderstood, including its cause and ways to predict who is at highest risk for the syndrome.

These new study findings could have immediate implications for treatment, said Martha Belury, lead author of the research and a professor of human nutrition at Ohio State.

"I think if we know certain types of cancer are associated with this wasting disease, it might be important to think about heart function earlier rather than once people are starting to lose weight. Clinicians could try to protect the heart while also giving patients chemotherapy for cancer and perhaps added nutrition to maintain weight," Belury said.

"The fatigue and weakness of cachexia have been attributed to skeletal muscle wasting. But our results support the idea that insufficient heart performance might also be responsible for fatigue symptoms, leading to less exercise and more severe muscle wasting. It's a vicious cycle that contributes to the complications of cancer cachexia."

The study is published in a recent issue of the *International Journal of Oncology*.

The researchers compared mice with and without colon cancer tumors. Colon cancer and other gastrointestinal tumors, as well as some lung cancers, are most commonly associated with development of cachexia

At day 14 of the study, when the mice with tumors were clearly losing weight, the scientists measured cardiac function in all of the mice using echocardiography, or an ultrasound of the heart. This evaluation showed that mice with tumors as a group had a heart rate of almost 21 percent fewer beats per minute on average and pumped significantly less blood than did the hearts of the healthy mice.

Three days later, the scientists observed a 23 percent difference in body weight between the mice with cancer and without tumors -- a sign that the syndrome had clearly taken hold in the mice with cancer.

Though the mice with tumors ate less as the disease developed, the study was designed to show that food consumption wasn't the sole cause of weight loss. A group of healthy mice whose food consumption matched the lower consumption of the mice with cancer also lost weight, but retained their skeletal muscle mass and showed normal heart function.

The researchers examined the heart tissue of all of the mice using electron microscopy. They found a number of signs of damage in the heart muscle tissue of mice with cachexia, including an increase in fibrous tissue and changes in mitochondria, the so-called "powerhouses" in cells that convert carbon to energy.

"The mitochondria looked pretty bad, almost as if they were breaking apart. And we also saw evidence of the precursors of scarring, or collagen formation, which you don't want to see in any type of muscle and especially not in the heart muscle," Belury said.

No similar problems were seen in the hearts of mice without tumors.

By also examining gene function in the heart tissue, the researchers found that the proteins associated with power generation in muscle had converted from their adult form to a fetal type in the hearts of mice with cachexia. This phenomenon has been linked to heart failure in previous research.

"The heart was still trying very hard to maintain function and structure, so it was inducing this kind of action to try to heal itself but it just couldn't. There was too much going on for this to work," Belury said. "We wonder if we could harness some of this knowledge into a way of reversing the heart disease."

Future research could test whether using medication or added nutrition in early stages of cachexia might prevent heart function deterioration, she said.

This work was supported by the Kennedy Professorship at Ohio State, which is held by Belury, and the Ohio Agricultural Research and Development Center.

Co-authors include Min Tian, Michelle Asp and Michael Stout of the Department of Human Nutrition, Yoshinori Nishijima of the College of Pharmacy and Peter Reiser of the Department of Oral Biology, all at Ohio State.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Ohio State University**. The original article was written by Emily Caldwell.

Journal Reference:

1. Min Tian, Yoshinori Nishijima, Michelle L. Asp, Michael B. Stout, Peter J. Reiser, Martha A. Belury. **Cardiac alterations in cancer-induced cachexia in mice**. *International Journal of Oncology*, 2010; 37 (2) DOI: 10.3892/ijo_00000683

http://www.sciencedaily.com/releases/2010/09/100908121956.htm

New Compound Safely Reduces Plaques in Mouse Model of Alzheimer's Disease

ScienceDaily (Sep. 9, 2010) — A team of scientists, led by University of California, San Diego School of Medicine researchers, has synthesized hundreds of new compounds with the potential of reducing the production of the A-beta 42 peptide, a primary component of Alzheimer's disease (AD).

In mouse models, one tested compound specifically reduced levels of A-beta 42, which is believed to be responsible for the destruction of neurons, but left other essential enzymatic activities in the brain unaffected, said Steven Wagner, PhD, a project scientist in the UCSD Department of Neurosciences.

The research, which will be published in the September 8 advance online edition of the journal *Neuron*, includes collaborators at the University of Chicago, Memorial Sloan Kettering Cancer Center, Massachusetts General Hospital and several San Diego-based biotechnology companies.

"Current drug efforts have tried to broadly knock out peptide activity, but with resulting adverse side effects such as nausea, gastrointestinal problems, hair color changes and skin cancer," said Wagner. "Our approach is to target and inhibit only the production of key peptides that may play a pivotal role in the pathogenesis of Alzheimer's disease, while leaving other catalytic processes alone. If some of the compounds we've synthesized are shown to do that in humans, we might eventually be able to inhibit or reduce further plaque production and ultimately prevent Alzheimer's before symptoms actually appear."

Amyloid plaques are tell-tale protein deposits found abundantly in the brains of Alzheimer's patients. The plaques, along with neurofibrillary tangles, interfere with normal neuron functioning. In healthy cellular metabolisms, chemical compounds are constantly being combined or parsed to perform different duties. Among them are two peptides known as A-beta 42 and A-beta 40. High levels of these peptides, particularly A-beta 42, have been linked to the creation of beta-amyloid plaques in Alzheimer's disease, a neurodegenerative condition that afflicts 5.3 Americans and more than 26 million people worldwide. AD is marked by progressive dementia, most notably memory loss. It is the seventh leading cause of death in the United States.

Existing drugs in development do not specifically target A-beta 42 levels. Wagner and colleagues looked for small molecules that might preferentially reduce levels of A-beta 42, but leave other cellular components and activities alone. The scientists screened more than 80,000 molecules looking for compounds that fit specific criteria. They found one, which they used as a template to synthesize hundreds of additional related compounds called gamma-secretase modulators or GSMs. These compounds are different and far more potent than non-steroidal anti-inflammatory molecules that have been used by others in previous studies. One GSM was tested in a transgenic mouse model designed to overproduce A-beta 42 and 40 and develop neuritic plaques. Given single daily oral doses of the GSM, the researchers report that levels of A-beta 42 declined and neuritic plaques were dramatically reduced in the mouse model.

"We've shown that a compound can modulate enzyme activity without completely shutting down the enzyme," said Wagner. "We think we've opened up a new area of drug discovery for pharmaceutical companies and universities. We hope they will pursue some of these compounds to see if they can be used in people."

Ultimately, said Rudolph Tanzi, PhD, the Joseph P. and Rose F. Kennedy Professor of Neurology at Harvard University and Massachusetts General Hospital and one of the paper's co-authors, the hope is that one or more of the synthesized compounds or something similar might be used to treat, even prevent, Alzheimer's disease.

"They could be used like statins are used today to prevent heart disease," said Tanzi. "If there was pre-symptomatic evidence that amyloid levels were too high in a patient's brain, a GSM might be taken to lower relevant peptide levels and reduce AD risk. You don't want to knock out these peptides. They have a purpose. You just want to dial them back to safe levels."

Co-authors include Maria Z. Kounnas of Neurogenetic Pharmaceuticals and Torrey Pines Therapeutics; Anne M. Danks of Torrey Pines Therapeutics and Helicon Therapeutics; Soan Cheng and Phuong Nguyen of Torrey Pines Therapeutics and UC San Diego Department of Neurosciences; Curtis Tyree, Elizabeth Ackerman, Dan Comer, Long Mao, Chengzhi Yu, David Pleynet and Paul J. Digregorio of Torrey Pines Therapeutics; Xulun Zhang of The Center for Molecular Neurobiology, University of Chicago; Kwangwook Ahn in the Molecular Pharmacology and Chemistry Program at Memorial Sloan Kettering Cancer Center; Gonul Velicelebi and Kenneth A. Stauderman of Torrey Pines Therapeutics and CalciMedica; William T. Comer of Neurogenetic Pharmaceuticals and Torrey Pines Therapeutics; William C. Mobley of the Department of Neurosciences at UC San Diego; Yue-Ming Li of the Molecular Pharmacology and Chemistry Program at Memorial Sloan Kettering Cancer Center and Sangram S. Sisodia at The Center for Molecular Neurobiology at the University of Chicago.

Story Source:

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

Journal Reference:

1. Maria Z. Kounnas, Anne M. Danks, Soan Cheng, Curtis Tyree, Elizabeth Ackerman, Xulun Zhang, Kwangwook Ahn, Phuong Nguyen, Dan Comer, Long Mao, Chengzhi Yu, David Pleynet, Paul J. Digregorio, Gonul Velicelebi, Kenneth A. Stauderman, William T. Comer, William C. Mobley, Yue-Ming Li, Sangram S. Sisodia, Rudolph E. Tanzi, Steven L. Wagner. **Modulation of γ-Secretase Reduces β-Amyloid Deposition in a Transgenic Mouse Model of Alzheimer's Disease**. *Neuron*, 2010; 67 (5): 769-780 DOI: 10.1016/j.neuron.2010.08.018

http://www.sciencedaily.com/releases/2010/09/100908121917.htm

Molecular Gatekeeper of Arthritis Identified: Removal of Key Protein Leads to Initiation of Disease

ScienceDaily (Sep. 9, 2010) — Elimination of a molecular gatekeeper leads to the development of arthritis in mice, scientists report in a study published in *The Journal of Experimental Medicine*. The newly discovered gatekeeper is a protein that determines the fate -- survival or death -- of damaging cells that mistakenly attack the body's own tissues and lead to autoimmune disorders such as arthritis.

Better understanding how arthritis develops will offer scientists an opportunity to explore new types of treatments for patients whose arthritis has not been effectively treated with current therapies.

"This finding is an encouraging step forward for researchers, clinicians and arthritis sufferers, many of whom fail available therapies," said lead researcher Frances Lund, Ph.D., professor of Medicine in the Division of Allergy/Immunology and Rheumatology at the University of Rochester Medical Center. "An added bonus is that this finding may help in the search for new treatments for other autoimmune disorders, such as lupus."

The protein at the center of the new finding, known as $G_{\alpha q}$ (G alpha q), is part of a larger signaling pathway that Lund and collaborators from across the United States and China investigated in mice. $G_{\alpha q}$ regulates B cells, one type of immune cell that the body maintains to fight off invaders like bacteria, viruses and parasites. While most B cells help defend the body, some B cells are autoreactive -- they turn against the body's own tissues.

In mice, $G_{\alpha q}$ normally stops autoreactive B cells from building up in tissues by suppressing the pro-survival signaling pathway uncovered by Lund's team. When $G_{\alpha q}$ is eliminated, autoreactive B cells are able to pass through internal 'checkpoints' that typically get rid of these harmful cells, creating a buildup of the cells that contributes to the development of autoimmune disease.

Several new studies expanding on the current finding are in the works, including testing whether drug compounds that alter the expression or activity of $G_{\alpha q}$ in mice can slow the development of autoimmunity. Beyond preclinical testing in mice, researchers also hope to start screening $G_{\alpha q}$ levels in patients to learn more about how the protein works in humans.

According to Lund, "There is a subset of cardiac patients who, due to an inherited genetic mutation, have increased levels of $G_{\alpha q}$. We are now looking to see if some arthritis patients have mutations that favor decreased levels of $G_{\alpha q}$. If we find these patients, someday we may be able to design targeted, personalized therapy for this subpopulation of arthritis sufferers."

"In the past few decades, nearly all of the really important advances in rheumatology have started with basic studies like this one," said **Richard John Looney, M.D.,** a rheumatologist and professor of Medicine at the University of Rochester Medical Center. "I will be particularly interested in the translational studies that will be starting soon, as they may result in new applications such as assessing the risk someone may develop lupus or other autoimmune diseases."

Lund's research also led to the creation of a new mouse model of arthritis. By eliminating $G_{\alpha q}$, the disease just happens in mice, as opposed to previous mouse models which require injecting an antigen or foreign body, such as collagen, into mice to trigger an immune response. The new model more closely mirrors how autoimmunity starts and progresses in humans, and may be used in the future to test new drugs in development.

"Our goal is to move the knowledge we've gained from basic research to meaningful results that will ultimately help patients, and our main finding coupled with the creation of an improved mouse model puts us in a very strong position to do that," said Lund.

As with many discoveries, the new finding came about unexpectedly. Scientists in Lund's lab were looking at cell migration to try to identify the molecular signals that cause inflammation in tissues in $G_{\alpha q}$ knockout mice. They noticed that as they grew older, the mice's joints swelled and it appeared as though they were getting arthritis. Lund's team pursued the lead, which led to the discovery of the protein's role in the development of the disease and the creation of the new mouse model.

In addition to Lund, Ravi Misra, Ph.D., Betty Mousseau, Kim Kusser, and Troy Randall, Ph.D., from the University of Rochester Medical Center contributed to the research. Scientists from Sichuan University, China, the University of Washington, Seattle Children's Research Institute, the Trudeau Institute, the University of Massachusetts Medical School, and the University of California, San Diego, School of Medicine were also part of the research team. Biogen Idec and Human Genome Sciences provided biologic drugs that were used to test whether B cells in the $G_{\alpha q}$ deficient mice were responsible for causing arthritis in the mice.

The research was funded by the National Institute of Allergy and Infectious Disease at the National Institutes of Health and the University of Rochester Medical Center.

Story Source:

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

Journal Reference:

1. R. S. Misra, G. Shi, M. E. Moreno-Garcia, A. Thankappan, M. Tighe, B. Mousseau, K. Kusser, S. Becker-Herman, K. L. Hudkins, R. Dunn, M. R. Kehry, T.-S. Migone, A. Marshak-Rothstein, M. Simon, T. D. Randall, C. E. Alpers, D. Liggitt, D. J. Rawlings, F. E. Lund. **G q-containing G proteins regulate B cell selection and survival and are required to prevent B cell-dependent autoimmunity**. *Journal of Experimental Medicine*, 2010; 207 (8): 1775 DOI: 10.1084/jem.20092735

http://www.sciencedaily.com/releases/2010/09/100908121923.htm

How Insulin Stimulates Fat Cells to Take in Glucose

ScienceDaily (Sep. 9, 2010) — Using high-resolution microscopy, researchers at the National Institutes of Health have shown how insulin prompts fat cells to take in glucose in a rat model. The findings were reported in the Sept. 8 issue of the journal *Cell Metabolism*.

By studying the surface of healthy, live fat cells in rats, researchers were able to understand the process by which cells take in glucose. Next, they plan to observe the fat cells of people with varying degrees of insulin sensitivity, including insulin resistance-considered a precursor to type 2 diabetes. These observations may help identify the interval when someone becomes at risk for developing diabetes.

"What we're doing here is actually trying to understand how glucose transporter proteins called GLUT4 work in normal, insulin-sensitive cells," said Karin G. Stenkula, Ph.D., a researcher at the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) and a lead author of the paper. "With an understanding of how these transporters in fat cells respond to insulin, we could detect the differences between an insulin-sensitive cell and an insulin-resistant cell, to learn how the response becomes impaired. We hope to identify when a person becomes pre-diabetic, before they go on to develop diabetes."

Glucose, a simple sugar, provides energy for cell functions. After food is digested, glucose is released into the bloodstream. In response, the pancreas secretes insulin, which directs the muscle and fat cells to take in glucose. Cells obtain energy from glucose or convert it to fat for long-term storage.

Like a key fits into a lock, insulin binds to receptors on the cell's surface, causing GLUT4 molecules to come to the cell's surface. As their name implies, glucose transporter proteins act as vehicles to ferry glucose inside the cell.

To get detailed images of how GLUT4 is transported and moves through the cell membrane, the researchers used high-resolution imaging to observe GLUT4 that had been tagged with a fluorescent dye.

The researchers then observed fat cells suspended in a neutral liquid and later soaked the cells in an insulin solution, to determine the activity of GLUT4 in the absence of insulin and in its presence.

In the neutral liquid, the researchers found that individual molecules of GLUT4 as well as GLUT4 clusters were distributed across the cell membrane in equal numbers. Inside the cell, GLUT4 was contained in balloon-like structures known as vesicles. The vesicles transported GLUT4 to the cell membrane and merged with the membrane, a process known as fusion.

After fusion, the individual molecules of GLUT4 are the first to enter the cell membrane, moving at a continuous but relatively infrequent rate. The researchers termed this process fusion with release.

When exposed to insulin, however, the rate of total GLUT4 entry into the cell membrane peaked, quadrupling within three minutes. The researchers saw a dramatic rise in fusion with release -- 60 times more often on cells exposed to insulin than on cells not exposed to insulin.

After exposure to insulin, a complex sequence occurred, with GLUT4 shifting from clusters to individual GLUT4 molecules. Based on the total amount of glucose the cells took in, the researchers deduced that glucose was taken into the cell by individual GLUT4 molecules as well as by clustered GLUT4. The researchers also noted that after four minutes, entry of GLUT4 into the cell membrane started to decrease, dropping to levels observed in the neutral liquid in 10 to 15 minutes.

"The magnitude of this change shows just how important the regulation of this process is for the survival of the cell and for the normal function of the whole body," said Joshua Zimmerberg, Ph.D., M.D., the paper's senior author and director of the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) Program in Physical Biology.

The research team next plans to examine the activity of glucose transporters in human fat cells, Zimmerberg said. "Understanding how insulin prepares the cell for glucose uptake may lead to ideas for stimulating this activity when the cells become resistant to insulin."

Stenkula and Samuel W. Cushman, Ph.D., of NIDDK worked with NICHD investigators Vladimir A. Lizunov, Ph.D. and Zimmerberg to complete the research.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NIH/National Institute of Diabetes and Digestive and Kidney Diseases**.

Journal Reference:

1. Karin G. Stenkula, Vladimir A. Lizunov, Samuel W. Cushman, Joshua Zimmerberg. **Insulin Controls the Spatial Distribution of GLUT4 on the Cell Surface through Regulation of Its Postfusion Dispersal**. *Cell Metabolism*, 2010; 12 (3): 250-259 DOI: 10.1016/j.cmet.2010.08.005

http://www.sciencedaily.com/releases/2010/09/100908094916.htm

Reading Food Labels, Combined With Exercise, Can Lead to Weight Loss, Study Finds

ScienceDaily (Sep. 9, 2010) — Nutritional science and food marketing has become so sophisticated in recent decades that a trip to the supermarket can require a complete nutritional re-education. The average consumer needs to be on guard against preservatives, added fat, colorings, and calories, false advertising, and sophisticated but misleading labels.

Although guidelines for the information of food labels have gotten a bad rap in recent years, a new study published in the *Journal of Consumer Affairs* suggests that observing them may lead to weight loss, especially for women entering their middle years. The study was authored by Bidisha Mandal, PhD, an assistant professor at the School of Economic Sciences at Washington State University.Using information on whether consumers read food labels the first time they buy a product, the study's author found that people who observe the labels and do not exercise display a slightly greater likelihood of weight loss than those who do exercise but do not pay attention to food labels. By simply adding an exercise routine to their lifestyle regular food label readers can increase their changes of losing weight. Women between the ages of 37-50 years are more likely to read food labels than men, and are therefore more likely to lose weight, according to the study.

Previous research has focused on food marketing and behaviour but has not followed related weight loss over time in this middle-aged demographic group. The data for this study was taken from a National Longitudinal Survey of Youth compiled from 2002-2006. The survey began in 1979 with over 12,000 male and female participants born in the years 1957-1964.

Over fifty percent of participants reported that they were trying to lose or control weight. Of these participants, almost seventy percent were obese or overweight. Almost fifty percent were actively reading food labels on their first time purchase and slightly more than twenty-five percent were actively participating in vigorous exercise. Overall, older individuals are less likely to lose weight by reading food labels, and general participation in vigorous exercise drops off after age forty-five.Additionally, the Nutrition Labeling and Education Act (NLEA), enacted in 1994, requires all food manufactures to present essential nutrient and ingredient information on food packages. According to the recently-passed health care reform bill there will be easier access to nutritional information at restaurants, retail food establishments and vending machines. Combined with these new findings, it is likely that this measure will be useful to those who want to lose weight and read food labels to make well-informed decision regarding their diets in and outside their homes.

Weight loss programs and plans would do well in augmenting their client's weight loss goals with the recommended use of food labels, in order to maintain a healthy weight. This is particularly important as people enter middle age and are at a risk for heart disease, obesity-related diabetes, cancer and dementia.

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Wiley - Blackwell**, via AlphaGalileo.

Journal Reference:

1. Bidisha Mandal. **Use of Food Labels as a Weight Loss Behavior**. *Journal of Consumer Affairs*, 2010; DOI: 10.1111/j.1745-6606.2010.01181.x

http://www.sciencedaily.com/releases/2010/09/100908122040.htm

Micro-RNA Determines Malignancy of Lung Cancer

ScienceDaily (Sep. 9, 2010) — A small RNA molecule determines whether or not lung cancer cells grow invasively and metastasize. This has been discovered in the culture dish by scientists of the German Cancer Research Center and the University Medical Center Mannheim. Moreover, they found out that the following is true also for patients with non-small cell lung cancer: The less micro-RNA is produced by tumor cells, the higher the tumor's tendency to metastasize.

Cancer becomes life-threatening when tumor cells start leaving their primary site. They travel through the lymph and blood streams to other tissues where they grow into metastases. This transition to malignancy is associated with characteristic changes in the cancer cells. The activity of several genes is reprogrammed and, thus, the production of proteins anchoring cells to a tissue is reduced. On the other hand, the amount of surface markers which make a cancer cell mobile increases.

Professor Dr. Heike Allgayer heads a Clinical Cooperation Unit of DKFZ and UMM. She is an expert for those cellular processes that lead to metastasis in cancer. In recent years, scientists have discovered that production of many proteins is regulated by what are called micro-RNAs. These RNA molecules, which consist of only about 23 building blocks, attach specifically to messenger RNAs, which contain the blueprints for proteins. In this way, they block the production of the respective protein.

"We believe that micro-RNAs also play an important role in metastasis and that they program cells in a way that leads to malignant growth," medical researcher Heike Allgayer explains. In an international collaboration with researchers in Turin, Italy, Allgayer and her team used various cell lines of non-small cell lung cancer to investigate a particularly suspicious candidate called miR-200c and its role in malignant growth. The research team found out that the less miR-200c is produced by a cell line, the higher its motility and its capacity to invade surrounding tissue. When the researchers experimentally equipped the cancer cells with additional miR-200c, the amount of tissue-anchoring molecules on their surface increased and their invasive capacity became lower. In animal experiments, these cells produced less metastasis.

A dreaded characteristic of non-small cell lung cancer is its resistance to chemotherapy and targeted anticancer drugs. A lack of miR-200c also seems to play a role here. Therapy-resistant lung cancer cell lines that were experimentally equipped with miR-200c could subsequently be killed by the chemotherapy drug cisplatin and responded to cetuximab, a drug that block growth signals.

Allgayer's Team also discovered how the loss of miR-200c is brought about in cancer cells. In the highly aggressive cells, the miR-200c genes are turned off by chemical labeling with methyl groups. Drugs that remove these labels made the production of miR-200c rise again.

Studying the tumor cells of 69 lung cancer patients, the investigators realized that miR-200c not only plays a role in the culture dish. They determined miR-200c levels and compared these with the patients' disease progression data. The lower the miR-200c level in the cancer cells, the more frequently metastasis had already begun. "Our results clearly show a connection between a loss of miR-200c and transition to aggressive, invasive growth, metastasis and chemoresistance," Heike Allgayer summarizes. "Therefore, we will now investigate whether miR-200c production in cancer cells can be used for predicting metastasis and, thus, may serve as a prognosis factor for the progression of a lung cancer. It is also possible that the miR-200c level can help to better predict the effectiveness of particular drugs."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Helmholtz Association of German Research Centres**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. P. Ceppi, G. Mudduluru, R. Kumarswamy, I. Rapa, G. V. Scagliotti, M. Papotti, H. Allgayer. **Loss of miR-200c Expression Induces an Aggressive, Invasive, and Chemoresistant Phenotype in Non-Small Cell Lung Cancer**. *Molecular Cancer Research*, 2010; DOI: 10.1158/1541-7786.MCR-10-0052

http://www.sciencedaily.com/releases/2010/09/100908094912.htm

Decision-Making Deficits Related to Driving Under the Influence Are Often Undetected

ScienceDaily (Sep. 7, 2010) — Driving under the influence (DUI) of alcohol is a major public health problem. A study of people who had relapsed to DUI found subtle deficits in their decision-making abilities that tend to go undetected through conventional neuropsychological testing.

Results will be published in the December 2010 issue of *Alcoholism: Clinical & Experimental Research* and are currently available at Early View.

"Not only was DUI reported to account for nearly 40 percent of fatal motor crashes in North America," said Muzaffer Kasar, resident in psychiatry at the Bakirkoy Research and Training Hospital in Istanbul, Turkey, "33 percent of DUI individuals were recidivists. We wanted to address the underlying neurocognitive mechanisms of recidivism which we assumed might be related to alteration in decision-making cognition." Kasar is also the corresponding author for the study.

Both Kasar and David J. Nutt, a professor of psychiatry at Imperial College London, noted that decision-making cognition had not been investigated in DUI recidivists before this study.

Researchers assessed 34 male, second-time DUI offenders who had been selected for an official psychoeducational rehabilitation program, as well as 31 healthy non-offenders who were matched for age, education, and alcohol use. All participants were given psychiatric assessments, conventional neuropsychological testing, the Iowa Gambling Task (IGT), and the Temperament and Character Inventory (TCI) in order to assess personality patterns.

"First, we found that second-time DUI offenders have a poorer performance on the IGT test than their matched counterparts," said Kasar. "The IGT is used in many studies investigating decision-making cognition in problems related to alcohol. Deficits in many neuropsychological testing may not necessarily reflect daily living problems associated with alcohol abuse, as some of the abusers could perform fairly well in conventional neuropsychological testing. That's why problems related to neurocognitive impairments in real-life situations might be better detected by tests such as the IGT which simulate real-life decision-making situations -- which our results confirm."

The second finding was a lack of differences between the DUI recidivists and their counterparts using conventional neuropsychological testing and TCI scores. "These findings suggest that second-time DUI offenders do not suffer from motor impulsiveness, that is, a lack of impulse control in 'here and now' situations. Rather, they suffer from cognitive impulsiveness, which depends on associating negative experiences with possible negative consequences and related to a specific decision-making deficit."

In other words, said Nutt, "there are brain reasons for why people make poor choices regarding DUI."

"Perhaps our results will increase awareness about brain mechanisms implicated in alcohol-related behavior," said Kasar. "We found a deficit previously shown to be associated with dysfunctioning in particular brain circuits and this may help to change public awareness towards DUI recidivism. Our findings might also influence the framework of psychoeducational programs, and suggest that neurocognitive testing include decision-making tasks such as the IGT as a routine part of the evaluation process."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Alcoholism: Clinical & Experimental Research**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Muzaffer Kasar, Ezequiel Gleichgerrcht, Cahit Keskinkilic, Abdulkadir Tabo and Facundo F. Manes. **Decision-Making in People Who Relapsed to Driving Under the Influence of Alcohol**. *Alcoholism: Clinical & Experimental Research*, 7 SEP 2010 DOI: 10.1111/j.1530-0277.2010.01313.x

http://www.sciencedaily.com/releases/2010/09/100907163315.htm

Parents Report a Widely Prescribed Antibiotic Is Effective for Fragile X Treatment

ScienceDaily (Sep. 8, 2010) — One of the antibiotics most commonly prescribed to treat adolescent acne can increase attention spans and communication and decrease anxiety in patients with fragile X syndrome, the most common inherited cause of mental impairment, according to a new survey study that is the first published on parents' reports of their children's responses to treatment with the medication.

Led by researchers at the UC Davis MIND Institute, the study examined parents' observations of their children's responses to minocycline -- not the efficacy of treating patients with the drug. However, the researchers said that the study results are extremely promising. They led to a placebo-controlled clinical trial of treating people with fragile X with minocycline, funded by the National Fragile X Foundation.

"Minocycline Treatment in Patients with Fragile X Syndrome and Exploration of Outcome Measures" is published in the September 2010 issue of the *American Journal of Intellectual and Developmental Disabilities*. In the study, parents relate that after being treated for an average of three months, their children showed improvements in their use of language, attention levels and behavior, while experiencing mostly mild side effects.

"This preliminary survey demonstrated improvements in participants, however, a controlled clinical trial is needed to compare the efficacy of treating patients with minocycline to treatment with a placebo," said Randi Hagerman, Fragile X Endowed Chair, medical director of the UC Davis MIND Institute and one of the world's leading experts on fragile X syndrome.

Fragile X syndrome is a genetic disorder, the result of a defect on the X chromosome. It is estimated to affect 1 in 3,600 males and 1 in 4,000 females. One-third of all children with fragile X syndrome develop autism and approximately 5 percent of children with an autism-spectrum disorder have fragile X.

The condition causes a range of disabilities, from learning disorders to mild-to-severe intellectual impairment (mental retardation) and behavioral and emotional problems. It also is associated with certain physical characteristics, including prominent ears and flexible finger joints. The symptoms typically are more severe in boys than in girls.

Minocycline is one of the most commonly prescribed medications for adolescent acne and has been in use since its introduction in the 1960s. The drug also has been found to have neuroprotective qualities and in animal models improves neurodegenerative diseases like Parkinson's and Huntington's. Interest in its use in human patients with fragile X surged after a 2009 study found that minocycline improved cognition in mice genetically engineered to have fragile X. That study's senior author was Iryna M. Ethell of UC Riverside, who also is an author with Hagerman of the current research.

Ethell and her colleagues in 2009 found that minocycline lowers the levels of matrix metalloproteinase 9 (MMP9), an enzyme present in the normal brain whose levels and activity are over-expressed in the fragile X mouse. MMP9 inhibits development of structures called dendritic spines, tiny mushroom-like projections at the ends of synapses that allow neural cells to communicate. Lowering the amount and activity of MMP9 strengthens the dendritic spines and improves the establishment and maintenance of circuits in the brain.

"It's really exciting to see applications like this of our mouse-model research," Ethell said.

For the parent study, Hagerman prescribed minocycline to patients at the Fragile X Research and Treatment Center at the MIND Institute. Other participants were treated elsewhere by their primary-care physicians. The

study included a total of 53 patients, three of whom dropped out after a few days because of side effects. The remaining 50 participants, seven females and 43 males, took the drug for between two weeks and 20 months, with dosages of 25 to 200 milligrams per day. Participants ranged in age from 4 months to 25 years.

Fifty-four percent of the participants' parents said their children showed improvements in their use of language. Fifty percent said their children's attention spans improved. Forty-four percent said their children's social communication improved and 30 percent said their children's anxiety levels decreased. Most said their children experienced mild side effects, such as an upset stomach. Hagerman had wanted to learn whether the patients would experience the tooth discoloration common to individuals using tetracyclines. Reports of those side effects were minimal.

In anecdotal reports, parents said that after taking minocycline their children used more language, had clearer speech and were more understandable. Some said their children were "becoming more conversational, articulate and talkative," the study states. Parents also reported that their children were more focused and "had longer attention spans when playing, doing homework or participating in another activity."

The study findings prompted the National Fragile X Foundation to fund a two-year, $100,000 pilot study of the use of minocycline in people with fragile X. The study is examining the efficacy of using the antibiotic to treat children between the ages of 4 and 16.

"The National Fragile X Foundation is honored to be able to support a research project that has the potential to bring significant improvement, in a relatively short period of time, to individuals with fragile X syndrome," said Executive Director Robert Miller. "We know that families also are excited about this possibility. A goal of the National Fragile X Foundation is to move research forward that translates scientific breakthroughs into near-term treatments -- and this study has the potential to do just that."

The study was conducted in collaboration with lead author Agustini Utari, a fellow at the UC Davis MIND Institute from the Center for Biomedical Research, Diponegoro University, Indonesia, where the prevalence of fragile X syndrome appears to be high. Utari has returned to Indonesia, where she plans to conduct a minocycline study.

"I am very excited about the opportunity to bring a study of minocycline and fragile X to Indonesia," Utari said.

Other study authors include Weerasak Chonchaiya, Susan M. Rivera and Andrea Schneider of the UC Davis MIND Institute; Sultana M.H. Faradz of the Center for Biomedical Research, Diponegoro University, Indonesia; and Danh V. Nguyen, Department of Public Health Sciences, UC Davis.

The study was funded by grants from the U.S. National Center for Research Resources, National Institutes of Health and the Health and Human Services Administration of Developmental Disabilities and the National Fragile X Foundation. Funding also was received from the Center for Biomedical Research, Diponegoro University and the Bureau of Foreign Planning and Cooperation, Ministry of National Education, Republic of Indonesia.

Story Source:

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

Journal Reference:

1. Agustini Utari, Weerasak Chonchaiya, Susan M. Rivera, Andrea Schneider, Randi J. Hagerman, Sultana M. H. Faradz, Iryna M. Ethell, and Danh V. Nguyen. **Side Effects of Minocycline Treatment in Patients With Fragile X Syndrome and Exploration of Outcome Measures**. *American Journal of Intellectual and Developmental Disabilities*, 2010; 115 (5): 433-443 DOI: 10.1352/1944-7558-115.5.433

http://www.sciencedaily.com/releases/2010/09/100908160352.htm

Potential New Drug for Neurodegenerative Disease Identified

ScienceDaily (Sep. 9, 2010) — Scientists have discovered a small molecule that helps human cells get rid of the misfolded, disfigured proteins implicated in Alzheimer[1]s disease and other neurodegenerative ailments. This potential drug could have applications for other conditions as well.

Cells create and discard proteins continuously, a process that relies on a balance between the speed with which new proteins are created and damaged ones destroyed. Protein destruction occurs through a sophisticated system that marks proteins for disposal by tagging them with a small molecule called ubiquitin. Ubiquitin latches onto these proteins, often forming long chains. The cell[1]s protein waste-disposal system, the proteasome, recognizes these ubiquitinated proteins and breaks them down.

If that finely tuned system malfunctions, damaged or misfolded proteins begin to accumulate in the cell and may become toxic. A number of ailments, including Parkinson[1]s, CreutzfeldtJakob and Alzheimer[1]s have been linked to this build up of misfolded proteins.

To better understand just what causes this malfunction, a research team led by Harvard Medical School researchers Daniel Finley, professor of cell biology, and Randall King, associate professor of cell biology, zeroed in on an enzyme called Usp14. They found that, when activated, Usp14 disassembles the ubiquitin chain, slowing down the proteasome[1]s ability to rid the cell of bad proteins. As a result, the cell makes new proteins faster than it rids itself of the old ones, leading to a build-up of misfolded proteins.

The researchers wanted to see if they could find a molecule that inhibited Usp14, thus allowing the proteosome to work effectively. To identify such a selective inhibitor, Byung-Hoon Lee, a postdoctoral researcher, developed a special screening assay with assistance from the Institute of Chemistry and Cell Biology-Longwood Screening Facility at HMS. Lee screened 63,000 compounds, looking for molecules that inhibited only Usp14 and could easily infiltrate the cell. The strongest candidate was a small molecule they named IU1.

Experimenting in both human and mouse cell cultures, Min Jae Lee, also a postdoctoral researcher, and his coworkers found that IU1 inhibited Usp14 and allowed the proteasome to dispose of proteins more quickly. In other words, adding IU1 to cells boosted proteasome activity.

Though scientists are still investigating just how IU1 works, it appears that the molecule suppresses Usp14[1]s ability to trim the ubiquitin chain.

In addition to discovering IU1, this research has also shed light on an aspect of proteasome function that was not previously understood, King says. Scientists had thought that the proteasome was not involved in regulating the speed of protein degradation, but that other proteins work with ubiquitin to modulate the process. [3]Our work suggests that there is another level of control where the rate at which the proteasome can degrade these ubiquinated proteins is also controlled,[2] King says. [3]It looks like there are multiple control steps along the way in this pathway.[2]

As scientists learn more about the link between misfolded proteins and human disease, interest in the proteasome has increased. While much of that focus has been on ways to inhibit proteasome function, there may be an advantage to developing a drug that boosts proteasome activity rather than hinders it, Finley speculates.

³If you take a typical cell growing in culture and kill its Usp14 activity, the cell will continue to thrive,² he says. ³If you kill its proteasome activity, it would immediately die.²

This research could have far-reaching implications for the development of drugs to treat not only neurodegenerative diseases, but also other illnesses that have been linked to an accumulation of misfolded proteins, King says.

For example, when a cell suffers oxidative damage‹say from a stroke or heart attack‹proteins may fold improperly and be marked for degradation by the ubiquitin system. If the proteasome becomes overwhelmed, misfolded proteins could accumulate in the cell, triggering a cascade of problems. In this latest study, researchers induced protein oxidation in cells and then treated them with IU1, which resulted in rapid elimination of the oxidized proteins. At the same time, the ability of cells to survive oxidative insult was enhanced.

Patents are pending for IU1 and the assay used to identify the molecule.

This research was funded by the National Institutes of Health, Harvard Technology Development Accelerator Fund, Merck & Co., and Johnson & Johnson.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Harvard Medical School**, via EurekAlert!, a service of AAAS. The original article was written by Kelli Whitlock Burton.

Journal Reference:

1. Lee et al. **Enhancement of proteasome activity by a small-molecule inhibitor of USP14**. *Nature*, 2010; 467 (7312): 179 DOI: 10.1038/nature09299

http://www.sciencedaily.com/releases/2010/09/100908132216.htm

Personality Predicts Cheating More Than Academic Struggles, Study Shows

ScienceDaily (Sep. 8, 2010) — Students who cheat in high school and college are highly likely to fit the profile for subclinical psychopathy -- a personality disorder defined by erratic lifestyle, manipulation, callousness and antisocial tendencies, according to research published by the American Psychological Association. These problematic students cheat because they feel entitled and disregard morality, the study found.

Cheating, a perennial concern for educators, "has been facilitated by new technologies," said Delroy Paulhus, PhD, who led the research. "At the same time, cheating may seem more apparent because we can more effectively detect it." Because it's hard or even dangerous to try to reform a psychopathic person, he recommends blocking cheating using other means.

College students who admitted to cheating in high school or turned in plagiarized papers ranked high on personality tests of the so-called Dark Triad: psychopathy, Machiavellianism (cynicism, amorality, manipulativeness), and narcissism (arrogance and self-centeredness, with a strong sense of entitlement). Of the three dark personality types, psychopathy was most strongly linked to cheating. These findings appear in the September *Journal of Experimental Psychology: Applied*.

Students were spurred to cheat by two motivations, the research found: First, they sought to get the grades to which they felt entitled; second, they either didn't think cheating was wrong or didn't care.

The first of three studies at the University of British Columbia surveyed 249 second-year college students who, without having to share their identities, filled out take-home personality tests that looked at the Dark Triad and psychology's "Big Five" core traits of extraversion, agreeableness, conscientiousness, stability and openness.

Also anonymously, students were asked whether they had cheated on high-school tests or handed in essays copied from someone else. (Questions specifically referred to high school to allay concerns about admitting to cheating at the university.)

Each of the Dark Triad variables went hand in hand with cheating at a high level of statistical significance. The more likely students were to have cheated, the higher they ranked on the psychopathy scale, followed by Machiavellianism and narcissism.

Students who were more conscientious and agreeable were significantly less likely to have cheated. Those low in conscientiousness were probably more likely to cheat because they were less prepared and more desperate, the authors wrote, adding that disagreeable students would by definition be less cooperative. However, the predictive power of those two core traits paled next to those of the Dark Triad.

A second study measured actual, not self-reported, cheating by analyzing two of each student's term papers -- one summarizing a research topic and one summarizing a personal experience. The students, who took the same personality tests, were warned that their papers would be scrutinized by an online service that calibrates how much of a paper directly matches sources in a database. Plagiarism was flagged when any string of seven words or more directly matched a published source or another finished paper.

Of the 114 students studied, 16 plagiarized on at least one essay. Again, the Dark Triad and plagiarism were closely and significantly linked, with psychopathy leading the pack. Although for the essay, poor verbal skills were also tied to cheating, the association with psychopathy was tighter still.

With both the self-report and the plagiarism screen detecting cheating, the authors concluded that personality profiling can help predict cheating.

Finally, a third study examined why students cheat. A total of 223 college students went online to take personality tests and rate themselves on a Self-Report Cheating Scale that included items tapping motivation, such as "I needed to get (or keep) a scholarship," or "I'm not concerned about punishment if caught."

Analysis unearthed subgroups of students who felt that cheating was an appropriate strategy for reaching their ambitious goals, who were not afraid of punishment, or who were not morally inhibited. Psychopathy was significantly linked with all three motivations.

"Incentives such as high grades and scholarships seem to activate dishonesty in these individuals," the authors wrote. "The achievement goals shared by most college students trigger cheating in psychopaths alone." Making it worse, moral deterrents don't matter to psychopaths, who scoff at social norms.

The authors caution that subclinical psychopaths are unlikely to exhibit the extreme behaviors of criminal psychopaths. Even with subclinical levels, however, it's nearly impossible and potentially dangerous to intervene with psychopaths. To foil the natural cheaters, the authors recommend that teachers use different forms of the same test, ban cell phones and other electronics, use random or assigned seats, ask for essays about personal experiences (which are not easily duplicated), and use plagiarism screening software.

To a lesser extent, educators can expect that students who aren't well prepared are also more likely to cheat. The authors suggest that making a classroom less competitive could avoid tempting the weaker students.

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

Journal Reference:

1. Kevin M. Williams, PhD, Craig Nathanson, PhD, and Delroy L. Paulhus, PhD. **Identifying and Profiling Scholastic Cheaters: Their Personality, Cognitive Ability, and Motivation**. *Journal of Experimental Psychology: Applied*, Vol. 16, No. 3 DOI: 10.1037/a0020773

http://www.sciencedaily.com/releases/2010/09/100907163523.htm

Compounds in Non-Stick Cookware May Be Associated With Elevated Cholesterol in Children and Teens

ScienceDaily (Sep. 7, 2010) — Children and teens with higher blood levels of chemicals used in the production of non-stick cookware and waterproof fabrics appear more likely to have elevated total and LDL cholesterol levels, according to a report in the September issue of *Archives of Pediatrics & Adolescent Medicine*, one of the JAMA/Archives journals.

Humans are exposed to the man-made compounds known as perfluoroalkyl acids -- including perfluorooctanoic acid (PFOA) and perfluorooctanesulfonate (PFOS) -- through drinking water, dust, food packaging, breast milk, cord blood, microwave popcorn, air and occupational exposure, according to background information in the article. Recent national survey results reported detection of PFOA and PFOS in almost all samples of human serum. Perfluoroalkyl acids are used during the manufacture of fluoropolymers, which give non-stick heat resistance to cookware and breathable, waterproof properties to fabrics and upholstery. PFOA and PFOS may also result from the breakdown of compounds used as coating for commercial food packaging, factory treatments for fabrics and carpets and manufacturer pretreatment for stain-resistant clothing.

Animal studies have identified the liver as the primary organ affected by perfluoroalkyl acid exposure, with potential effects in human including alterations in cholesterol levels. Stephanie J. Frisbee, M.Sc., M.A., of West Virginia University School of Medicine, Morgantown, and colleagues assessed serum lipid levels in 12,476 children and adolescents (average age 11.1) included in the C8 Health Project, which resulted from the settlement of a class-action lawsuit regarding PFOA contamination of the drinking water supply in the mid-Ohio River Valley.

After enrolling in 2005 or 2006, the children and teens submitted blood samples; their average PFOA concentration was 69.2 nanograms per milliliter and average PFOS concentration was 22.7 nanograms per milliliter. Among 12- to 19-year old participants, PFOA concentrations were higher than those detected in a nationally representative survey (29.3 nanograms per milliliter vs. 3.9 nanograms per milliliter), but PFOS concentrations were similar (19.1 nanograms per milliliter vs. 19.3 nanograms per milliliter).

After adjusting for related variables, higher PFOA levels were associated with increased total cholesterol and LDL or "bad" cholesterol, and PFOS was associated with increased total cholesterol, LDL cholesterol and HDL or "good" cholesterol. There was no association between either compound and triglyceride levels.

On average, the one-fifth of children and teens with the highest PFOA levels had total cholesterol levels 4.6 milligrams per deciliter higher and LDL cholesterol levels 3.8 milligrams per deciliter higher than the one-fifth with the lowest PFOA levels. In addition, there was an average difference of 8.5 milligrams per deciliter in total cholesterol levels and 5.8 milligrams per deciliter in LDL cholesterol levels between the one-fifth of participants with the highest and lowest PFOS levels.

"The non-linear nature of the observed associations, particularly for PFOA, suggests a possible saturation point in an underlying physiologic mechanism," the authors write. "PFOA and PFOS specifically, and possibly perfluoroalkyl acids as a general class, appear to be associated with serum lipids, and the association seems to exist at levels of PFOA and PFOS exposure that are in the range characterized by nationally representative studies."

Although the design of the study limits cause-and-effect interpretations, the results suggest the association between PFOA and PFOS and elevated cholesterol levels warrant further study, the authors note. "Should the

association prove to be etiologic, the cumulative effects of such an elevation in cholesterol on long-term cardiovascular health are unclear given the early age at which these associations were observed."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **JAMA and Archives Journals**.

Journal Reference:

1. Frisbee et al. **Perfluorooctanoic Acid, Perfluorooctanesulfonate, and Serum Lipids in Children and Adolescents: Results From the C8 Health Project**. *Archives of Pediatrics and Adolescent Medicine*, 2010; 164 (9): 860 DOI: 10.1001/archpediatrics.2010.163

http://www.sciencedaily.com/releases/2010/09/100906203040.htm

Insight Offered Into Superstitious Behavior

ScienceDaily (Sep. 2, 2010) — People who believe that fate and chance control their lives are more likely to be superstitious -- but when faced with death they are likely to abandon superstition altogether, according to a recent Kansas State University undergraduate research project.

The project, led by Scott Fluke, a May 2010 K-State bachelor's graduate in psychology, Olathe, focuses on personality traits that lead to superstition. Fluke received a $500 Doreen Shanteau Undergraduate Research Fellowship in 2009 to work with the team of Russell Webster, graduate student in psychology, Shorewood, Ill., and Donald Saucier, K-State associate professor of psychology.

For the project, "Re-Examining the Form and Function of Superstition," the team defined superstition as the belief in a casual relationship between an action, object, or ritual and an unrelated outcome. Such superstitious behavior can include actions like wearing a lucky jersey or using good luck charms.

After performing two studies, the researchers developed three reasons for superstitious behavior: individuals use superstitions to gain control over uncertainty; to decrease feelings of helplessness; and because it is easier to rely on superstition instead of coping strategies.

"People sometimes fall back on their superstitions as a handicap," Saucier said. "It's a parachute they think will help them out."

In the first study, the researchers conducted questionnaires with 200 undergraduates, asking about how pessimistic they were, whether they believed in chance or fate, if they liked to be in control and other questions. One of the major discoveries was that people who believe that chance and fate control their lives are more likely to be superstitious.

In the second study the researchers wanted to know how participants reacted to death, and asked them to write about how they felt about their own death. The team was surprised to find that participants' levels of superstition went down when they thought about their own death, which the researchers attributed to death being a situation of extreme uncertainty.

"We theorized that when people thought about death, they would behave more superstitiously in an effort to gain a sense of control over it," Fluke said. "What we didn't expect was that thinking about death would make people feel helpless -- like they cannot control it -- and that this would actually reduce their superstitious belief."

Fluke got the idea for his research in an undergraduate methods research course his first semester at K-State, when he realized there were many unanswered questions about psychology and superstition. He decided to pursue the topic further as a research project.

"I was interested in superstition because it frustrates me when people do things that don't make sense," Fluke said. "It boggled me that people would use a good luck charm to do well on a test rather than studying for it. We wanted to know why people would go about almost actively hurting themselves."

The research is part of Saucier's overall research program, and the team is now preparing results of their study for publication.

Saucier offers some tips to avoid superstitious behavior:

- Don't believe in bad luck and take some ownership over what control you do have in situations. Sometimes we use bad luck to let ourselves off the hook, Saucier said, but we should instead focus on what we can do to avoid difficult situations in the first place.
- Be decisive and proactive.People who are less decisive believe in superstition more, Saucier said, and those who are proactive are less superstitious.
- Don't be in a situation where you have to rely on bad luck.Bad luck would never occur if only good things happened. If something bad happens and you call it bad luck, do it as a coping mechanism after the fact rather than before the event, Saucier said.

Story Source:

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

http://www.sciencedaily.com/releases/2010/09/100902131736.htm

Great apes protected as EU restricts animal testing

By Pete HarrisonPosted 2010/09/09 at 9:41 am EDT

BRUSSELS, Sep. 9, 2010 (Reuters) — Primates, including mankind's closest relatives -- chimpanzees, gorillas, bonobos and orangutans -- have gained new protection after the European Parliament backed a clampdown on animal testing.

A young mountain gorilla from the Kabirizi family sits in Virunga National Park, just north of the eastern Congolese city of Goma, August 19, 2010. REUTERS/Finbarr O'Reilly

"The use of non-human primates should be permitted only in those biomedical areas essential for the benefit of human beings, for which no other alternative replacement methods are yet available," a new EU law said.

The strongest protection was given to the "great apes," although sustained public pressure has already ensured none have been used in European Union research in eight years.

Less stringent measures were brought in to protect the 12,000 other smaller primates, such as macaques, used in EU labs each year.

The revision of the 25-year-old rules had originally envisaged a more complete ban on primate research, but were heavily contested and lobbied by industry.

Researchers argued primates were indispensable for work to find cures for diseases including HIV, Alzheimer's Disease, cancer, hepatitis, malaria, multiple sclerosis and tuberculosis.

In theory, great apes can be used in such research, but in practice license applications face rigorous EU scrutiny.

Researchers said a fair balance had been found.

"Today's agreement should bring direct and tangible animal welfare benefits and allow essential medical research to continue in Europe to deliver the new and innovative treatments," said drug industry group EFPIA.

Some 12 million vertebrate animals are used each year in experiments throughout the 27-nation EU -- half for drug development and testing, a third for biology studies and the rest for cosmetics tests, toxicology and disease diagnosis.

Around 80 percent are mice and rats and primates account for around a tenth of 1 percent or about 12,000 animals.

Researchers will have to keep files on the history of each individual primate, dog or cat to ensure their welfare needs are met. They will also be obliged to use alternatives to animal testing whenever they are available.

Government authorities will be required to perform inspections on laboratories, some of them snap checks.

Animal rights campaigners gave the rules a mixed welcome, saying they represented business as usual for laboratories in Germany and Britain, but might lead to improvements in eastern Europe.

"This directive also sends a challenge to other countries such as the United States where chimps are still used in significant numbers," said campaigner Wendy Higgins of the Humane Society International.

(Reporting by Pete Harrison)

http://www.newsdaily.com/stories/tre6873ms-us-eu-primates-ban/#

Fears of a Decline in Bee Pollination Confirmed

A recent study provides the first long-term evidence of a downward trend in pollination. (Credit: iStockphoto)

ScienceDaily (Sep. 7, 2010) — Widespread reports of a decline in the population of bees and other flower-visiting animals have aroused fear and speculation that pollination is also likely on the decline. A recent University of Toronto study provides the first long-term evidence of a downward trend in pollination, while also pointing to climate change as a possible contributor.

"Bee numbers may have declined at our research site, but we suspect that a climate-driven mismatch between the times when flowers open and when bees emerge from hibernation is a more important factor," says James Thomson, a scientist with U of T's Department of Ecology and Evolutionary Biology.

Thomson's 17-year examination of the wild lily in the Rocky Mountains of Colorado is one of the longest-term studies of pollination ever done. It reveals a progressive decline in pollination over the years, with particularly noteworthy pollination deficits early in the season. The study will be published in *Philosophical Transactions of the Royal Society B: Biological Sciences* on September 6.

Three times each year, Thomson compared the fruiting rate of unmanipulated flowers to that of flowers that are supplementally pollinated by hand. "Early in the year, when bumble bee queens are still hibernating, the fruiting rates are especially low," he says. "This is sobering because it suggests that pollination is vulnerable even in a relatively pristine environment that is free of pesticides and human disturbance but still subject to climate change."

Thomson began his long-term studies in the late 1980s after purchasing a remote plot of land and building a log cabin in the middle of a meadow full of glacier lilies. His work has been supported by the U.S. National Science Foundation and the Natural Sciences and Engineering Research Council of Canada.

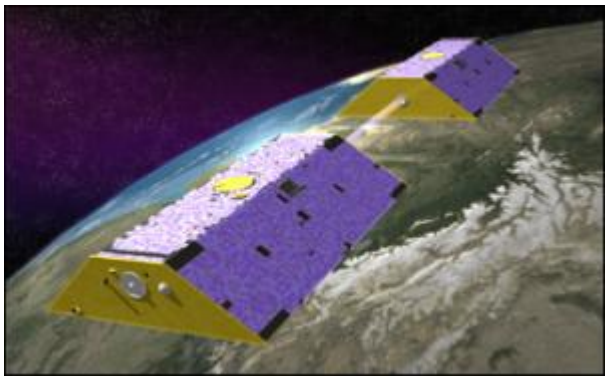
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Toronto**.

Journal Reference:

1. James D. Thomson. **Flowering phenology, fruiting success and progressive deterioration of pollination in an early-flowering geophyte**. *Philosophical Transactions of The Royal Society B Biological Sciences*, 2010; 365 (1555): 3187 DOI: 10.1098/rstb.2010.0115

http://www.sciencedaily.com/releases/2010/09/100905231237.htm

Melting Rate of Icecaps in Greenland and Western Antarctica Lower Than Expected



This artist's concept shows GRACE's twin satellites, which orbit Earth in a back-to-back manner and change positions in response to variations in Earth's gravity field. The GRACE satellites house microwave ranging systems that measure the change in the distance between the satellites over time, enabling them to essentially "weigh" the changes in glaciers. (Credit: NASA)

ScienceDaily (Sep. 7, 2010) — The Greenland and West Antarctic ice caps are melting at half the speed previously predicted, according to analysis of recent satellite data.

The finding is the result of research by a joint US/Dutch team from the Jet Propulsion Laboratory, Delft University of Technology (TU Delft, The Netherlands) and SRON Netherlands Institute for Space Research. The scientists have published their work in the September issue of *Nature Geoscience*.

GRACE

The melting of the ice caps has been charted since 2002 using the measurements produced by the two GRACE satellites. From space they detect small changes in the Earth's gravitational field. These changes are related to the exact distribution of mass on Earth, including ice and water. When ice melts and lands in the sea, this therefore has an effect on the gravitational field.

Gigatonnes

Based on this principle, previous estimates for the Greenland ice cap calculated that the ice was melting at a rate of 230 gigatonnes a year (i.e. 230,000 billion kg). That would result in an average rise in global sea levels of around 0.75 mm a year. For West Antarctica, the estimate was 132 gigatonnes a year. However, it now turns out that these results were not properly corrected for glacial isostatic adjustment, the phenomenon that the Earth's crust rebounds as a result of the melting of the massive ice caps from the last major Ice Age around 20,000 years ago. These movements of the Earth's crust have to be incorporated in the calculations, since these vertical movements change the Earth's mass distribution and therefore also have an influence on the gravitational field.

GPS

Researchers from the Jet Propulsion Laboratory in Pasadena (US), TU Delft and SRON Netherlands Institute for Space Research have now succeeded in carrying out that correction far more accurately. They did so using

combined data from the GRACE mission, GPS measurements on land and sea floor pressure measurements. These reveal that the sea floor under Greenland is falling more rapidly than was first thought.

One of the researchers, Dr Bert Vermeersen of TU Delft, explains: "The corrections for deformations of the Earth's crust have a considerable effect on the amount of ice that is estimated to be melting each year. We have concluded that the Greenland and West Antarctica ice caps are melting at approximately half the speed originally predicted." The average rise in sea levels as a result of the melting ice caps is also lower.

Model

"The innovative aspect of our method is that we simultaneously matched the current changes in the ice mass and glacial isostatic adjustment to the observations, instead of assuming that a particular glacial isostatic adjustment model is correct," says Dr Vermeersen. "For Greenland in particular, we have found a glacial isostatic adjustment model that deviates rather sharply from general assumptions. But at present there are too few data available to verify this independently. A more extensive network of GPS readings in combination with geological indicators for the local and regional changes in sea level changes around Greenland over the last 10,000 years, will possibly be able to provide conclusive evidence on this matter in the years to come."

Story Source:

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

Journal References:

1. Xiaoping Wu, Michael B. Heflin, Hugo Schotman, Bert L. A. Vermeersen, Danan Dong, Richard S. Gross, Erik R. Ivins, Angelyn W. Moore, Susan E. Owen. **Simultaneous estimation of global present-day water transport and glacial isostatic adjustment**. *Nature Geoscience*, 2010; 3 (9): 642 DOI: 10.1038/ngeo938
2. David H. Bromwich, Julien P. Nicolas. **Sea-level rise: Ice-sheet uncertainty**. *Nature Geoscience*, 2010; 3 (9): 596 DOI: 10.1038/ngeo946

http://www.sciencedaily.com/releases/2010/09/100906085152.htm

'Conan the Bacterium' Reveals Its Recipe for Success

Long-sought chemical antioxidants in the world's toughest microbe has now been discovered. (Credit: Image courtesy of Uniformed Services University of the Health Sciences (USU))

ScienceDaily (Sep. 7, 2010) — Researchers report the discovery of long-sought chemical antioxidants in the world's toughest microbe -- *Deinococcus radiodurans*. First studied nearly 50 years ago, this bacterium can survive massive exposures to gamma-radiation, ultraviolet radiation, desiccation, and other agents which kill cells by generating reactive oxygen species (ROS).

The study, headed by Michael J. Daly, Ph.D., professor at the Uniformed Services University of the Health Sciences (USU) Department of Pathology, appears in the September 3 edition of *PLoS ONE*.

Daly's team previously reported that *D. radiodurans* accomplishes its astonishing survival feats in an unexpected way -- by protecting its proteins from oxidation. This spares DNA repair enzymes from radiation damage and allows the cells to reassemble their broken genomes with extraordinary efficiency. The current study identifies divalent manganese-complexes in *D. radiodurans* cell extracts, which protect purified proteins, and Escherichia coli and human cells from extreme cellular insults caused by ionizing radiation. When bombarded by gamma-rays, *D. radiodurans* appears to salvage breakdown products of protein and DNA, endowing mixtures of peptides and orthophosphate with potent ROS-scavenging activities when combined with Mn(II).

When reconstituted, the Mn-complexes were immensely protective of irradiated enzymes, preserving their structure and function, but they did not protect DNA significantly. Prospectively, *D. radiodurans* has presented the scientific community with a novel and highly defensive chemical strategy to combat oxidative stress in diverse settings, including bioremediation of radioactive waste, preparation of irradiated vaccines, long-term protein storage, against ultraviolet rays during sunbathing, during radiotherapy and as we age.

The three-year project was a collaboration between Daly's group at USU, a team led by Dr. Rodney L. Levine, chief of the laboratory of biochemistry at the National Heart, Lung, and Blood Institute (NHLBI) at the National Institutes of Health and Drs. Juliann G. Kiang and Risaku Fukumoto at the Armed Forces

Radiobiology Research Institute (AFRRI) in Bethesda, Md. Funding was by the Air Force Office of Scientific Research (AFOSR) and the intramural programs of the NHLBI and AFRRI.

The USU, located in Bethesda, Maryland, on the grounds of the National Naval Medical Center, is a traditional U.S. academic health center with a unique emphasis on educating the next generation of health care providers and researchers in military medicine, tropical diseases, humanitarian assistance, as well as responses to disasters and other public health emergencies. USU's nationally ranked military and civilian faculty conduct cutting edge research in the biomedical sciences and in areas specific to the DoD health care mission.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Uniformed Services University of the Health Sciences (USU)**, via Newswise.

Journal Reference:

1. Michael J. Daly, Elena K. Gaidamakova, Vera Y. Matrosova, Juliann G. Kiang, Risaku Fukumoto, Duck-Yeon Lee, Nancy B. Wehr, Gabriela A. Viteri, Barbara S. Berlett, Rodney L. Levine, Michael Otto. **Small-Molecule Antioxidant Proteome-Shields in Deinococcus radiodurans**. *PLoS ONE*, 2010; 5 (9): e12570 DOI: 10.1371/journal.pone.0012570

http://www.sciencedaily.com/releases/2010/09/100906142136.htm

Colorful Mix of Asteroids Discovered, May Aid Future Space Travel

This image, taken by NASA's Near Earth Asteroid Rendezvous mission in 2000, shows a close-up view of Eros, an asteroid with an orbit that takes it somewhat close to Earth. NASA's Spitzer Space Telescope observed Eros and dozens of other near-Earth asteroids as part of an ongoing survey to study their sizes and compositions using infrared light. (Credit: NASA/JHUAPL)

ScienceDaily (Sep. 7, 2010) — New research from NASA's Spitzer Space Telescope reveals that asteroids somewhat near Earth, termed near-Earth objects, are a mixed bunch, with a surprisingly wide array of compositions.

Like the chocolates and fruity candies inside a piñata, these asteroids come in assorted colors and compositions. Some are dark and dull; others are shiny and bright. The Spitzer observations of 100 known near-Earth asteroids demonstrate that their diversity is greater than previously thought.

The findings are helping astronomers better understand near-Earth objects as a whole -- a population whose physical properties are not well known.

"These rocks are teaching us about the places they come from," said David Trilling, assistant professor of physics and astronomy at Northern Arizona University, and lead author of a new paper on the research appearing in the September issue of *Astronomical Journal*. "It's like studying pebbles in a streambed to learn about the mountains they tumbled down."

One of the mission's programs is to survey about 700 near-Earth objects, cataloguing their individual traits. By observing in infrared, Spitzer is helping to gather more accurate estimates of asteroids' compositions and sizes than what is possible with visible-light alone.

Trilling and his team have analyzed preliminary data on 100 near-Earth asteroids so far. They plan to observe 600 more over the next year. There are roughly 7,000 known near-Earth objects out of a population expected to number in the tens to hundreds of thousands.

"Very little is known about the physical characteristics of the near-Earth population," Trilling said. "Our data will tell us more about the population, and how it changes from one object to the next. This information could be used to help plan possible future space missions to study a near-Earth object."

The data show that some of the smaller objects have surprisingly high albedos (a measurement of how much sunlight an object reflects). Since asteroid surfaces become darker with time due to exposure to solar radiation, the presence of lighter, shinier surfaces for some asteroids may indicate that they are relatively young. This is evidence for the continuing evolution of the near-Earth object population.

In addition, the asteroids observed so far have a greater degree of diversity than expected, indicating that they might have different origins. Some might come from the main belt between Mars and Jupiter, and others could come from farther out in the solar system. This diversity also suggests that the materials that went into creating the asteroids -- the same materials that make up our planets -- were probably mixed together like a big solar-system soup very early on in its history.

The research complements that of NASA's Wide-field Infrared Survey Explorer, or WISE, an all-sky infrared survey mission up in space now. WISE has already observed more than 430 near-Earth objects. Of these, more than 110 are newly discovered.

In the future, both Spitzer and WISE will reveal even more about the "flavors" of near-Earth objects. This could reveal new clues about how the cosmic objects might have dotted our young planet with water and organics -- ingredients needed to jump-start life.

Other authors include Cristina Thomas, a post-doctoral scholar of physics and astronomy at NAU, and researchers from around the world.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Northern Arizona University**, via Newswise.

Journal Reference:

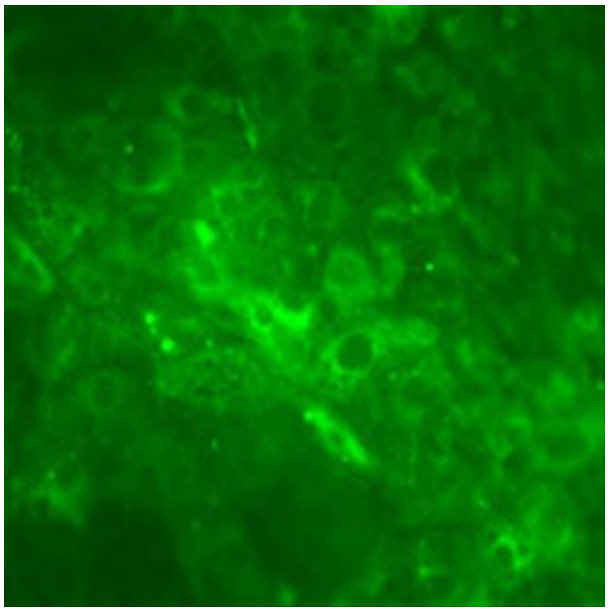
1. D. E. Trilling, M. Mueller, J. L. Hora, A. W. Harris, B. Bhattacharya, W. F. Bottke, S. Chesley, M. Delbo, J. P. Emery, G. Fazio, A. Mainzer, B. Penprase, H. A. Smith, T. B. Spahr, J. A. Stansberry, C. A. Thomas. **Exploreneos. I. Description and First Results from the Warmspitzernear-Earth Object Survey**. *The Astronomical Journal*, 2010; 140 (3): 770 DOI: 10.1088/0004-6256/140/3/770

http://www.sciencedaily.com/releases/2010/09/100906142753.htm

Scientists create liver cells from patients' skin

By Kate KellandPosted 2010/08/25 at 4:29 pm EDT

LONDON, Aug. 25, 2010 (Reuters) — Scientists have created liver cells in a lab for the first time using reprogrammed cells from human skin, paving the way for the potential development of new treatments for liver diseases that kill thousands each year.



Diseased liver cells in an image courtesy of the University of Cambridge. REUTERS/Dr Tamir Rashid

Cambridge University scientists who reported their results in the Journal of Clinical Investigation on Wednesday, said they also found a way of avoiding the kind of intense political and ethical rows over embryonic stem cells which are currently hampering work in the United States.

"This technology bypasses the need for using human embryos," said Tamir Rashid of Cambridge's laboratory for regenerative medicine, who led the study. "The cells we created were just as good as if we had used embryonic stem cells."

Embryonic stem cells are seen as the most powerful and malleable type of cells but are controversial because they are harvested from human embryos when they are just a few days old.

Liver disease is the fifth largest cause of death in developed nations after cardiovascular, cancer, stroke, and respiratory diseases. In the United States, it accounts for around 25,000 deaths a year, and experts say that in Britain liver disease death rates among young and middle-aged people are increasing at a rate of 8 to 10 percent a year.

Rashid said that despite 40 years of trying, scientists have so far never been able to grow liver cells in a lab, making research into liver disorders extremely difficult.

Given a shortage of donor liver organs, alternatives are urgently needed, he added. This study increases the likelihood that alternatives can be found, either by developing new drugs or by using cell-based therapy -- when cells from patients with genetic diseases are "cured" and transplanted back.

Liver diseases can be either inherited, or caused by alcohol abuse or infections such as hepatitis.

STEM CELLS

For their study, Rashid's team took skin samples from seven patients who were suffering from a variety of inherited liver diseases, and three from healthy people to act as comparisons.

They then reprogrammed cells from the skin samples into a kind of stem cell called induced pluripotent stem (IPS) cells, and then reprogrammed them to generate liver cells which mimicked the broad range of liver diseases in the patients they had come from. They used the same technique to create "healthy" liver cells from the comparison group.

Stem cells are the body's master cells and scientists are trying to find ways to use them to grow new organs, repair damaged hearts or severed spinal cords, or replace brain cells destroyed by strokes, Alzheimer's or Parkinson's disease.

"Previously we have never been able to grow liver cells in the laboratory, so this should open up a whole new sphere of research," Rashid said.

Commenting on the study, Mark Thursz, a specialist in liver disease at Imperial College in London, said it was a major step which may in future be a potential source of new liver cells for patients with liver failure.

Research work using human embryonic stem cells was thrown into doubt on Monday after a district court issued a preliminary injunction halting federal funding for it.

(Editing by Nina Chestney)

http://www.newsdaily.com/stories/tre67o4rc-us-stemcells-liver/#

Drugs protect monkeys from Ebola, U.S. study finds

Posted 2010/08/22 at 5:20 pm EDT

WASHINGTON, Aug. 22, 2010 (Reuters) — U.S. government researchers working to find ways to treat the highly deadly Ebola virus said on Sunday a new approach from AVI BioPharma Inc saved monkeys after they were infected.

Two experimental treatments protected more than 60 percent of monkeys infected with Ebola and all the monkeys infected with a related virus called Marburg, the team at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) in Fort Detrick, Maryland reported.

AVI BioPharma already has a contract worth up to $291 million from the U.S. Department of Defense to develop Ebola treatments.

Writing in the journal Nature Medicine, Sina Bavari and colleagues said the drugs tested are antisense phosphorodiamidate morpholino oligomers, or PMOs, called AVI-6002 and AVI-6003.

"Taken together, these studies provide a major advancement in therapeutic development efforts for treatment of filovirus hemorrhagic fever," Bavari's team wrote.

The company has submitted investigational new drug applications for AVI-6002 and AVI-6003 to the U.S. Food and Drug Administration and may now test the drugs in people.

Ebola causes a very serious hemorrhagic fever that has caused dozens of frightening and deadly outbreaks across Africa and threaten endangered gorilla populations as well as people.

It is considered a possible bioterrorism weapon.

There is no treatment and no vaccine against Ebola, which passes via close personal contact and, depending on the strain, kills up to 90 percent of victims.

But several studies in the past few months have shown that experimental "antisense" therapies can stop the virus.

In May a U.S. government team reported that small interfering RNAs or siRNAs could hold the virus at bay for a week until the immune system could take over.

SiRNAs are little stretches of genetic material that can block the action of a specific gene, in this case preventing Ebola from replicating.

PMOs are a little different but also interfere with genes.

An hour after infection with Ebola, 5 of 8 monkeys survived, while the remaining animal was untreated, Bavari's team found.

AVI-6003 worked best, protecting 90 percent or more of monkeys against Ebola, they said, and 100 percent against Marburg.

Canada's Tekmira Pharmaceuticals Corp has a separate contract to develop antisense treatments against Ebola.

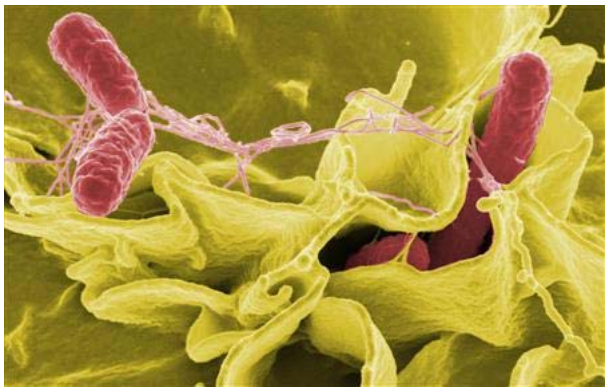
(Reporting by Maggie Fox; Editing by Cynthia Osterman)

http://www.newsdaily.com/stories/tre67l216-us-ebola-drug/

Scientists use salmonella bug to kill cancer cells

By Kate KellandPosted 2010/08/11 at 3:51 pm EDT

LONDON, Aug. 11, 2010 (Reuters) — Treating tumors with salmonella bacteria can induce an immune response that kills cancer cells, scientists have found -- a discovery that may help them create tumor-killing immune cells to inject into patients.



Salmonella bacteria (red) in an undated color-enhanced scanning electron micrograph. REUTERS/Rocky Mountain Laboratories/NIAID/NIH

Researchers from Italy and the United States who worked with mouse and human cancer cells in laboratories said their work might help in developing a new drug in a class of cancer treatments called immunotherapies or therapeutic vaccines, which harness the body's immune system to fight disease.

"We did experiments first in mice and then in cancer cells and immune cells from human patients, and found that the salmonella was doing exactly the same job," Maria Rescigno of European Institute of Oncology in Milan, who worked on the study, said in a telephone interview. "Now we are ready to go into (testing on) humans, but we are waiting for authorization."

The scientists said they thought the salmonella bacteria, which they used in a safe form that did not cause illness itself, helped to flag up cancer cells to the body's immune system, which was then able to find and kill them.

In the very earliest stages of cancer, patrolling immune cells often recognize cancer cells as abnormal and destroy them, they explained in their study, which was published in the journal Science Translational Medicine on Wednesday.

PROTEIN

This process relies on connexin 43, a protein that forms tiny communication channels between different types of cells. Fragments of tumor proteins called peptides escape through these channels, enter immune cells and act as "red flags" triggering a specific immune response against the disease.

But as cancer cells grow and proliferate, they can become invisible to immune cells because not enough connexin 43 is made to keep the "red flag" process going.

In this study, the scientists looked mainly at cells from melanoma -- the deadliest form of skin cancer and one which has no cure and few effective treatments.

Rescigno and colleagues found that injecting salmonella into cancerous mice and melanoma cells from humans increased the amount of connexin 43 in the tumor cells. As a result, new communication channels formed, and immune cells were activated and went on to kill the tumor cells.

The technique also protected mice from cancer spreading to other parts of the body, Rescigno said, suggesting a potential "vaccination-style" preventative strategy.

Immunotherapy drugs -- medicines that enlist the help of the body's immune system to fight disease -- are a relatively new form of cancer treatment.

In April, the U.S. Food and Drug Administration medicines regulators approved Dendreon Corp's Provenge, a therapeutic vaccine designed to stimulate the immune system to attack prostate cancer, as the first vaccine to treat tumors.

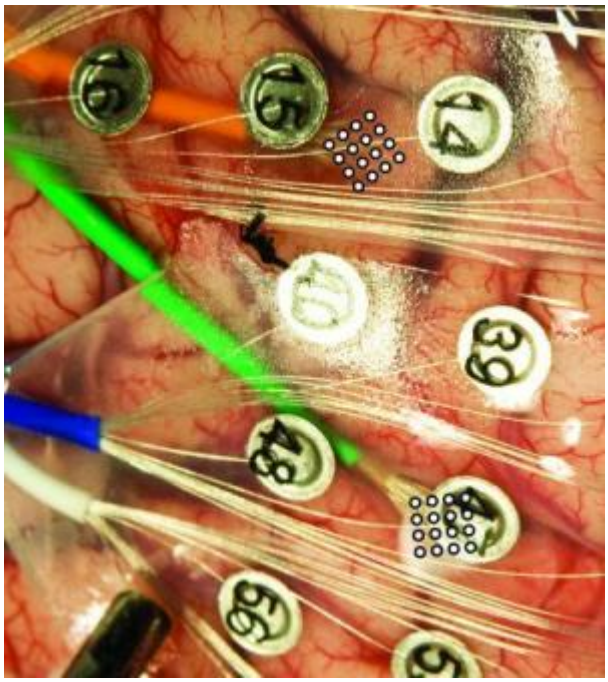
An experimental immunotherapy drug called ipilimumab being developed by Bristol-Myers Squibb showed promise in fighting melanoma in trial data released in June.

Rescigno said the team used melanoma cells in the study because it was one of the deadliest forms of the disease, but the same technique could also be trialed in other types of cancer.

(Editing by Alison Williams)

http://www.newsdaily.com/stories/tre67a40q-us-cancer-salmonella/#

The Brain Speaks: Scientists Decode Words from Brain Signals



This photo shows two kinds of electrodes sitting atop a severely epileptic patient's brain after part of his skull was removed temporarily. The larger, numbered, button-like electrodes are ECoGs used by surgeons to locate and then remove brain areas responsible for severe epileptic seizures. While the patient had to undergo that procedure, he volunteered to let researchers place two small grids -- each with 16 tiny "microECoG" electrodes -- over two brain areas responsible for speech. These grids are at the end of the green and orange wire bundles, and the grids are represented by two sets of 16 white dots since the actual grids cannot be seen easily in the photo. University of Utah scientists used the microelectrodes to translate speech-related brain signals into actual words -- a step toward future machines to allow severely paralyzed people to speak. (Credit: University of Utah Department of Neurosurgery)

ScienceDaily (Sep. 7, 2010) — In an early step toward letting severely paralyzed people speak with their thoughts, University of Utah researchers translated brain signals into words using two grids of 16 microelectrodes implanted beneath the skull but atop the brain.

"We have been able to decode spoken words using only signals from the brain with a device that has promise for long-term use in paralyzed patients who cannot now speak," says Bradley Greger, an assistant professor of bioengineering.

Because the method needs much more improvement and involves placing electrodes on the brain, he expects it will be a few years before clinical trials on paralyzed people who cannot speak due to so-called "locked-in syndrome."

The *Journal of Neural Engineering*'s September issue is publishing Greger's study showing the feasibility of translating brain signals into computer-spoken words.

The University of Utah research team placed grids of tiny microelectrodes over speech centers in the brain of a volunteer with severe epileptic seizures. The man already had a craniotomy -- temporary partial skull removal -- so doctors could place larger, conventional electrodes to locate the source of his seizures and surgically stop them.

Using the experimental microelectrodes, the scientists recorded brain signals as the patient repeatedly read each of 10 words that might be useful to a paralyzed person: yes, no, hot, cold, hungry, thirsty, hello, goodbye, more and less.

Later, they tried figuring out which brain signals represented each of the 10 words. When they compared any two brain signals -- such as those generated when the man said the words "yes" and "no" -- they were able to distinguish brain signals for each word 76 percent to 90 percent of the time.

When they examined all 10 brain signal patterns at once, they were able to pick out the correct word any one signal represented only 28 percent to 48 percent of the time -- better than chance (which would have been 10 percent) but not good enough for a device to translate a paralyzed person's thoughts into words spoken by a computer.

"This is proof of concept," Greger says, "We've proven these signals can tell you what the person is saying well above chance. But we need to be able to do more words with more accuracy before it is something a patient really might find useful."

People who eventually could benefit from a wireless device that converts thoughts into computer-spoken spoken words include those paralyzed by stroke, Lou Gehrig's disease and trauma, Greger says. People who are now "locked in" often communicate with any movement they can make -- blinking an eye or moving a hand slightly -- to arduously pick letters or words from a list.

University of Utah colleagues who conducted the study with Greger included electrical engineers Spencer Kellis, a doctoral student, and Richard Brown, dean of the College of Engineering; and Paul House, an assistant professor of neurosurgery. Another coauthor was Kai Miller, a neuroscientist at the University of Washington in Seattle.

The research was funded by the National Institutes of Health, the Defense Advanced Research Projects Agency, the University of Utah Research Foundation and the National Science Foundation.

Nonpenetrating Microelectrodes Read Brain's Speech Signals

The study used a new kind of nonpenetrating microelectrode that sits on the brain without poking into it. These electrodes are known as microECoGs because they are a small version of the much larger electrodes used for electrocorticography, or ECoG, developed a half century ago.

For patients with severe epileptic seizures uncontrolled by medication, surgeons remove part of the skull and place a silicone mat containing ECoG electrodes over the brain for days to weeks while the cranium is held in place but not reattached. The button-sized ECoG electrodes don't penetrate the brain but detect abnormal electrical activity and allow surgeons to locate and remove a small portion of the brain causing the seizures.

Last year, Greger and colleagues published a study showing the much smaller microECoG electrodes could "read" brain signals controlling arm movements. One of the epileptic patients involved in that study also volunteered for the new study.

Because the microelectrodes do not penetrate brain matter, they are considered safe to place on speech areas of the brain -- something that cannot be done with penetrating electrodes that have been used in experimental devices to help paralyzed people control a computer cursor or an artificial arm.

EEG electrodes used on the skull to record brain waves are too big and record too many brain signals to be used easily for decoding speech signals from paralyzed people.

Translating Nerve Signals into Words

In the new study, the microelectrodes were used to detect weak electrical signals from the brain generated by a few thousand neurons or nerve cells.

Each of two grids with 16 microECoGs spaced 1 millimeter (about one-25th of an inch) apart, was placed over one of two speech areas of the brain: First, the facial motor cortex, which controls movements of the mouth, lips, tongue and face -- basically the muscles involved in speaking. Second, Wernicke's area, a little understood part of the human brain tied to language comprehension and understanding.

The study was conducted during one-hour sessions on four consecutive days. Researchers told the epilepsy patient to repeat one of the 10 words each time they pointed at the patient. Brain signals were recorded via the two grids of microelectrodes. Each of the 10 words was repeated from 31 to 96 times, depending on how tired the patient was. Then the researchers "looked for patterns in the brain signals that correspond to the different words" by analyzing changes in strength of different frequencies within each nerve signal, says Greger.

The researchers found that each spoken word produced varying brain signals, and thus the pattern of electrodes that most accurately identified each word varied from word to word. They say that supports the theory that closely spaced microelectrodes can capture signals from single, column-shaped processing units of neurons in the brain.

One unexpected finding: When the patient repeated words, the facial motor cortex was most active and Wernicke's area was less active. Yet Wernicke's area "lit up" when the patient was thanked by researchers after repeating words. It shows Wernicke's area is more involved in high-level understanding of language, while the facial motor cortex controls facial muscles that help produce sounds, Greger says.

The researchers were most accurate -- 85 percent -- in distinguishing brain signals for one word from those for another when they used signals recorded from the facial motor cortex. They were less accurate -- 76 percent -- when using signals from Wernicke's area. Combining data from both areas didn't improve accuracy, showing that brain signals from Wernicke's area don't add much to those from the facial motor cortex.

When the scientists selected the five microelectrodes on each 16-electrode grid that were most accurate in decoding brain signals from the facial motor cortex, their accuracy in distinguishing one of two words from the other rose to almost 90 percent.

In the more difficult test of distinguishing brain signals for one word from signals for the other nine words, the researchers initially were accurate 28 percent of the time -- not good, but better than the 10 percent random chance of accuracy. However, when they focused on signals from the five most accurate electrodes, they identified the correct word almost half (48 percent) of the time.

"It doesn't mean the problem is completely solved and we can all go home," Greger says. "It means it works, and we now need to refine it so that people with locked-in syndrome could really communicate."

"The obvious next step -- and this is what we are doing right now -- is to do it with bigger microelectrode grids" with 121 micro electrodes in an 11-by-11 grid, he says. "We can make the grid bigger, have more electrodes and get a tremendous amount of data out of the brain, which probably means more words and better accuracy."

Story Source:

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

Journal Reference:

1. Spencer Kellis, Kai Miller, Kyle Thomson, Richard Brown, Paul House, Bradley Greger. **Decoding spoken words using local field potentials recorded from the cortical surface**. *Journal of Neural Engineering*, 2010; 7 (5): 056007 DOI: 10.1088/1741-2560/7/5/056007

http://www.sciencedaily.com/releases/2010/09/100907071249.htm

Irrigation's Cooling Effects May Mask Warming in Some Regions -- For Now

Irrigation can have a major cooling effect in some regions. (Credit: iStockphoto/Benjamin Hernandez)

ScienceDaily (Sep. 8, 2010) — Expanded irrigation has made it possible to feed the world's growing billions -- and it may also temporarily be counteracting the effects of climate change in some regions, say scientists in a new study. But some major groundwater aquifers, a source of irrigation water, are projected to dry up in coming decades from continuing overuse, and when they do, people may face the double whammy of food shortages and higher temperatures.

A new study in the *Journal of Geophysical Research* pinpoints where the trouble spots may be.

"Irrigation can have a significant cooling effect on regional temperatures, where people live," said the study's lead author, Michael Puma, a hydrologist who works jointly with Columbia University's Earth Institute and its affiliated NASA Goddard Institute for Space Studies. "An important question for the future is what happens to the climate if the water goes dry and the cooling disappears? How much warming is being hidden by irrigation?"

Scientists generally agree that in the last century, humans have warmed the planet about .7 degrees C (about 1.3 degrees F) by pumping vast amounts of carbon dioxide into the air. How much warmer earth will get depends not only on future carbon emissions but an array of other variables. For instance, earth's oceans and vegetation have been absorbing a growing share of emissions, but recent studies suggest this uptake may be slowing. This could lead to more carbon dioxide in the air, and accelerated warming. On the other hand, humans are also cooling the planet to some degree, by releasing air-polluting particles that lower temperatures by reflecting the sun's energy back into space. Pumping of vast amounts of heat-absorbing water onto crops is lowering temperatures in some regions as well, say the authors.

Scientists are just beginning to get a handle on irrigation's impact. In a hundred years, the amount of irrigated farmland has grown four-fold, now covering an area four times the size of Texas. Puma and his coauthor, Benjamin Cook, a climatologist at Goddard and Columbia's Lamont-Doherty Earth Observatory, are the first to look at the historic effects of mass watering on climate globally by analyzing temperature, precipitation and irrigation trends in a series of model simulations for the last century. They found that irrigation-linked cooling grew noticeably in the 1950s as irrigation rates exploded, and that more rain is now falling downstream of these heavily watered regions.

In warm, dry regions, irrigation increases the amount of water available for plants to release into the air through a process called evapotranspiration. When the soil is wet, part of the sun's energy is diverted from

warming the soil to vaporizing its moisture, creating a cooling effect. The same process explains why drying off in the sun after a swim at the beach can be so refreshing.

Globally, irrigation's effect on climate is small -- one-tenth of one degree C (about 0.2 degree F). But regionally, the cooling can match or exceed the impacts of greenhouse gases, say the scientists. For example, the study found some of the largest effects in India's arid Indus River Basin, where irrigation may be cooling the climate up to 3 degrees C, (5.4 degrees F) and up to 1-2 degrees C in other heavily irrigated regions such as California's Central Valley and parts of China. The study also found as much as .5 degree C cooling in heavily watered regions of Europe, Asia and North America during the summer.

The study suggests also that irrigation may be shaping the climate in other ways, by adding up to a millimeter per day of extra rain downwind of irrigated areas in Europe and parts of Asia. It also suggests that irrigation may be altering the pattern of the Asian monsoon, the rains that feed nearly half of the world's population. These findings are more uncertain, the authors caution, and will require further research.

"Most previous modeling studies were idealized experiments used to explore potential impacts, but this is a much more realistic simulation of the actual impacts," said David Lobell, a Stanford University scientist who studies climate impacts on agriculture and was not involved in the study. "Their results show some interesting differences by time period and region that will lead to more research and contribute to more accurate simulations of future climate, particularly in agricultural areas."

Irrigation has increased because it boosts crop yields, supporting many millions of small farmers, said Upmanu Lall, head of the Columbia Water Center at the Earth Institute. But concern is growing that groundwater supplies in India and China may not keep up. "Near term and future climate predictions are essential for anticipating climate shocks and improving food security," he said. "The study points to the importance of including irrigation in regional and global climate models so that we can anticipate precipitation and temperature impacts, and better manage our land, water and food in stressed environments."

Story Source:

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

Journal Reference:

1. M. J. Puma, B. I. Cook. **Effects of irrigation on global climate during the 20th century**. *Journal of Geophysical Research*, 2010; 115 (D16): D16120 DOI: 10.1029/2010JD014122

http://www.sciencedaily.com/releases/2010/09/100907171644.htm

Termites Foretell Climate Change in Africa's Savannas

Huge termite mound in Namibia. (Credit: iStockphoto)

ScienceDaily (Sep. 8, 2010) — Using sophisticated airborne imaging and structural analysis, scientists at the Carnegie Institution's Department of Global Ecology mapped more than 40,000 termite mounds over 192 square miles in the African savanna. They found that their size and distribution is linked to vegetation and landscape patterns associated with annual rainfall. The results reveal how the savanna terrain has evolved and show how termite mounds can be used to predict ecological shifts from climate change.

The research is published in the September 7, 2010, advanced online edition of *Nature Communications*.

Mound-building termites in the study area of Kruger National Park in South Africa tend to build their nests in areas that are not too wet, nor too dry, but are well drained, and on slopes of savanna hills above boundaries called seeplines. Seeplines form where water has flowed belowground through sandy, porous soil and backs up at areas rich in clay. Typically woody trees prefer the well-drained upslope side where the mounds tend to locate, while grasses dominate the wetter areas down slope.

"These relationships make the termite mounds excellent indicators of the geology, hydrology, and soil conditions," commented lead author Shaun Levick at Carnegie. "And those conditions affect what plants grow and thus the entire local ecosystem. We looked at the mound density, size, and location on the hills with respect to the vegetation patterns."

Most research into the ecology of these savannas has focused on the patterns of woody trees and shorter vegetation over larger, regional scales. Work at the smaller, hill-slope scales has, until now, been limited to 2-dimensional studies on specific hillsides. The Carnegie research was conducted by the Carnegie Airborne Observatory (CAO)-a unique airborne mapping system that operates much like a diagnostic medical scan. It can penetrate the canopy all the way to the soil level and probe about 40,000 acres per day. The CAO uses a waveform LiDAR system (light detection and ranging) that maps the 3-dimensional structure of vegetation and, in this case, termite mounds and combines that information with spectroscopic imaging -- imaging that reveals chemical fingerprints of the species below. It renders the data in stunning 3-D maps.

"We looked at the vegetation and termite mound characteristics throughout enormous areas of African savanna in dry, intermediate, and wet zones," explained Levick. "We found that precipitation, along with elevation, hydrological, and soil conditions determine whether the area will be dominated by grasses or woody vegetation and the size and density of termite mounds."

The advantage of monitoring termite mounds in addition to vegetation is that mounds are so tightly coupled with soil and hydrological conditions that they make it easier to map the hill slope seeplines. Furthermore, vegetation cover varies a lot between wet and dry season, while the mounds are not subject to these fluctuations.

"By understanding the patterns of the vegetation and termite mounds over different moisture zones, we can project how the landscape might change with climate change," explained co-author Greg Asner at Carnegie. "Warming is expected to increase the variability of future precipitation in African savannas, so some areas will get more, while others get less rain. The predictions are that many regions of the savanna will become drier, which suggests more woody species will encroach on today's grasslands. These changes will depend on complex but predictable hydrological processes along hill slopes, which will correspond to pattern changes in the telltale termite mounds we see today from the air."

This research was funded by a grant from the Andrew Mellon Foundation. The Carnegie Airborne Observatory is supported by the W.M. Keck Foundation and William Hearst, III. SANParks provided logistical support.

Story Source:

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

Journal Reference:

1. Shaun R. Levick, Gregory P. Asner, Oliver A. Chadwick, Lesego M. Khomo, Kevin H. Rogers, Anthony S. Hartshorn, Ty Kennedy-Bowdoin, David E. Knapp. **Regional insight into savanna hydrogeomorphology from termite mounds**. *Nature Communications*, 2010; 1 (6): 1 DOI: 10.1038/ncomms1066

http://www.sciencedaily.com/releases/2010/09/100907113038.htm

B vitamins found to slow progression of dementia

By Kate KellandPosted 2010/09/09 at 7:22 am EDT

LONDON, Sep. 9, 2010 (Reuters) — Daily tablets of large doses of B vitamins can halve the rate of brain shrinkage in elderly people with memory problems and may slow their progression toward dementia, data from a British trial showed on Wednesday,

Seniors relax by the sea in Andernos, Southwestern France, June 23, 2010. REUTERS/Regis Duvignau

Scientists from Oxford University said their two-year clinical trial was the largest to date into the effect of B vitamins on so-called "mild cognitive impairment" -- a major risk factor for Alzheimer's disease and other forms of dementia.

Experts commenting on the findings said they were important and called for larger, longer full-scale clinical trials to see if the safety and effectiveness of B vitamins in the prevention of neurodegenerative conditions could be confirmed.

"This is a very dramatic and striking result. It's much more than we could have predicted," said David Smith of Oxford's department of pharmacology, who co-led the trial.

"It is our hope that this simple and safe treatment will delay development of Alzheimer's in many people who suffer from mild memory problems."

Mild cognitive impairment (MCI) affects around 16 percent of people aged over 70 worldwide and is characterized by slight problems with memory loss, language or other mental functions.

MCI does not usually interfere with daily life, but around 50 percent of people diagnosed with it go on to develop the far more severe Alzheimer's disease within five years. Alzheimer's is a mind-wasting disease for which there are few treatments and no cure, and which affects 26 million people around the world.

Smith and colleagues conducted a two-year trial with 168 volunteers with MCI who were given either a vitamin pill containing very high doses of folic acid, vitamin B6 and vitamin B12, or a placebo dummy pill.

These B vitamins are known to control levels of an amino acid called homocysteine in the blood, and high blood levels of homocysteine are linked to an increased risk of developing Alzheimer's disease.

Helga Refsum, who also worked on the trial, stressed that vitamins were given in extremely high doses.

"This is a drug, not a vitamin intervention," she said.

The pills, called "TrioBe Plus" contained around 300 times the recommended daily intake of B12, four times daily advised folate levels and 15 times the recommended amount of B6.

Brain scans were taken at the beginning and the end of the trial to monitor the rate of brain shrinkage, or atrophy.

The results, published in the Public Library of Science (PLoS) One journal, showed that on average the brains of those taking the vitamin treatment shrank at a rate of 0.76 percent a year, while those taking the dummy pill had an average brain shrinkage of 1.08 percent.

People who had the highest levels of homocysteine at the start of the trial benefited the most from the treatment, with their brains shrinking at half the rate of those on the placebo.

Although the trial was not designed to measure cognitive ability, the researchers found those people who had lowest rates of shrinkage had the highest scores in mental tests.

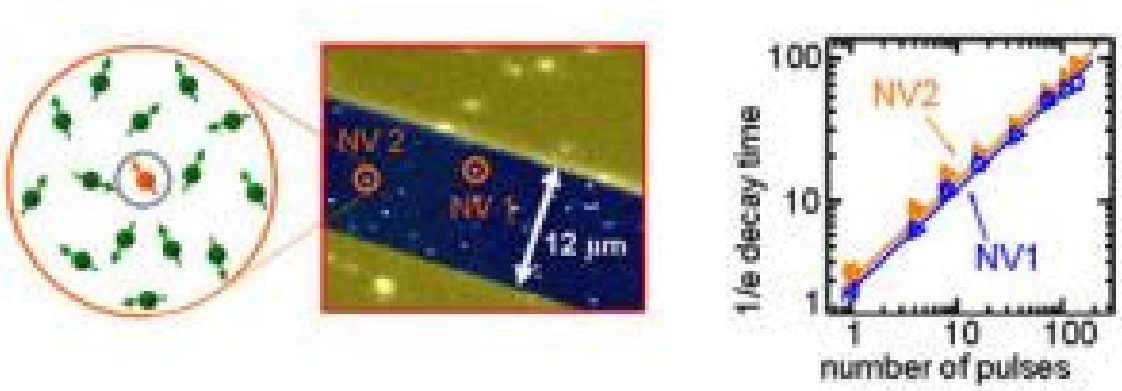
Commenting on the study, Paul Matthews, a professor of clinical neurology at Imperial College London said that although the vitamins used are generally safe and inexpensive, the study "should not drive an immediate change in clinical practice"

"Instead, it sets out important questions for further study and gives new confidence that effective treatments modifying the course of some dementias may be in sight," he said.

(Editing by Angus MacSwan)

http://www.newsdaily.com/stories/tre6875cl-us-memory-vitaminb/

Physicists Cross Hurdle in Quantum Manipulation of Matter



A collaboration of experimentalists from the Kavli Institute of Nanosciences at Delft University of Technology and theorists at the US Department of Energy's Ames Laboratory made a breakthrough in the area of controlling single quantum spins. The researchers developed and implemented a special kind of quantum control over a single quantum magnetic moment (spin) of an atomic-sized impurity in diamond. (Credit: Image courtesy of DOE/Ames Laboratory)

ScienceDaily (Sep. 17, 2010) — Finding ways to control matter at the level of single atoms and electrons fascinates many scientists and engineers because the ability to manipulate single charges and single magnetic moments (spins) may help researchers penetrate deep into the mysteries of quantum mechanics and modern solid-state physics. It may also allow development of new, highly sensitive magnetometers with nanometer resolution, single-spin transistors for coherent spintronics, and solid-state devices for quantum information processing.

Recently, a collaboration of experimentalists from the Kavli Institute of Nanosciences at Delft University of Technology and theorists at the U.S. Department of Energy's Ames Laboratory made a breakthrough in the area of controlling single quantum spins. The results were published in *Science* Express on Sept. 9.
The researchers developed and implemented a special kind of quantum control over a single quantum magnetic moment (spin) of an atomic-sized impurity in diamond. These impurities, called nitrogen-vacancy (or N-V) centers, have attracted much attention due to their unusual magnetic and optical properties. But their fragile quantum states are easily destroyed by even miniscule interactions with the outside world.

By applying a specially designed sequence of high-precision electromagnetic pulses, the scientists were able to protect the arbitrary quantum state of a single spin, and they made the spin evolve as if it was completely decoupled from the outside world. In this way, scientists achieved a 25-fold increase in the lifetime of the quantum spin state at room temperature. This is the first demonstration of a universal dynamical decoupling realized on a single solid state quantum spin.

"Uncontrolled interactions of the spins with the environment have been the major hurdle for implementing quantum technologies" said the leader of Dutch experimental group, associate professor Ronald Hanson from Kavli Institute of Nanoscience at Delft. "Our results demonstrate that this hurdle can be overcome by advanced control of the spin itself."

"Implementing dynamical decoupling on a single quantum spin in solid state at room temperature has been an appealing but distant goal for quite a while. In the meantime, much theoretical and experimental knowledge has been accumulated in the community," added Viatcheslav Dobrovitski, who led the theoretical research effort at the Ames Laboratory. "We used this knowledge to design our pulse sequences, and the collaboration between theory and experiment greatly helped us in this work."

Besides its importance to fundamental understanding of quantum mechanics, the team's achievement opens a way to using the impurity centers in diamond as highly sensitive nanoscale magnetic sensors, and potentially, as qubits for larger-scale quantum information processing.

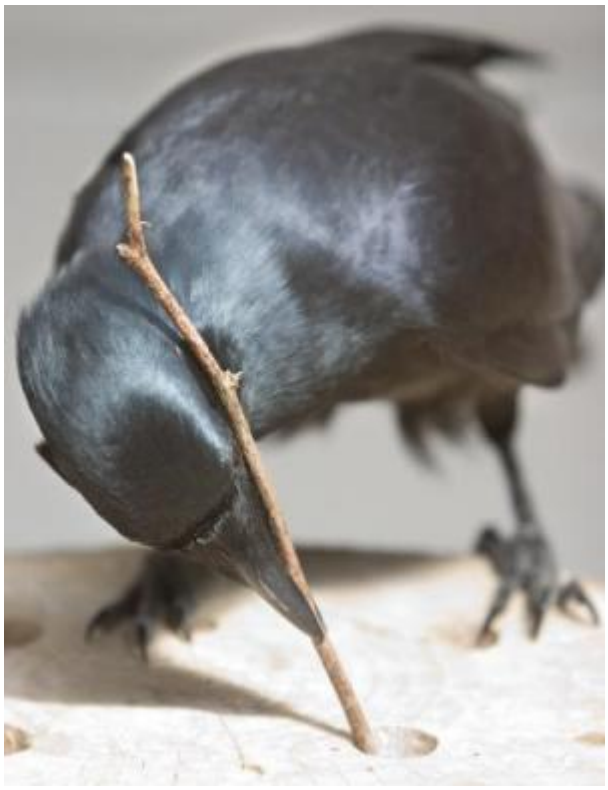
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Ames Laboratory**.

Journal Reference:

1. G. de Lange, Z. H. Wang, D. Riste, V. V. Dobrovitski, R. Hanson. **Universal Dynamical Decoupling of a Single Solid-State Spin from a Spin Bath**. *Science*, 2010; DOI: 10.1126/science.1192739

http://www.sciencedaily.com/releases/2010/09/100917111118.htm

Foraging for Fat: Crafty Crows Use Tools to Fish for Nutritious Morsels



A captive New Caledonian crow forages for food using a stick tool. (Credit: Dr. Simon Walker)

ScienceDaily (Sep. 17, 2010) — Tool use is so rare in the animal kingdom that it was once believed to be a uniquely human trait. While it is now known that some non-human animal species can use tools for foraging, the rarity of this behaviour remains a puzzle. It is generally assumed that tool use played a key role in human evolution, so understanding this behaviour's ecological context, and its evolutionary roots, is of major scientific interest. A project led by researchers from the Universities of Oxford and Exeter examined the ecological significance of tool use in New Caledonian crows, a species renowned for its sophisticated tool-use behaviour.

The scientists found that a substantial amount of the crows' energy intake comes from tool-derived food, highlighting the nutritional significance of their remarkable tool-use skills. A report of the research appears in this week's *Science*.

To trace the evolutionary origins of specific behaviours, scientists usually compare the ecologies and life histories of those species that exhibit the trait of interest, searching for common patterns and themes. "Unfortunately, this powerful technique cannot be used for studying the evolution of tool use, because there are simply too few species that are known to show this behaviour in the wild," says Dr Christian Rutz from Oxford University's Department of Zoology, who led the project. But, as he explains further, some light can still be shed on this intriguing question. "Examining the ecological context, and adaptive significance, of a species' tool-use behaviour under contemporary conditions can uncover the selection pressures that currently maintain the behaviour, and may even point to those that fostered its evolution in the past. This was the rationale of our study on New Caledonian crows."

Observing New Caledonian crows in the wild, on their home island in the South Pacific, is extremely difficult, because they are easily disturbed and live in densely forested, mountainous terrain. To gather quantitative data on the foraging behaviour and diet composition of individual crows, the scientists came up

with an unconventional study approach. New Caledonian crows consume a range of foods, but require tools to extract wood-boring longhorn beetle larvae from their burrows. These larvae, with their unusual diet, have a distinct chemical fingerprint -- their stable isotope profile -- that can be traced in the crows' feathers and blood, enabling efficient sample collection with little or no harm to the birds. "By comparing the stable isotope profiles of the crows' tissues with those of their putative food sources, we could estimate the proportion of larvae in crow diet, providing a powerful proxy for individual tool-use dependence," explains Dr Rutz.

The analysis of the samples presented further challenges. Dr Stuart Bearhop from Exeter University's School of Biosciences, who led the stable-isotope analyses, points out: "These crows are opportunistic foragers, and eat a range of different foods. The approach we used is very similar to that employed by forensic scientists trying to solve crimes, and has even appeared on CSI. We have developed very powerful statistical models that enabled us to use the unique fingerprints, or stable isotope profiles, of each food type to estimate the amount of beetle larvae consumed by individual New Caledonian crows."

The scientists found that beetle larvae are so energy rich, and full of fat, that just a few specimens can satisfy a crow's daily energy requirements, demonstrating that competent tool users can enjoy substantial rewards. "Our results show that tool use provides New Caledonian crows with access to an extremely profitable food source that is not easily exploited by beak alone," says Dr Rutz. And, Dr Bearhop adds: "This suggests that unusual foraging opportunities on the remote, tropical island of New Caledonia selected for, and currently maintain, these crows' sophisticated tool technology. Other factors have probably played a role, too, but at least we now have a much better understanding of the dietary significance of this remarkable behaviour."

The scientists believe that their novel methodological approach could prove key to investigating in the future whether particularly proficient tool users, with their privileged access to larvae, produce offspring of superior body condition, and whether a larva-rich diet has lasting effects on future survival and reproduction. "The fact that we can estimate the importance of tool use from a small tissue sample opens up exciting possibilities. This approach may even be suitable for studying other animal tool users, like chimpanzees," speculates Dr Rutz.

A report of the research,was published in *Science* on September 17, 2010.

The researchers studied the New Caledonian crow (*Corvus moneduloides*), a species that has attracted attention with its unusually sophisticated use of tools for extracting invertebrates from holes and crevices. The species is endemic to the tropical island of New Caledonia in the South Pacific, where fieldwork was conducted.

New Caledonian crows use stick tools to probe for longhorn beetle larvae (Agrianome fairmairei) in decaying trunks of candlenut trees (Aleurites moluccana). The larva-extraction technique of crows relies on exploiting defensive responses of their prey, similar to the well-known 'termite fishing' of chimpanzees. Crows insert a twig or leaf stem into a burrow, 'teasing' the larva by repeatedly poking it with the tool until it bites the tip of the tool with its powerful mandibles, and can be levered out.

The use of stable isotopes to examine the diets of wild animals is a well-established research technique. It relies on the premise "you are what you eat." Thus, the unique stable isotope profile of a food source can often be traced in the tissues of a consumer. Using relatively simple conversion factors (and some assumptions), it is possible to use this information to calculate the amount of any given food type in the diet of an animal. The Exeter-based research group has recently been involved in developing powerful Bayesian analysis techniques that are suitable for estimating animal diets in more complex situations, for example when consumers are known to eat many different food types. This advance was key to their collaboration with the Oxford-based scientists, who study the ecology and behaviour of the New Caledonian crow -- a species that, like many other crows and ravens, is an opportunistic, generalist forager.

Previous studies on New Caledonian crows have shown that: wild crows manufacture and use at least three distinct tool types (including the most sophisticated animal tool yet discovered); the species has a strong genetic predisposition for basic stick-tool use (tool-related behaviour emerges in juvenile crows that had no opportunity to learn from others); crows have a preferred way of holding their tools (comparable to the way that humans are either left- or right-handed); adult crows can make or select tools of the appropriate length or diameter for experimental tasks; at least some birds can 'creatively' solve novel problems; and wild crows may

socially transmit certain aspects of their tool-use behaviour (but claims for 'crow tool cultures' are still contentious).
An earlier paper in *Science* by Dr Christian Rutz's team (published in 2007) described the use of miniaturized, animal-borne video cameras to study the undisturbed foraging behaviour of wild, free-ranging New Caledonian crows.
This work was funded by the UK's Biotechnology and Biological Sciences Research Council (BBSRC) and Natural Environment Research Council (NERC). Dr Christian Rutz is a BBSRC David Phillips Fellow at the Department of Zoology, University of Oxford, and Dr Stuart Bearhop is a Senior Lecturer in the School of Biosciences, University of Exeter.
Stable isotope measurements were carried out by Dr Jason Newton, Senior Research Fellow and Manager of the NERC Life Science Mass Spectrometry Facility in East Kilbride. The Facility exists to provide access for UK scientists in the biological, environmental and other sciences to training and research facilities, offering an integrated and comprehensive suite of stable isotope techniques and expertise.

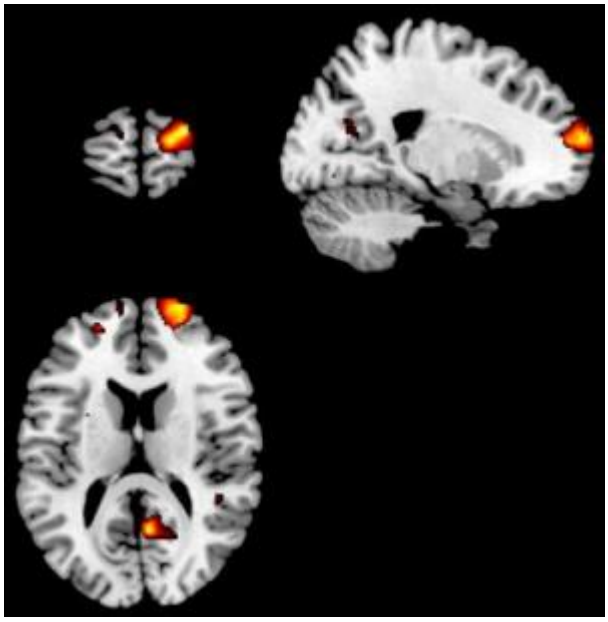
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Exeter**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Christian Rutz, Lucas A. Bluff, Nicola Reed, Jolyon Troscianko, Jason Newton, Richard Inger, Alex Kacelnik, Stuart Bearhop. **The ecological significance of tool use in New Caledonian crows**. *Science*, September 17, 2010 DOI: 10.1126/science.1192053

http://www.sciencedaily.com/releases/2010/09/100916145057.htm

Brain Matter Linked to Introspective Thoughts: Structure of Prefrontal Cortex Helps Humans Think About One's Own Thinking



Views of inflated cortical surface showing areas of brain gray matter correlating with introspective accuracy. (Credit: Image © Science/AAAS)

ScienceDaily (Sep. 17, 2010) — A specific region of the brain appears to be larger in individuals who are good at turning their thoughts inward and reflecting upon their decisions, according to new research published in the journal *Science*. This act of introspection -- or "thinking about your thinking" -- is a key aspect of human consciousness, though scientists have noted plenty of variation in peoples' abilities to introspect.

The new study will be published in the 17 September issue of the journal *Science*. *Science* is published by AAAS, the nonprofit science society.

In light of their findings, this team of researchers, led by Prof. Geraint Rees from University College London, suggests that the volume of gray matter in the anterior prefrontal cortex of the brain, which lies right behind our eyes, is a strong indicator of a person's introspective ability. Furthermore, they say the structure of white matter connected to this area is also linked to this process of introspection.

It remains unclear, however, how this relationship between introspection and the two different types of brain matter really works. These findings do not necessarily mean that individuals with greater volume of gray matter in that region of the brain have experienced -- or will experience -- more introspective thoughts than other people. But, they do establish a correlation between the structure of gray and white matter in the prefrontal cortex and the various levels of introspection that individuals may experience.

In the future, the discovery may help scientists understand how certain brain injuries affect an individual's ability to reflect upon their own thoughts and actions. With such an understanding, it may eventually be possible to tailor appropriate treatments to patients, such as stroke victims or those with serious brain trauma, who may not even understand their own conditions.

"Take the example of two patients with mental illness -- one who is aware of their illness and one who is not," said one of the study's authors, Stephen Fleming from University College London. "The first person is likely to take their medication, but the second is less likely. If we understand self-awareness at the neurological level, then perhaps we can also adapt treatments and develop training strategies for these patients."

This new study was born from collaboration between Rees' group, which investigates consciousness, and another group at University College London led by Prof. Ray Dolan, which studies decision-making. Fleming, together with co-author Rimona Weil, designed an experiment to measure both an individual's

performance at a task, as well as how confident that individual felt about his or her decisions during the task. By taking note of how accurately the study's participants were able to judge their own decision-making, the researchers were able to gain insight into the participants' introspective abilities.

To begin, Fleming and Weil recruited 32 healthy human participants and showed them two screens, each containing six patterned patches. One of the screens, however, contained a single patch that was brighter than all the rest. The researchers asked the participants to identify which screen contained the brighter patch, and then to rate how confident they felt about their final answer. After the experiment, participants' brains were scanned using magnetic resonance imaging, or MRI.

Fleming and the researchers designed the task to be difficult, so that participants were never completely sure if their answer was correct. They reasoned that participants who are good at introspection would be confident after making correct decisions about the patch, and less confident when they were incorrect about the patch. By adjusting the task, the researchers ensured all of the participants' decision-making abilities were on par with each others' -- only the participants' knowledge of their own decision-making abilities differed.

"It's like that show, 'Who Wants to Be a Millionaire?'" said Weil. "An introspective contestant will go with his or her final answer when they are quite sure of it, and perhaps phone a friend when they are unsure. But, a contestant who is less introspective would not be as effective at judging how likely their answer is to be correct."

So, although each participant performed equally well at the task, their introspective abilities did vary considerably, the researchers confirmed. By comparing the MRI scans of each participant's brain, they could then identify a correlation between introspective ability and the structure of a small area of the prefrontal cortex. An individual's meta-cognitive, or "higher-thinking," abilities were significantly correlated with the amount of gray matter in the right anterior prefrontal cortex and the structure of neighboring white matter, Rees and his team found.

These findings, however, could reflect the innate differences in our anatomy, or alternatively, the physical effects of experience and learning on the brain. The latter possibility raises the exciting prospect that there may be a way to "train" meta-cognitive abilities by exploiting the malleable nature of these regions of prefrontal cortex. But, more research is needed to explore the mental computations behind introspection -- and then to link these computations to actual biological processes.

"We want to know why we are aware of some mental processes while others proceed in the absence of consciousness," said Fleming. "There may be different levels of consciousness, ranging from simply having an experience, to reflecting upon that experience. Introspection is on the higher end of this spectrum -- by measuring this process and relating it to the brain we hope to gain insight into the biology of conscious thought."

Story Source:

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

http://www.sciencedaily.com/releases/2010/09/100916145047.htm

Tyrannosaurus Redux: T. Rex Was More Than Just a Large Carnivore at Top of Food Chain, New Findings Reveal

This is an adult Tyrannosaurus from the American Museum of Natural History. (Credit: AMNH)

ScienceDaily (Sep. 17, 2010) — We've all heard this story: the Late Cretaceous of Asia and North America -- about 65 million years ago -- was dominated by several large-headed, bipedal predatory dinosaurs like *Tyrannosaurus rex* and *Tarbosaurus* that had tiny arms. But a decade of new fossil discoveries that have more than doubled the number of known tyrannosaur species has changed this tale. Older and smaller tyrannosaurs have made the evolutionary tree of this group richer and more complex. Furthermore, a series of innovative research projects on topics like bone growth and biomechanics have added an enormous amount of information about tyrannosaurs, so much so that the group could now be considered an exemplar for studying many themes in paleontology research.

A new paper describing recent research and a new evolutionary tree is published in the journal *Science*.

"*T. rex* is the most iconic of all dinosaurs," says Mark Norell, curator in the Division of Paleontology at the American Museum of Natural History. "Its star power has allowed a research focus into questions not normally undertaken with fossils, questions like bone growth, biomechanics, and neurology."

"We know more about tyrannosaurs than any other group of dinosaurs -- even more than some groups of living organisms," says Stephen Brusatte, a graduate student affiliated with the Museum and first author of the paper. "Over the past year, five new species of tyrannosaurs have been described, and over the last ten years we have found the oldest and smallest members of the group. Now we can understand the family tree of tyrannosaurs in unprecedented detail."

The *Science* paper combines a new analysis of tyrannosaur phylogenetics, or their genealogy, with a review of recent research into their biology. After scoring 19 well-documented tyrannosaur fossils for over 300 different traits, the researchers developed the most comprehensive evolutionary tree of this group to date. This essentially redefined tyrannosaurs, at least when compared to the popular perception of them as large meat-eaters. Tyrannosaurs have a long evolutionary history of which the largest, *T. rex*, *Albertosaurus*, and *Tarbosaurus*, represent species that were ecologically dominant only during the Late Cretaceous in Asia and North America. Earlier tyrannosaurs, on the other hand, lived up to 100 million years before the large apex (top) predators, which were often small in size (some one-one hundredth of the size of *T. rex* and akin to a lynx in body mass), and lived all over the world.

"*T. rex* is really just the tip of the iceberg of tyrannosaur diversity, and honestly, is quite abnormal when compared with other members of the group. For most of their evolutionary history, tyrannosaurs were small and living in the shadow of other giant apex predators," says Brusatte. "They stayed small until the end of the Cretaceous -- the final 20 million years of dinosaur history."

The new paper also reviews exciting research on tyrannosaurs, including biomechanical analyses of how quickly they could run (work of co-author John Hutchinson of the Royal Veterinary College in the U.K.), how quickly they grew (work of co-author Gregory Erickson of Florida State University and Norell), demographics of the population (Erickson), and reconstructions of the brain and neurology (work of co-authors Amy Balanoff of the American Museum of Natural History and Gabe Bever of Yale University).

"The work on tyrannosaurs underscores how much can be done using modern techniques to understand the biology of fossil organisms," says Norell. "Many of us in the field now look at ourselves as biologists who just happen to work on dinosaurs."

In addition to Norell, Brusatte (who is also affiliated with Columbia University), Hutchinson, Erickson, Bever, and Balanoff, authors include Jonah Choiniere of the American Museum of Natural History, Thomas Carr of Carthage College, Peter J. Makovicky of the Field Museum, and Xing Xu of the Chinese Academy of Sciences (People's Republic of China). This research was funded by the National Science Foundation, the American Museum of Natural History, Natural Environment Research Council of the U.K., the National Natural Science Foundation of China, and Special Funds for Major State Basic Research Projects of China.

Story Source:

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

Journal Reference:

1. Stephen L. Brusatte, Mark A. Norell, Thomas D. Carr, Gregory M. Erickson, John R. Hutchinson, Amy M. Balanoff, Gabe S. Bever, Jonah N. Choiniere, Peter J. Makovicky, and Xing Xu. **Tyrannosaur Paleobiology: New Research on Ancient Exemplar Organisms**. *Science*, 2010; 329 (5998): 1481-1485 DOI: 10.1126/science.1193304

http://www.sciencedaily.com/releases/2010/09/100916145131.htm

---

Journal Reference:

1. Stephen M. Fleming, Rimona S. Weil, Zoltan Nagy, Raymond J. Dolan, and Geraint Rees. **Relating Introspective Accuracy to Individual Differences in Brain Structure**. *Science*, 2010; 329 (5998): 1541-1543 DOI: 10.1126/science.1191883

http://www.sciencedaily.com/releases/2010/09/100916145047.htm

Scientists Document Fate of Deep Hydrocarbon Plumes in Gulf Oil Spill

Gulf oil spill. In the aftermath of the Deepwater Horizon disaster in the Gulf of Mexico, a team of scientists led by UC Santa Barbara's David Valentine and Texas A&M University's John Kessler embarked on a research cruise with an urgent mission: determining the fate and impact of hydrocarbon gases escaping from a deep-water oil spill. (Credit: NASA Goddard / MODIS Rapid Response Team Text credit: Rob Gutro / NASA's Goddard Space Flight Center)

ScienceDaily (Sep. 17, 2010) — In the aftermath of the Deepwater Horizon disaster in the Gulf of Mexico, a team of scientists led by UC Santa Barbara's David Valentine and Texas A&M University's John Kessler embarked on a research cruise with an urgent mission: determining the fate and impact of hydrocarbon gases escaping from a deep-water oil spill.

The spill provided a rare opportunity for Valentine, a professor in the Department of Earth Science at UCSB, and Kessler, an assistant professor in the Department of Oceanography at Texas A&M, to study the behavior of methane and other natural gases in the murky depths of the Gulf of Mexico.

"We were fortunate to have the expertise and opportunity to get to the heart of this national disaster and to contribute meaningfully to understanding what was happening in the deep ocean during the spill," Valentine, the lead author, said. "As a scholar, it is rare that your intellectual domain comes so abruptly to the forefront of the national consciousness. Circumstances aside, I feel that it reflects well on our country's scientific and educational systems that we foster such expertise."

The scientists conducted their tests June 11-21, less than two months after the Deepwater Horizon platform exploded, causing the largest marine oil spill in history. Their team conducted its experiments as close as 1,500 feet from the epicenter of the active spill, using underwater sampling devices and sensors to measure hydrocarbons and oxygen depletion at various depths, and to collect water samples to study the biodegradation of natural gas and the associated blooms of bacteria.

Their research was funded by the National Science Foundation and the Department of Energy, and was conducted on the Research Vessel Cape Hatteras.

The team reported several new findings in their study. At the time they sampled in June, they identified four large plumes of suspended hydrocarbons that had been moved by deep currents in different directions from the leaking well. Since each plume originated from the well at a different time, the scientists were able to compare the chemicals and isotopes to determine what compounds were preferentially respired by the bacteria.

What they found was surprising: Three specific hydrocarbon gases -- ethane, propane and butane -- were responsible for most of the respiration and oxygen loss observed in the deep plumes. They further identified the dominant bacteria present in the plumes and suggested some of the organisms were targeting the natural gases.

The team also found that methane gas, the single most abundant compound spilled by Deepwater Horizon, was initially consumed very slowly, but that the rate increased as other gases were depleted. They estimate that ultimately two-thirds of the bacterial productivity and respiration in the deep-water plumes will be linked to natural gas.

"Because the Deepwater Horizon rig accident occurred almost a mile deep, the slow migration of petroleum from that depth allowed time for dissolution of volatile hydrocarbons such as methane, ethane, propane, and

butane," Valentine said. "Had it occurred in shallower water, these gases would have certainly escaped into the atmosphere. This gas trapping will go down as one of the distinguishing hallmarks of a deep oil spill."
Kessler added: "Dissolving these gases in the ocean is a bit of a double-edged sword. On the one hand, these gases influenced both the air quality and the radiative budget of the atmosphere, so trapping them within the ocean is a good thing. But their eventual marine biodegradation leads to the consumption of dissolved oxygen, which is an annual problem in the northern Gulf of Mexico. Fingerprinting the main chemicals responsible for the majority of the oxygen reductions associated with this spill is extremely helpful as we decide how to deal with this and other such events."
The scientists found that propane and ethane were the primary foodstuffs for microbial respiration, accounting for up to 70 percent of the observed oxygen depletion in fresh plumes. They further suggest that butane accounts for much of the remainder. They learned that the ratio of methane to ethane and propane varied substantially throughout the deep plumes and served as the indicator of bacterial activity.
The scientists concluded that deep oil and gas spills elicit a distinctive microbial response because of the trapped gases. They also suggest that bacterial blooms may turn their attention to oil after the gas is depleted as many bacteria can cross over with their metabolism. However, they caution that the metabolism of these bugs has not been established and that the specific bacteria that bloomed may only target specific compounds in oil.
While the results of this study suggest that ethane, propane and butane plumes may disappear quickly, methane may not, due to its relatively slow consumption rate. This suggests the potential for a much longer-lived methane plume in the deep ocean, with unknown consequences. To address this issue, Valentine and Kessler are currently leading another expedition supported by the National Oceanic and Atmospheric Administration in an attempt to determine the longer-term fate of methane and oil in the deep Gulf waters.
###
Joining Valentine on this research from UCSB were Molly Redmond, Stephanie Mendes, Monica Heintz, Christopher Farwell, Franklin Kinnaman and Christine Villanueva. Other Texas A&M researchers included Lei Hu, Shari Yvon-Lewis, Mengran Du, Eric Chan and Fenix Garcia Tigreros.
(Note to editors: For more information, contact David Valentine by e-mail at valentine@geol.ucsb.edu. For downloadable images from the research cruise, go to http://www.ia.ucsb.edu/pa/display.aspx?pkey=2321)
About research at Texas A&M University: As one of the world's leading research institutions, Texas A&M is in the vanguard in making significant contributions to the storehouse of knowledge, including that of science and technology. Research conducted at Texas A&M represents an annual investment of more than $582 million, which ranks third nationally for universities without a medical school, and underwrites approximately 3,500 sponsored projects. That research creates new knowledge that provides basic, fundamental and applied contributions resulting in many cases in economic benefits to the state, nation and world.

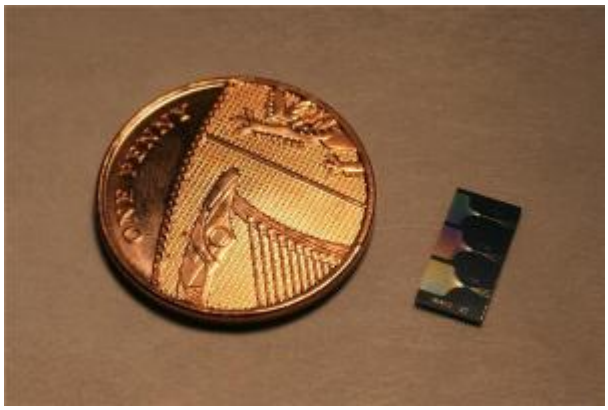
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Texas A&M University**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. David L. Valentine, John D. Kessler, Molly C. Redmond, Stephanie D. Mendes, Monica B. Heintz, Christopher Farwell, Lei Hu, Franklin S. Kinnaman, Shari Yvon-Lewis, Mengran Du, Eric W. Chan, Fenix Garcia Tigreros, and Christie J. Villanueva. **Propane respiration jump-starts microbial response to a deep oil spill**. *Science*, Sept. 16, 2010 DOI: 10.1126/science.1196830

http://www.sciencedaily.com/releases/2010/09/100916145133.htm

Optical Chip Enables New Approach to Quantum Computing



This is the photonic chip next to a UK penny. The chip contains micrometer and sub-micrometer features and guide light using a network of waveguides. The output of this network can be seen on the surface of the chip. (Credit: Photograph by Jasmin Meinecke)

ScienceDaily (Sep. 17, 2010) — An international research group led by scientists from the University of Bristol has developed a new approach to quantum computing that could soon be used to perform complex calculations that cannot be done by today's computers.

Scientists from Bristol's Centre for Quantum Photonics have developed a silicon chip that could be used to perform complex calculations and simulations using quantum particles in the near future. The researchers believe that their device represents a new route to a quantum computer -- a powerful type of computer that uses quantum bits (qubits) rather than the conventional bits used in today's computers.

Unlike conventional bits or transistors, which can be in one of only two states at any one time (1 or 0), a qubit can be in several states at the same time and can therefore be used to hold and process a much larger amount of information at a greater rate.

"It is widely believed that a quantum computer will not become a reality for at least another 25 years," says Professor Jeremy O'Brien, Director of the Centre for Quantum Photonics. "However, we believe, using our new technique, a quantum computer could, in less than ten years, be performing calculations that are outside the capabilities of conventional computers."

The technique developed in Bristol uses two identical particles of light (photons) moving along a network of circuits in a silicon chip to perform an experiment known as a quantum walk. Quantum walk experiments using one photon have been done before and can even be modelled exactly by classical wave physics. However, this is the first time a quantum walk has been performed with two particles and the implications are far-reaching.

"Using a two-photon system, we can perform calculations that are exponentially more complex than before," says O'Brien. "This is very much the beginning of a new field in quantum information science and will pave the way to quantum computers that will help us understand the most complex scientific problems."

In the short term, the team expect to apply their new results immediately for developing new simulation tools in their own lab. In the longer term, a quantum computer based on a multi-photon quantum walk could be used to simulate processes which themselves are governed by quantum mechanics, such as superconductivity and photosynthesis.

"Our technique could improve our understanding of such important processes and help, for example, in the development of more efficient solar cells," adds O'Brien. Other applications include the development of ultra-fast and efficient search engines, designing high-tech materials and new pharmaceuticals.

The leap from using one photon to two photons is not trivial because the two particles need to be identical in every way and because of the way these particles interfere, or interact, with each other. There is no direct analogue of this interaction outside of quantum physics.
"Now that we can directly realize and observe two-photon quantum walks, the move to a three-photon, or multi-photon, device is relatively straightforward, but the results will be just as exciting" says O'Brien. "Each time we add a photon, the complexity of the problem we are able to solve increases exponentially, so if a one-photon quantum walk has 10 outcomes, a two-photon system can give 100 outcomes and a three-photon system 1000 solutions and so on."
The group, which includes researchers from Tohoku University, Japan, the Weizmann Institute in Israel and the University of Twente in the Netherlands, now plans to use the chip to perform quantum mechanical simulations. The researchers are also planning to increase the complexity of their experiment not only by adding more photons but also by using larger circuits.
The research is published in the journal *Science.*

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

Journal Reference:

1. Alberto Peruzzo, Mirko Lobino, Jonathan C. F. Matthews, Nobuyuki Matsuda, Alberto Politi, Konstantinos Poulios, Xiao-Qi Zhou, Yoav Lahini, Nur Ismail, Kerstin Wörhoff, Yaron Bromberg, Yaron Silberberg, Mark G. Thompson, and Jeremy L. O'Brien. **Quantum Walks of Correlated Photons**. *Science*, 2010; 329 (5998): 1500-1503 DOI: 10.1126/science.1193515

http://www.sciencedaily.com/releases/2010/09/100916145049.htm

Understanding Behavioral Patterns: Why Bird Flocks Move in Unison

Flock of sea gulls flying. Animal flocks, be it honeybees, fish, ants or birds, often move in surprising synchronicity and seemingly make unanimous decisions at a moment's notice, a phenomenon which has remained puzzling to many researchers. (Credit: iStockphoto)

ScienceDaily (Sep. 16, 2010) — Animal flocks, be it honeybees, fish, ants or birds, often move in surprising synchronicity and seemingly make unanimous decisions at a moment's notice, a phenomenon which has remained puzzling to many researchers.

New research published September 15, in *New Journal of Physics*, uses a particle model to explain the collective decision making process of flocks of birds landing on foraging flights.

Using a simple self-propelled particle (SPP) system, which sees the birds represented by particles with such parameters as position and velocity, the researchers from Budapest, Hungary, find that the collective switching from the flying to the landing state overrides the individual landing intentions of each bird.

In the absence of a decision making leader, the collective shift to land is heavily influenced by perturbations the individual birds are subject to, such as the birds' flying position within the flock. This can be compared to an avalanche of piled up sand, which would occur even for perfectly symmetric and cautiously placed grains, but in reality happens much sooner because of increasing, non-linear fluctuations.

As the researchers explain, "Our main motivation was to better understand something which is puzzling and out there in nature, especially in cases involving the stopping or starting of a collective behavioural pattern in a group of people or animals.

"We propose a simple model for a system whose members have the tendency to follow the others both in space and in their state of mind concerning a decision about stopping an activity. This is a very general model, which can be applied to similar situations."

Possible applications include collectively flying, unmanned aerial vehicles, initiating a desired motion pattern in crowds or groups of animals and even finance, where the results could be used to interpret collective effects on selling or buying shares on the stock market.

urce:

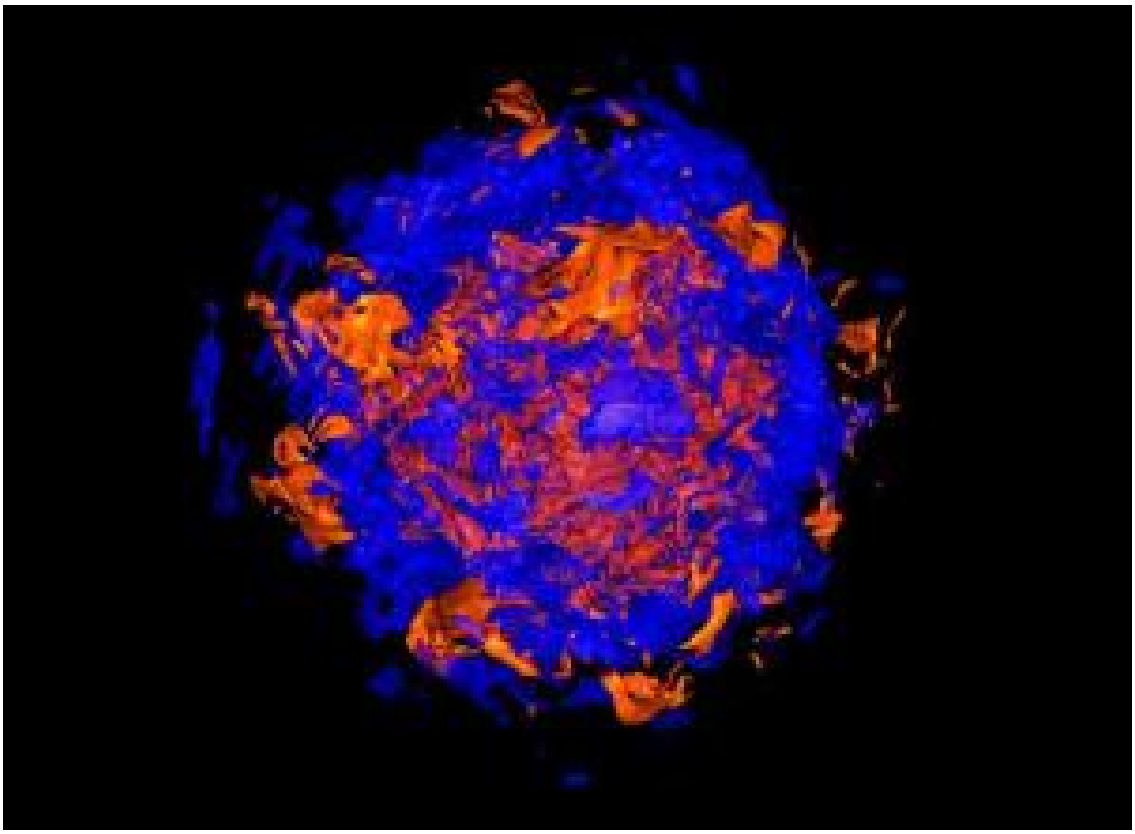
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Institute of Physics**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. K Bhattacharya, Tamás Vicsek. **Collective decision making in cohesive flocks**. *New Journal of Physics*, 2010; 12 (9): 093019 DOI: 10.1088/1367-2630/12/9/093019

http://www.sciencedaily.com/releases/2010/09/100915080439.htm

3-D Computer Simulations Help Envision Supernovae Explosions



The new 3-D simulations like this one are based on the idea that the collapsing star itself is not sphere-like, but distinctly asymmetrical and affected by a host of instabilities. (Credit: Image courtesy of Princeton University)

ScienceDaily (Sep. 16, 2010) — For scientists, supernovae are true superstars -- massive explosions of huge, dying stars that shine light on the shape and fate of the universe.

For a brief burst of time, supernovae can radiate more energy than the sun will emit in its lifetime. With the potential energy of 25 hundred trillion trillion nuclear weapons, they can outshine entire galaxies, producing some of the biggest explosions ever seen, and helping track distances across the cosmos.

Now, a Princeton-led team has found a way to make computer simulations of supernovae exploding in three dimensions, which may lead to new scientific insights.

Even though these mammoth explosions have been observed for thousands of years, for the past 50 years researchers have struggled to mimic the step-by-step destructive action on computers. Researchers argue that such simulations, even crude ones, are important, as they can lead to new information about the universe and help address this longstanding problem in astrophysics.

The new 3-D simulations are based on the idea that the collapsing star itself is not sphere-like, but distinctly asymmetrical and affected by a host of instabilities in the volatile mix surrounding its core.

"I think this is a big jump in our understanding of how these things can explode," said Adam Burrows, a professor of astrophysical sciences at Princeton, who led the research. "In principle, if you could go inside the supernovae to their centers, this is what you might see."

Writing in the Sept. 1 issue of The *Astrophysical Journal*, Burrows -- along with first author Jason Nordhaus, a postdoctoral research fellow at Princeton, and Ann Almgren and John Bell from the Lawrence Berkeley National Laboratory in California -- reports that the Princeton team has developed simulations that are beginning to match the massive blow-outs astronomers have witnessed when gigantic stars die.

In the past, simulated explosions represented in one and two dimensions often stalled, leading scientists to conclude that their understanding of the physics was incorrect or incomplete. This team used the same guiding physics principles, but used supercomputers that were many times more powerful, employing a representation in three dimensions that allowed the various multidimensional instabilities to be expressed.

"It may well prove to be the case that the fundamental impediment to progress in supernova theory over the last few decades has not been lack of physical detail, but lack of access to codes and computers with which to properly simulate the collapse phenomenon in 3-D," the team wrote. "This could explain the agonizingly slow march since the 1960s toward demonstrating a robust mechanism of explosion."

Birth of a supernova

Supernovae are the primary source of heavy elements in the cosmos. Their brightness is so consistently intense that supernovae have been used as "standard candles" or gauges, acting as yardsticks indicating astronomical distances.

Most result from the death of single stars much more massive than the sun.

As a star ages, it exhausts its supplies of hydrogen and helium fuel at its core. With still enough mass and pressure to fuse carbon and produce other heavier elements, it gradually becomes layered like an onion with the bulkiest tiers at its center. Once its core exceeds a certain mass, it begins to implode. In the squeeze, the core heats up and grows even more dense.

"Imagine taking something as massive as the sun, then compacting it to something the size of the Earth," Burrows said. "Then imagine that collapsing to something the size of Princeton."

What comes next is even more mysterious.

At some point, the implosion reverses. Astrophysicists call it "the bounce." The core material stiffens up, acting like what Burrows calls a "spherical piston," emitting a shock wave of energy. Neutrinos, which are inert particles, are emitted too. The shock wave and the neutrinos are invisible.

Then, very visibly, there is a massive explosion, and the star's outer layers are ejected into space. This highly perceptible stage is what observers see as the supernova. What's left behind is an ultra-dense object called a neutron star. Sometimes, when an ultramassive star dies, a black hole is created instead.

Scientists have a sense of the steps leading to the explosion, but there is no agreed upon fundamental process about what happens during the "bounce" phase when the implosion at the core reverses direction. Part of the difficulty is that no one can see what is happening on the inside of a star. During this phase, the star looks undisturbed. Then, suddenly, a blast wave erupts on the surface. Scientists don't know what occurs to make the central region of the star instantly unstable. The emission of neutrinos is believed to be related, but no one is sure how or why.

"We don't know what the mechanism of explosion is," Burrows said. "As a theorist who wants to get to root causes, this is a natural problem to explore."

Multiple scientific approaches to solve the problem

The scientific visualization employed by the research team is an interdisciplinary effort combining astrophysics, applied mathematics and computer science. The endeavor produces a presentation through computer-generated images of three-dimensional phenomena. In general, researchers employ visualization techniques with the aim of making realistic renderings of quantitative information including surfaces, volumes and light sources. Time is often an important component, contributing to making the images dynamical as well.

To do their work, Burrows and his colleagues came up with mathematical values representing the energetic behaviors of stars by using mathematical representations of fluids in motion -- the same partial differential equations solved by geophysicists for climate modeling and weather forecasting. To solve these complex equations and simulate what happens inside a dying star, the team used an advanced computer code called CASTRO that took into account factors that changed over time, including fluid density, temperature, pressure, gravitational acceleration and velocity.

The calculations took months to process on supercomputers at Princeton and the Lawrence Berkeley Laboratory.
The simulations are not an end unto themselves, Burrows noted. Part of the learning process is viewing the simulations and connecting them to real observations. In this case, the most recent simulations are uncannily similar to the explosive behavior of stars in their death throes witnessed by scientists. In addition, scientists often learn from simulations and see behaviors they had not expected.
"Visualization is crucial," Burrows said. "Otherwise, all you have is merely a jumble of numbers. Visualization via stills and movies conjures the entire phenomenon and brings home what has happened. It also allows one to diagnose the dynamics, so that the event is not only visualized, but understood."
The research was funded by the U.S. Department of Energy and the National Science Foundation.

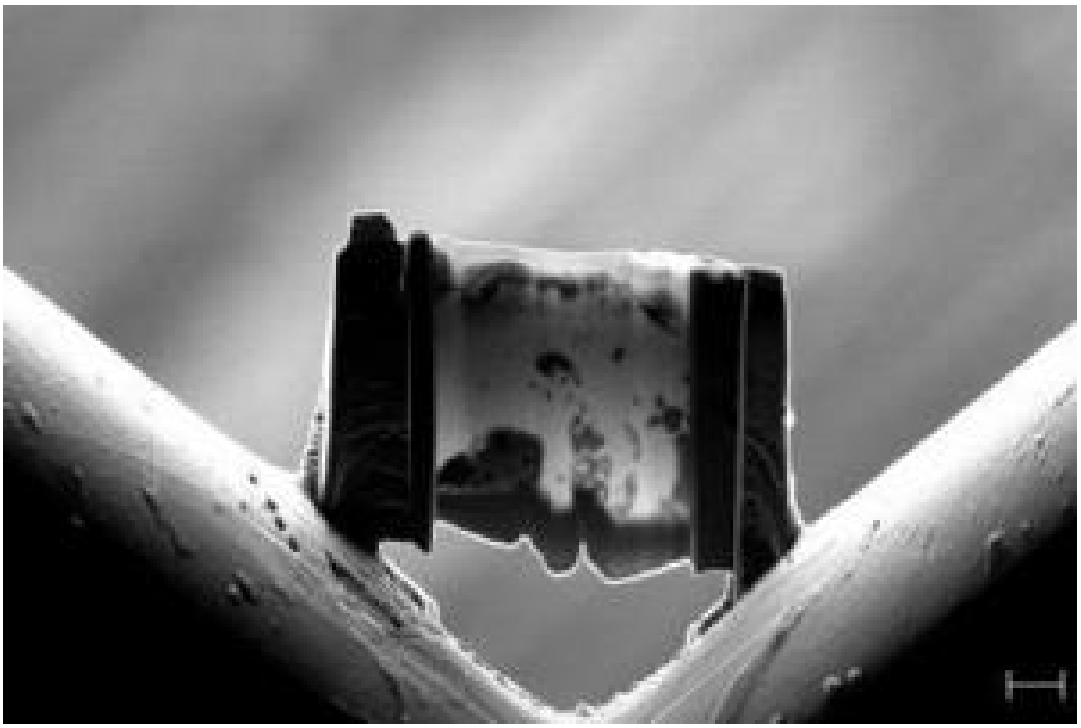
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Princeton University**. The original article was written by Kitta MacPherson.

Journal Reference:

1. J. Nordhaus, A. Burrows, A. Almgren, J. Bell. **Dimension as a Key to the Neutrino Mechanism of Core-collapse Supernova Explosions**. *The Astrophysical Journal*, 2010; 720 (1): 694 DOI: 10.1088/0004-637X/720/1/694

http://www.sciencedaily.com/releases/2010/09/100916113417.htm

When Earth's Mantle Meets Its Core: Findings Boost Hypothesis of Deep Magma Ocean



This is a scanning electron microscopy image of a "mantle" sample after transformation, stuck on a copper grille and thinned down by a focused ion beam (FIB). It allows to detect the different synthesized minerals and liquids during these experiments: a matrix, consisting of a phase of a perovskite structure ((Mg,Fe)SiO3), -- the most abundant mineral in the Earth because it is the most stable in the inferior mantle), is shown in light gray. The veins and liquid pockets enriched in iron and calcium are visible (in dark grey). Scale of the horizontal bar is 2 micrometers. (Credit: G. Fiquet, IMPMC)

ScienceDaily (Sep. 17, 2010) — Earth's mantle and its core mix at a distance of 2900 kilometers under our feet in a mysterious zone. A team of geophysicists has just verified that the partial fusion of the mantle is possible in this area when the temperature reaches 4200 Kelvin. This reinforces the hypothesis of the presence of a deep magma ocean.

The originality of this work, carried out by the scientists of the Institut de minéralogie et de physique des milieux condensés (UPMC/Université Paris Diderot/Institut de Physique du Globe/CNRS/IRD), lies in the use of X-ray diffraction at the European Synchrotron Radiation Facility in Grenoble (France). The results will have an effect in the understanding of the dynamics, composition and the formation of the depths of our planet.

On top of Earth's core, consisting of liquid iron, lies the solid mantle, which is made up essentially of magnesium oxides, iron and silicon. The border between the core and the mantle, located at 2900 km below Earth's surface, is highly intriguing to geophysicists. With a pressure of around 1.4 million times the atmospheric pressure and a temperature of more than 4000 Kelvin, this zone is home to chemical reactions and changes in states of matter still unknown. The seismologists who have studied this subject have acknowledged an abrupt reduction of the speed of the seismic waves, which sometimes reach 30% when getting close to this border. This fact has led scientists to formulate the hypothesis, for the last 15 years, of the partial melting of the Earth mantle at the level of this mantle-core border. Today, this hypothesis has been confirmed.

In order to access the depths of our planet, scientists have not only seismological images but also a precious experimental technique: diamond anvil cells, coupled with a heating layer. This instrument allows scientists to

re-create the same pressure and temperature conditions as those in Earth's interior on samples of a few microns. This is the technique used by the researchers of the Institut de minéralogie et de physique des milieux condensés on natural samples that are representatives of Earth's mantle and that have been put under pressures of more than 140 gigapascals (or 1.4 million times the atmospheric pressure), and temperatures of more than 5000 Kelvin.

A new approach to this study has been the use of the X-ray diffraction technique at the European synchrotron (ESRF). This has allowed the scientists to determine what mineral phases melt first, and they have also established, without extrapolation, fusion curves of the deep Earth mantle -- i.e., the characterization of the passage from a solid state to a partially liquid state. Their observations show that the partial fusion of the mantle is possible when the temperature approaches 4200 Kelvin. These experiments also prove that the liquid produced during this partial fusion is dense and that it can hold multiple chemical elements, among which are important markers of the dynamics of Earth's mantle. These studies will allow geophysicists and geochemists to achieve a deeper knowledge of the mechanisms of differentiation of Earth and the history of its formation, which started around 4.5 billion years ago.

Story Source:

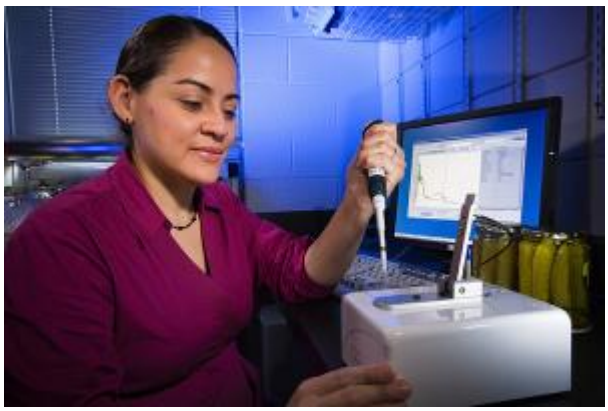
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **European Synchrotron Radiation Facility**.

Journal Reference:

1. G. Fiquet, A. L. Auzende, J. Siebert, A. Corgne, H. Bureau, H. Ozawa, and G. Garbarino. **Melting of Peridotite to 140 Gigapascals**. *Science*, 2010; 329 (5998): 1516-1518 DOI: 10.1126/science.1192448

http://www.sciencedaily.com/releases/2010/09/100917121607.htm

Pickle Spoilage Bacteria May Help Environment



Bacteria that can color pickles' skin red during fermentation may turn out to benefit the environment by cleaning up azo dyes that impart red, orange and yellow color to fabrics which can end up in textile industry wastewater if untreated, according to new research by ARS microbiologist Ilenys Pérez-Díaz. (Credit: Photo by Peggy Greb)

ScienceDaily (Sep. 17, 2010) — Spoilage bacteria that can cause red coloration of pickles' skin during fermentation may actually help clean up dyes in textile industry wastewater, according to a U.S. Department of Agriculture (USDA) study.

Some species of Lactobacilli-food-related microorganisms-can cause red coloring when combined with tartrazine, a yellow food-coloring agent used in the manufacture of dill pickles. Now Agricultural Research Service (ARS) microbiologist Ilenys Pérez-Díaz and her colleagues have found that these spoilage Lactobacilli also may have environmental benefits. ARS is USDA's principal intramural scientific research agency.

The scientists from the ARS Food Science Research Unit in Raleigh, N.C., noted that several Lactobacilli modify azo dyes, which are used in the textile industry and may wind up in wastewater if untreated. These azo dyes impart vivid and warm colors such as red, orange and yellow to fabric. Though many azo dyes are nontoxic, some have been found to be mutagenic.

This is the first report that food-related microorganisms can transform azo dyes into non-mutagenic substances. The findings from this work have been reported in the *Journal of Applied Microbiology*.

According to Pérez-Díaz, considerable effort has been made to identify microorganisms capable of degrading azo dyes in wastewater. If food-grade Lactobacilli capable of degrading a range of azo dyes were identified, they might become organisms of choice for wastewater treatment applications.

This discovery was made during Pérez-Díaz's search for the culprit responsible for causing some commercial dill pickles to have red spoilage bacteria. Pérez-Díaz and her colleagues isolated Lactobacilli from spoiled jars of hamburger dill pickles and used those isolates to inoculate non-spoiled jars of hamburger dill pickles. Jars that contained brines with tartrazine developed the red hue on the pickle skins; those that had turmeric or no added coloring did not.

Seven treatments were tested to find a preventive measure for red-colored spoilage. Pérez-Díaz found that adding sodium benzoate prevented bacterial growth and the development of red-colored spoilage in hamburger pickles.

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 Sharon Durham.

Journal Reference:

1. Roger F. McFeeters, Ilenys Pérez-Díaz. **Fermentation of Cucumbers Brined with Calcium Chloride Instead of Sodium Chloride**. *Journal of Food Science*, 2010; 75 (3): C291 DOI: 10.1111/j.1750-3841.2010.01558.x

http://www.sciencedaily.com/releases/2010/09/100917161157.htm

Father Absence Linked to Earlier Puberty Among Certain Girls

ScienceDaily (Sep. 17, 2010) — Girls in homes without a biological father are more likely to hit puberty at an earlier age, according to a new study led by researchers at the University of California, Berkeley's School of Public Health.

The findings, to be published Sept. 17 in the *Journal of Adolescent Health*, found that the absence of a biologically related father in the home predicted earlier breast and pubic hair development, but only for girls in higher income households. The findings held even after the girls' weight was taken into account.

"The age at which girls are reaching puberty has been trending downward in recent decades, but much of the attention has focused on increased body weight as the primary culprit," said study lead author Julianna Deardorff, UC Berkeley assistant professor of maternal and child health. "While overweight and obesity alter the timing of girls' puberty, those factors don't explain all of the variance in pubertal timing. The results from our study suggest that familial and contextual factors -- independent of body mass index -- have an important effect on girls' pubertal timing."

The findings came from the Cohort study of Young Girls' Nutrition, Environment and Transitions (CYGNET), an epidemiologic project headed by Lawrence Kushi, associate director of etiology and prevention research at the Kaiser Permanente Northern California Division of Research. The project is part of the UC San Francisco Bay Area Breast Cancer and the Environment Research Center (BCERC), one of four centers funded by the National Cancer Institute and the National Institute of Environmental Health Sciences. Early puberty has been linked to greater risk for breast and other reproductive cancers later in life, among other health impacts.

"Although the main focus of the CYGNET Study is on environmental exposures, we are also keenly interested in the social and behavioral contexts in which maturation occurs," said Kushi. "These findings demonstrate that such factors may play important roles in the onset of puberty in girls."

The link between father absence and earlier puberty in girls has been found in previous research, but most of those studies relied upon recall of the girls' first periods, and few examined the contributions of body mass index, ethnicity and income.

In this new study, researchers recruited 444 girls ages 6-8 through Kaiser Permanente Northern California, and have been following them annually. Their analysis was based on the first two years of follow-up. They considered signs of puberty that occur before the start of menarche. In interviews with the girls' caregivers, the researchers asked about the residents in the girls' homes and their relationships to the children.

Among the girls studied, 80 reported biological father absence at the time of recruitment. Contrary to what the researchers expected, the absence of a biologically related father was linked to earlier breast development for girls in higher income families -- those having annual household incomes of $50,000 or more. Father absence predicted earlier onset of pubic hair development only in higher income African Americans families.

The mechanisms behind these findings are not entirely clear, the study authors said. Evolutionary biologists have theorized that the absence of a biological father may signal an unstable family environment, leading girls to enter puberty earlier.

Another theory that has been posited is that girls without a biological father in the home are exposed more to unrelated adult males -- specifically, the pheromones of these males -- that lead to earlier onset of puberty. However, in this study, the presence of other adult males, including stepfathers, in the home did not alter the findings.

It is also unclear why father absence predicted early puberty only in higher income families, particularly for African American girls.

"It's possible that in lower income families, it is more normative to rely upon a strong network of alternative caregivers," said Deardorff. "A more controversial hypothesis is that higher income families without fathers are more likely to have a single mother who works long hours and is not as available for caregiving. Recent studies have suggested that weak maternal bonding is a risk factor for early puberty."

Another possibility is that higher income girls in father-absent homes may be exposed to more artificial light -- which has been shown to accelerate puberty in animal studies -- through television, computers and other forms of technology, according to the study authors. The researchers also suggested that higher income African American girls may be more exposed to certain beauty products, such as hair straighteners, which have estrogenic properties that could influence pubertal timing.

The study adds to the debate of why girls in the United States are entering puberty at an increasingly early age. Last month, a study of 1,200 girls led by BCERC researchers at Cincinnati Children's Hospital Medical Center found that about 15 percent of the girls showed the beginnings of breast development at age 7, an increase from similar studies conducted in the 1990s.

"The hunt for an explanation to this trend is significant since girls who enter puberty earlier than their peers are not only at greater risk for reproductive cancers, they are also more likely to develop asthma and engage in higher risk sexual behaviors and substance abuse, so these studies have broader relevance to women's health," said Bay Area BCERC's principal investigator Dr. Robert Hiatt, UCSF professor and co-chair of epidemiology and biostatistics, and director of population science at the campus's Helen Diller Family Comprehensive Cancer Center.

"In some ways, our study raises more questions than it answers," said Deardorff. "It's definitely harder for people to wrap their minds around this than around the influence of body weight. But these findings get us away from assuming that there is a simple, clear path to the earlier onset of puberty."

Other co-authors of the study are Paul Ekwaru, UC Berkeley Ph.D. student in epidemiology; Bruce Ellis, professor at the University of Arizona; and pediatrician Dr. Louise Greenspan, project manager Anousheh Mirabedi, and research assistant Evelyn Landaverde at Kaiser Permanente Northern California's Division of Research.

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.

http://www.sciencedaily.com/releases/2010/09/100917072126.htm

Women With Diabetes Having More C-Sections and Fetal Complications, Study Finds

ScienceDaily (Sep. 17, 2010) — Nearly half of women with diabetes prior to pregnancy have a potentially-avoidable C-section and their babies are twice as likely to die as those born to women without diabetes, according to the POWER study.

Researchers from St. Michael's Hospital, the Institute for Clinical Evaluative Sciences (ICES) and Women's College Hospital say rates of diabetes in Ontario have doubled in the last 12 years. Nearly one in 10 Ontario adults has been diagnosed with diabetes, including more women than ever before.

As women develop type 2 diabetes (adult onset) during childbearing age, complications during pregnancy are becoming increasingly common.

"We are seeing more younger women living with diabetes. In fact, while older men still have higher rates than older women, women under 45 are getting diagnosed at the same rate as men in that age group," says Dr. Lorraine Lipscombe, a scientist at the Women's College Research Institute at Women's College Hospital and ICES. "This trend is having increasing implications for younger women. With more women having babies later in life, we are seeing a greater number of women getting pregnant with diabetes. The POWER Study found that having diabetes before pregnancy significantly increases the risk of pregnancy and fetal complications."

The POWER (Project for an Ontario Women's Health Evidence-Based Report) Study -- a joint study from St. Michael's Hospital and ICES -- is the first in the province to provide a comprehensive overview of women's health in relation to income, education, ethnicity and geography. The findings are detailed in the report titled Diabetes-the ninth chapter to be released as part of the study. Findings can be used by policymakers and health-care providers to improve access, quality and outcomes of care for Ontario women. The POWER Study was funded by Echo: Improving Women's Health in Ontario, an agency of the Ontario Ministry of Health and Long-Term Care.

"By identifying the provincial variations in diabetes care, the Local Health Integration Networks can now use this data for priority setting, planning and quality improvement activities," says Pat Campbell, CEO, Echo. "By implementing interventions at the policy, population health and practice levels we can reduce these regional inequities and improve the health of both men and women with diabetes."

The POWER study, released Sept. 17, examined the impact of diabetes on Ontarians. Key findings include:

- 45 per cent of women with pre-gestational diabetes are having C-sections compared with 37 per cent of women with gestational diabetes and 27 percent of women without diabetes.
- Babies born to women with pre-pregnancy diabetes have twice as many fetal complications as those born to women without diabetes.
- The rate of stillbirth/in-hospital mortality in women with pre-pregnancy diabetes is twice the rate in women with diabetes (5.2 per 1,000 vs 2.5 per 1,000) than women without diabetes.
- Rates of major and minor congenital anomalies were 60 per cent higher among women with pre-pregnancy diabetes than women without diabetes.
- More than 50 per cent of people who don't yet have diabetes have risk factors for the disease.
- One in four adults aged 65 and older have been diagnosed with diabetes.

"Infants born to women with diabetes are at much higher risk for serious complications -which can be prevented by controlling glucose and blood pressure levels at the time of conception and during pregnancy," says Dr. Gillian Booth, scientist at St. Michael's Hospital and scientist at ICES. "This reflects a need for more targeted pre-pregnancy counselling and better pregnancy care for this group of women."

"Diabetes is quickly becoming a worldwide epidemic, owing to a dramatic rise in type 2 diabetes -- but most diabetes can be prevented," says Arlene Bierman, a physician at St. Michael's Hospital and principal investigator of the study. "We need to focus on preventing or reducing rates of diabetes among young women, one of the most vulnerable groups, and ensure that women who have diabetes get effective treatment," adds Dr. Bierman, also an ICES investigator.

For more information on the POWER Study and its partners, visit www.powerstudy.ca. Other findings from the study will be released later this year.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **St. Michael's Hospital**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/09/100917151850.htm

Teenagers Are More Sedentary on Weekends

ScienceDaily (Sep. 17, 2010) — The new school year has started and the school routine is back. A European study led by Spanish researchers has shown how the proportion of young people who watch television and play on the computer for more than two hours per day doubles at the weekend. And while boys opt for video games, teenage girls prefer to surf the net.

"A sedentary lifestyle has become one of the major public health problems in developed countries," Juan P. Rey-López, lead author of the study and a researcher at the University of Zaragoza (UNIZAR), said. "During the week, one-third of teenagers said the watched more than two hours of television per day. At weekends, this figure exceeds 60%."The results, published in the July issue of the journal *Preventive Medicine*, show that teenagers devote more time to sedentary behaviour (in front of a screen) at the weekend.

The study, which forms part of the European HELENA study, analysed the prevalence of sedentary behaviour in 3,278 adolescents (1,537 boys and 1,741 girls aged between 12.5 and 17.5) in 10 European cities (Athens and Heraklion in Greece, Dortmund in Germany, Ghent in Belgium, Lille in France, Pécs in Hungary, Rome in Italy, Stockholm in Sweden, Vienna in Austria, and Zaragoza in Spain).The teenagers indicated the amount of time they spent in front of the television, computer and games consoles, the amount of time spent connected to the Internet and the amount of time spent studying (outside school hours). The researchers also studied the availability of computers, televisions and consoles at home and in teenagers' bedrooms, and their impact on whether they watched too much television (more than two hours per day).

"Our findings support the recommendation of the American Academy of Pediatrics not to put televisions in teenagers' bedrooms, in order to (theoretically) reduce the amount of time they spend watching the television," says Rey-López.

Computers in the bedroom, but not televisions

"Having a games console or television in the bedroom triples the risk of exceeding the health recommendations to not spend more than two hours per day watching television. However, having a computer in the bedroom reduces the risk of excessive television watching," the researcher from Aragon explains.

The authors also observed significant differences between the sexes in terms of the amount of time spent on sedentary pastimes. Adolescent girls are more sedentary in terms of the amount of time spent studying and surfing the net, while boys spend more time playing electronic games.

According to a study published last month in the *Journal Medicine and Science in Sports and Exercise,* there is a strong association in adults (dose-dependent) between the number of hours spent watching television and cardiometabolic health, making it highly recommendable not to watch television to excess during leisure time.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Plataforma SINC**, via AlphaGalileo.

Journal References:

1. Wijndaele K, Healy GN, Dunstan DW, Barnett AG, Salmon J, Shaw JE, Zimmet PZ, Owen N. **Increased cardiometabolic risk is associated with increased TV viewing time**. *Medicine and Science in Sports and Exercise*, 42(8):1511-8
2. Juan P. Rey-López, Germán Vicente-Rodriguez, Francisco B. Ortega, Jonatan R. Ruiz, David Martinez-Gómez, Stefan De Henauw, Yannis Manios, Denes Molnar, Angela Polito, Maite Verloigne, Manuel J. Castillo, Michael Sjöström, Ilse De Bourdeaudhuij, Luis A. Moreno and on behalf of the HELENA Study Group. **Sedentary patterns and media availability in European adolescents: The HELENA study**. *Preventive Medicine*, 51:50-55 DOI: 10.1016/j.ypmed.2010.03.013

http://www.sciencedaily.com/releases/2010/09/100917085228.htm

Popular Supplements to Combat Joint Pain Do Not Work, Study Finds

ScienceDaily (Sep. 17, 2010) — Two popular supplements taken by millions of people around the world to combat joint pain, do not work, finds research published online in the *British Medical Journal*.

The supplements, glucosamine and chondroitin, are either taken on their own or in combination to reduce the pain caused by osteoarthritis in hips and knees.

The researchers, led by Professor Peter Jüni at the University of Bern in Switzerland, argue that given these supplements are not dangerous "we see no harm in having patients continue these preparations as long as they perceive a benefit and cover the cost of treatment themselves."

However, they add: "Health authorities and health insurers should not cover the costs for these preparations, and new prescriptions to patients who have not received treatment should be discouraged."

Osteoarthritis of the hip or knee is a chronic condition which is mainly treated with painkillers and anti-inflammatory drugs but these can cause stomach and heart problems, especially if used long-term. Treatments that not only reduce pain but slow the progression of the disease would be desirable, say the authors.

In the last decade, GPs and rheumatologists have increasingly prescribed glucosamine and chondroitin to their patients. And many individuals around the world have purchased them over the counter. In 2008 global sales of glucosamine supplements reached almost $2bn, which represents an increase of about 60% since 2003.

The authors say that results from existing trials about the effectiveness of glucosamine and chondroitin are conflicting. A large scale review of studies was therefore needed to determine whether or not the supplements work.

Professor Jüni and colleagues analysed the results of 10 published trials involving 3,803 patients with knee or hip osteoarthritis. They assessed changes in levels of pain after patients took glucosamine, chondroitin, or their combination with placebo or head to head.

They found no clinically relevant effect of chondroitin, glucosamine, or their combination on perceived joint pain or on joint space narrowing.

Despite this finding, some patients are convinced that these preparations are beneficial, say the authors. They suggest this might be because of the natural course of osteoarthritis or the placebo effect.

"Compared with placebo, glucosamine, chondroitin, and their combination do not reduce joint pain or have an impact on narrowing of joint space. Health authorities and health insurers should be discouraged from funding glucosamine and chondroitin treatment," they conclude.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **BMJ-British Medical Journal**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Simon Wandel, Peter Jüni, Britta Tendal, Eveline Nüesch, Peter M Villiger, Nicky J Welton, Stephan Reichenbach, Sven Trelle. **Effects of glucosamine, chondroitin, or placebo in patients with osteoarthritis of the hip or knee: network meta-analysis**. *British Medical Journal*, 2010; DOI: 10.1136/bmj.c4675

http://www.sciencedaily.com/releases/2010/09/100916202428.htm

Veterinarian Says Natural Foods Not Always Best for Pets

While natural food is a rising trend among humans, pet owners should be careful before feeding similar types of food to their pets, according to a Kansas State University veterinarian. All too often pet owners assume that because certain foods, such as fruits and vegetables, are healthy for them, they are also healthy for their pets. (Credit: iStockphoto)

ScienceDaily (Sep. 16, 2010) — While natural food is a rising trend among humans, pet owners should be careful before feeding similar types of food to their pets, according to a Kansas State University veterinarian. All too often pet owners assume that because certain foods, such as fruits and vegetables, are healthy for them, they are also healthy for their pets, said Susan Nelson, K-State assistant professor of clinical services. "Natural and veggie-based pet foods are based more on market demand from owners, not because they are necessarily better for the pet," she said.

Natural pet food isn't necessarily unhealthy for pets, and there are good brands on the market. But cats and dogs have specific nutritional needs that some of these foods may not provide, Nelson said.

For instance, a natural dog food may provide antioxidants through fruits and vegetables, but it may be deficient in other nutrients the dog needs. If pet owners opt for natural pet food, it's important to make sure pets still receive a well-balanced diet, she said.

Before buying any pet food that is labeled natural, owners should make sure it comes from a reputable company. Nelson said the Association of American Feed Control Officials, or AAFCO, sets guidelines for the production, labeling and distribution of pet food and sets minimum standards for the nutritional adequacy of diets.

To ensure that food contains the proper nutrients a pet needs, pet owners should only buy pet food that has at least one of the two AAFCO nutritional adequacy statements on its label, Nelson said. The association's standards determine whether a pet food company's product is complete and balanced for a specific life stage according to one of two criteria: the diet's formula meets the minimum nutrient requirements established by the association or the diet has undergone association feeding trials.

Feeding trials, while not perfect, generally give the best assessment on how well the food performs for a specific life stage, Nelson said. Owners should look closely at the feeding statement on the label, as some foods are intended for intermittent feeding or only for specific life stages, and they could be detrimental to a pet if fed long-term.

Nelson said it is important to differentiate between terms such as natural, organic and holistic. Organic and holistic currently have no specific definitions for pet foods under the Association of American Feed Control Officials guidelines. Organic is defined by the U.S. Department of Agriculture for human food, but the department has no definition of natural foods for humans.

The feed control association defines natural products as those that don't contain any chemically synthesized ingredients except vitamins or minerals. The labels for natural products containing any of these ingredients must state: "Natural with added vitamins, minerals and other trace nutrients." Consumers should be wary of any pet food company that claims to have organic or holistic food because they don't exist by the association's definition, Nelson said.

Consumers should also pay attention to food ingredients. For instance, cats and dogs should not eat onions or garlic. While flaxseed oil can provide fatty acids for dogs, cats can't use it for this purpose. Any manufacturer that uses these ingredients should be avoided, Nelson said.

"Most reputable companies have a veterinary nutritionist on hand," Nelson said. "These companies also conduct nutritional research and have their own internal quality control in place."

Because dry pet food needs preservatives, there is often debate about whether artificial or natural preservatives are better. Studies show that synthetic preservatives seem to work better and aren't bad for pets at the levels contained in the food. However, market demand is for using vitamins E and C because they are natural preservatives.

As with any pet diet, pet owners who opt for natural pet food should keep an eye on their pets to make sure the food is not negatively affecting them, Nelson said.

"Assuming the diet you have chosen meets AAFCO minimum standards of nutritional adequacy, and if your pet looks healthy, has good coat quality, is in good body condition, has good fecal consistency and is able to do its job, the diet is probably adequate for him," she said.

Story Source:

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

http://www.sciencedaily.com/releases/2010/09/100917085624.htm

Tornado-Chasing Becomes Vacation Choice, Researchers Find

A tornado in a field. (Credit: iStockphoto/Patrick Heagney)

ScienceDaily (Sep. 17, 2010) — Instead of heading to the coast for vacation, people are traveling to Tornado Alley. The number of people registering to get a closer look at tornadoes is growing as vacationers trade in their beach towels for a ride with storm chasers. Labeled "Tornado Tourists" by a University of Missouri research team, these travelers are searching for an experience beyond just thrills.

Sonja Wilhelm Stanis and Carla Barbieri, associate professors in the School of Natural Resources Department of Parks, Recreation and Tourism in the MU College of Agriculture, Food and Natural Resources, found that most of these travelers aren't just looking for risk; rather, they are seeking a unique and unconventional opportunity to enjoy nature's power and beauty.

"With the help of movies like Twister, storm-chasing has become an international phenomenon," Barbieri said. "While more than half of the surveyed travelers lived in North America, 11 percent came from Australia and nearly a third traveled from Europe to get a close encounter with a tornado."

Handling three to 10 tours per season, experienced meteorologists and trained storm chasers are serving as tour guides using sophisticated equipment to track the severe weather on the road. Typically costing between $3,000 and $5,000, not including food and hotels, the tours last one to two weeks as tour guides drive among tornado watch areas in a van.

The study found that most of the amateur storm chasers were happy with their experiences. One-third of the tourists experienced a tornado, while 50 percent spotted funnel clouds and more than 95 percent reported seeing a significant atmospheric event. Most respondents were so satisfied, they said they would take another tour and recommended tornado chasing to their friends.

"Although tornado tourism is a small niche market, the market continues to grow with help from television shows and movies," Stanis said. "Storm-chasing tours continue to develop as a part of the Midwest's tourism scene, with tours filling up as much as a year in advance."

The research team presented the first demographic and socio-psychographic profile of the tornado tourists to a national academic audience at the 2010 Northeaster Recreation Research Symposium in New York. These tornado tourists were introduced into the broader research category called "risk recreation and tourism" that includes activities such as skydiving and white-water rafting.

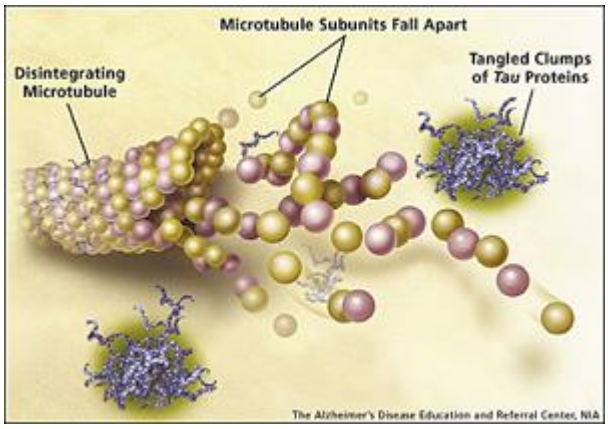
"Tornado tourists were found to be primarily middle-aged, single, highly educated and wealthy," Babieri said. "With this information, storm-chasing tour guides will be better able to cater to their market."

Story Source:

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

http://www.sciencedaily.com/releases/2010/09/100916170921.htm

Researchers Identify Genetic Marker of Aggressive Alzheimer's Disease



When neurofibrillary tangles form, brain cells die and release tau. (Credit: National Institute on Aging)

ScienceDaily (Sep. 17, 2010) — An international team of Alzheimer's disease experts, led by Washington University School of Medicine in St. Louis, has uncovered a gene variation that appears to predict the rate at which Alzheimer's disease will progress.

The investigators report their findings online in the journal *Public Library of Science (PLoS) Genetics*. Whereas previous studies have focused on factors that influence the risk for Alzheimer's, the new research points to a way to determine how rapidly Alzheimer's patients may develop full-blown dementia after their diagnosis.

The investigators studied 846 patients with elevated levels of a protein called tau in their cerebrospinal fluid (CSF). Recent studies have found that the presence of a particular form of the tau protein in the CSF is an indicator of Alzheimer's disease. The researchers also looked at single DNA variations in the patients and identified a genetic marker linked to elevated tau levels. That marker turned out to be associated with rapid progression of Alzheimer's disease.

"People who carry this genetic marker tend to have higher tau levels at any given stage of the disease than individuals without it," says senior investigator Alison M. Goate, DPhil., the Samuel and Mae S. Ludwig Professor of Genetics in Psychiatry. "Until now, most studies of genetic risks associated with Alzheimer's disease have looked at the risk of developing the disease, not the speed at which you will progress once you have it. The genetic marker we've identified deals with progression."

For many patients and their families, that information may be more useful than the knowledge that a person may be developing Alzheimer's damage in the brain even if that individual hasn't yet developed clinical symptoms, according to Goate. Damage from the disease can be present for years before symptoms appear. But this study suggests that elevated tau, combined with the genetic marker, could be a sign that clinical symptoms may quickly advance from mild impairment to severe dementia.

The study advances recent research that found it was possible to diagnose Alzheimer's disease, even in patients with no clinical symptoms, by measuring levels of the amyloid beta protein in the CSF. A-beta makes up the senile plaques that form in the brains of Alzheimer's patients, but it turns out that low levels of A-beta in the CSF predict the presence of Alzheimer's pathology in the brain.

Meanwhile, the tau protein collects in the other abnormal brain structures that characterize the illness, called neurofibrillary tangles. The tangles cause brain cells to die, and when those cells die, tau is released into the CSF. So just as low A-beta levels in the CSF are associated with Alzheimer's disease, elevated tau levels also indicate the presence of disease.

"Tau also can be released in stroke patients or those with other types of brain injuries," says first author Carlos Cruchaga, PhD. "However, a particular form of tau is specific to Alzheimer's. It's a phosphorylated form of the protein called ptau. Other neurodegenerative conditions, like Parkinson's disease, don't produce elevated ptau in the CSF. It's only found in Alzheimer's disease."
Cruchaga, an assistant professor of psychiatry at Washington University, says there was no association between ptau and overall Alzheimer's disease risk or age of onset for Alzheimer's patients, but there was a significant association between a variant of a gene that plays a role in modifying the tau protein, ptau levels in the CSF and the rate at which the disease progressed.
"We have looked at data from three separate, international studies, and in all three, we found the same association," Cruchaga says. "So we are confident that it is real and that this gene variant is associated with progression in Alzheimer's disease."
He says the genetic finding, combined with the ability to measure ptau in the CSF may mean that if drugs could inhibit the protein's accumulation in the fluid, it might prevent or delay some of the devastation associated with Alzheimer's disease.
"If we could somehow decrease tau pathology in those individuals who also have low levels of A-beta in the CSF, we might be able to slow the progression of the disease," Cruchaga says.
Goate says the findings might initially be most useful in the design of clinical trials. If researchers knew in advance that particular study patients were going to progress at a rapid rate, they could better evaluate the effects of drugs designed to slow the progression of Alzheimer's disease.
"I think that if the drug target is A-beta, then treatment really needs to begin even before someone develops symptoms," Goate says. "In contrast, since most of the changes in tau occur after someone already has symptoms, it may be possible to target that pathway to slow progression of the disease, by interfering with the actions of the tau protein."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Washington University School of Medicine**. The original article was written by Jim Dryden.

Journal Reference:

1. Cruchaga C, Kauwe JSK, Mayo K, Spiegel N, Bertelsen S, et al. **SNPs Associated with Cerebrospinal Fluid Phospho-Tau Levels Influence Rate of Decline in Alzheimer's Disease**. *PLoS Genetics*, 2010; 6 (9): e1001101 DOI: 10.1371/journal.pgen.1001101

http://www.sciencedaily.com/releases/2010/09/100916170916.htm

Discovery of Key Pathway Interaction May Lead to Therapies That Aid Brain Growth and Repair

ScienceDaily (Sep. 16, 2010) — Researchers at the Center for Neuroscience Research at Children's National Medical Center have discovered that the two major types of signaling pathways activated during brain cell development -- the epidermal growth factor receptor pathway and the Notch pathway -- operate together to determine how many and which types of brain cells are created during growth and repair in developing and adult brains.

This knowledge may help scientists design new ways to induce the brain to repair itself when these signals are interrupted, and indicate a need for further research to determine whether disruptions of these pathways in early brain development could lead to common neurodevelopmental disorders such as epilepsy, cerebral palsy, autism, Down syndrome, ADHD, and intellectual disabilities.

"By understanding how these cellular signaling pathways operate in the brain, we may be able to develop genetic or molecular approaches that target those signals to facilitate or induce regeneration of the brain from neural stem cells," said Vittorio Gallo, PhD, director of the Center for Neuroscience Research at Children's National. "These signaling pathways, normally activated during brain development, work in concert through the cellular microenvironment and through interactions with existing brain cells to determine how many of each type of brain cell are required for proper brain function."

These findings are being published in the journal *Nature*.

Dr. Gallo and the research team used an approach in a laboratory setting that modified genes involved in the two signaling pathways. This approach induced gain or loss of function, allowing researchers to change the properties of neural stem cells as they developed -- including altering the size of the pool of neural stem cells in the brain, the number of viable neural stem cells, and types of brain cells these stem cells ultimately become.

Neural stem cells can develop into all major cell types of the brain. The discovery of the interaction between the two types of cellular signaling pathways is a critical step toward understanding, and potentially impacting, the molecular networks that regulate the cellular microenvironments, or niches, in which these neural stem cells operate.

"Children's National provides an ideal setting for pursuing this research, because we are able to use a multidisciplinary approach to our studies," Dr. Gallo said. "Investigators and clinical fellows work together in the labs to tackle important questions that have great clinical importance for children with neurodevelopmental disabilities, and tap resources and expertise at other institutions as well. This environment allows us to translate our findings into the design of specific therapeutic approaches, working together with neuroscientists, child neurologists, neurosurgeons, and neuro-oncologists."

The research was conducted by Dr. Gallo and Adan Aguirre, PhD, of the Center for Neuroscience Research at Children's National Medical Center, and Maria E. Rubio, MD, PhD, of the Department of Otolaryngology at the University of Pittsburgh Medical School.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Children's National Medical Center**.

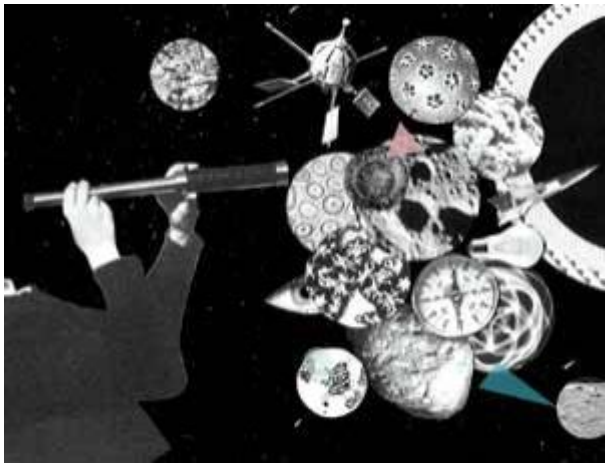
Journal Reference:

1. Adan Aguirre, Maria E. Rubio, Vittorio Gallo. **Notch and EGFR pathway interaction regulates neural stem cell number and self-renewal**. *Nature*, 2010; 467 (7313): 323 DOI: 10.1038/nature09347

http://www.sciencedaily.com/releases/2010/09/100916101902.htm

What's eating the stars out of our galaxy's heart?

- 20 September 2010 by **Marcus Chown**
- Magazine issue 2778.



There's a hole at the centre of our galaxy (Image: http://www.iamciara.co.uk/

The centre of the Milky Way is darker than you'd expect – and not just because it's home to a supermassive black hole

A LITTLE over 25,000 light years away lies the most mysterious place in the nearby universe. Jam-packed with colliding stars and cloaked in dust, it is the centre of our galaxy. At its very heart, we suspect, lurks a monstrous black hole more than 4 million times as massive as the sun. Known as Sagittarius A*, it is thought to rip stars apart, orchestrating stellar mayhem as it warps the very fabric of space and time.

Similar supermassive black holes are thought to exist at the centre of every galaxy. It is only now, by observing stars whirling about the monster closest to home, that we stand on the verge of confirming their existence once and for all. Not only that, we could also test Einstein's general theory of relativity in the most extreme environment yet.

While the centre of our galaxy could serve as a lab for studying processes that occur in other galaxies, the first tantalising glimpses of it are throwing up surprises about our own. Recent observations have revealed that the heart of our galaxy harbours a second kind of hole - a region of space containing only a few young stars and mysteriously empty of older ones.

Previous scans of the Milky Way's heart showed a few dozen young stars whose bright blue light is intense enough to shine through the shroud of dust. Astronomers expected them to be the tip of the stellar iceberg, their light overwhelming the faint glow emitted by vast numbers of more ancient stars.

That all changed when three teams independently got their hands on sensitive infrared telescopes capable of penetrating the dust shrouding the galactic centre. As they scanned the Milky Way, they counted thousands of old stars. But when they got very close to the galactic centre, the numbers plummeted, revealing a patch of space 3 light years across that was seriously lacking in stars (*Astronomy & Astrophysics*, vol 499, p 483).

The hole story

This is a big surprise because it goes against our ideas of what ought to be happening at the galactic centre. The gravitational field around Sagittarius A* is thought to be strong enough to have herded stars into its neighbourhood over billions of years. So why aren't there more ancient stars at the galactic centre?

The most mundane explanation is that even the latest infrared telescopes are not sensitive enough to pick up their faint light. But there is also a more exciting possibility: that the centre of the galaxy is composed of super-dense bodies that are hard to see, such as neutron stars and stellar-mass black holes left behind in supernova explosions. If this idea is correct, it suggests that most of the stars that form at centre of the galaxy are massive ones that end their lives as supernovae. "This would make the region different from all other places we have observed," says David Merritt of the Rochester Institute of Technology in New York.

There are problems with this scenario, however. The main one, says Merritt, is that these massive stars would not grow up alone: a small number of less massive stars should also have formed here. At the end of their life these would have grown into red giants, luminous stars that should be easy to observe. So why haven't we seen any? One possibility is that the stellar-mass black holes ate all the red giants, but "it is hard to make this

scenario work", Merritt says. "We would need more stellar-mass black holes than can be accounted for by the 1 million solar masses of matter known to exist in the innermost part of the galaxy."
An even more exotic explanation is that sometime in the past, the Milky Way merged with another galaxy whose own supermassive black hole swallowed some of the Milky Way's stars. Alternatively Sagittarius A* itself could be responsible for the stellar void surrounding it. Anything straying within about 5 light minutes of a supermassive black hole would be ripped apart, a fate that could have befallen the missing stars.

Eyeing the monster

Merritt also blames Sagittarius A*, but favours a slightly different scenario. He has calculated that the orbits of stars circling Sagittarius A* will become longer and narrower over time. Eventually the stars will venture close enough to the black hole to be sucked in. Alas, this theory, too, has problems. As stars are continually forming, in order to create a void "you would have to send stars towards the supermassive black hole, then stop further stars being resupplied" to the central region, Merritt says. But it is hard to see just what could stop stars arriving at the galaxy's heart.
So while there are plenty of ideas on the table, the mystery persists. "The observational results are not sufficient to really determine which of these scenarios is most likely, or even rule one out completely," says Rainer Buchholz of the University of Cologne in Germany, who helped discover the void at the galactic centre. "For now, we can assume the hole is there, though we do not know for certain why." To find an answer we will need to get closer to the monster at the heart of the Milky Way.
Luckily, a number of techniques are allowing astronomers to do that. Those same techniques could also help us achieve something even more profound: putting general relativity - Einstein's theory of gravity - to the test. Its effects in the vicinity of planets, stars and galaxies have been probed, and the theory has passed with flying colours every time. Where relativity hasn't been checked is in the extreme gravitational field of a black hole, where space and time are warped to an extraordinary degree. By watching exactly how matter falls into a black hole, astronomers hope to tell whether black holes are anything like the picture of them painted by general relativity.
Up till now the most promising technique has been very long baseline interferometry (VLBI), which combines the signals from radio telescopes scattered across the globe to simulate a radio dish as big as the Earth. This virtual dish can resolve fine detail in astronomical objects, but even so its vision isn't yet acute enough to discern the most distinguishing feature of the supermassive black hole: its event horizon. The point of no return for in-falling matter, it is about 15 million kilometres across, or one-tenth of the distance between Earth and the sun - minuscule in astronomical terms. Even the best picture of Sagittarius A* to date, taken by a team led by Shep Doeleman at the Massachusetts Institute of Technology's Haystack Observatory in Westford, is still too blurred by a factor of 3.
There is, however, a way to boost VLBI's resolution: observing at wavelengths shorter than the centimetre-long ones studied so far. By looking at wavelengths of 1.3 millimetres and maybe even 0.87 millimetres, the technique should finally be able to pick out what is happening near the event horizon (*New Scientist*, 23 May 2009, p 28).
Even so, it won't be easy. The radio waves we are trying to observe are emitted by electrons inside "hotspots" in the electrically charged gas swirling into the supermassive black hole. To test general relativity in the vicinity of the black hole, we would first have to run computer simulations of the swirling gas, predict its radio emission, and compare it with the observations. "VLBI is a promising technique but it is unlikely to give us a clean signal," says Merritt. "It's messy."
Two groups of astronomers have a far cleaner way of probing Sagittarius A*: observing the individual stars orbiting it. Teams led by Reinhard Genzel of the Max Planck Institute for Extraterrestrial Physics in Garching, Germany, and Mark Morris of the University of California, Los Angeles, have been observing 20 super-bright stars orbiting within 100 light days of our galaxy's centre.
One star is pre-eminent in their studies: a heavyweight called S2 that is 20 times as massive as the sun. S2 is the only star to have been observed making a complete orbit of the galactic centre, a journey that takes it 15 years. From this, Genzel and Morris's teams have calculated the mass of the central supermassive black hole to be 4.3 million times that of the sun, which is slightly higher than previous estimates (*The Astrophysical Journal Letters*, vol 707, p L114-L117).

Let's not forget that, until now, there has only been indirect evidence for a black hole at the centre of our galaxy. We know that something massive lurks there because its gravity affects the motion of nearby stars, and the most likely culprit is a black hole. But we need direct evidence to be sure. Now the hope is that stars like S2 will not only provide that evidence but also allow us to test our most cherished ideas about black holes.

We know that something massive lurks at the galaxy's centre because of its gravitational effects, but we need direct evidence to be sure that it is a black hole

Among them is the idea, known as the no-hair theorem, that black holes are essentially so simple that they can be described adequately by their mass and how fast they spin. Theorist Clifford Will of Washington University in St Louis, Missouri, suggests that we could test the theorem, and therefore general relativity, by examining the orbits of stars close to the supermassive black hole. One way to do this would be to watch a star complete many orbits around the galactic centre. Einstein's theory predicts that the star's point of closest approach to the centre should progressively shift from one orbit to the next. If the no-hair theorem is correct, the rate of this "precession" depends on the mass and spin rate of the black hole, and nothing else. Even better, says Will, would be to track two stars (*The Astrophysical Journal Letters*, vol 674, p L25). That way, you can use the relationship between both stars' orbits to cancel out the mass of the black hole, so the precession depends only on its spin. If it turns out that the precession depends on something more complex, then the no-hair theorem is wrong. And if that is true, then general relativity is also wrong. So the stakes are high.

If a black hole's gravity doesn't depend on just its mass and spin rate, then general relativity is wrong

Another way to test relativity is to use pulsars. These super-dense remnants of supernova explosions spin very rapidly, sweeping a lighthouse beam of radio waves across the sky once every turn. This makes them fantastically precise timekeepers. If any exist in the centre of the galaxy, then we might be able to pick up another relativistic effect - gravitational time dilation, where the passage of time slows down in the warped space-time surrounding a massive object. Spot this and we would have evidence of a massive black hole.

Star-spotting

Unfortunately, pulsars are intrinsically faint, making them difficult to detect in the dusty galactic centre. But astronomers have just embarked on an attempt to detect all the pulsars in the Milky Way, and they are hopeful of observing pulsars in the centre of the galaxy (*New Scientist*, 17 March 2010, p 30).

General relativity isn't under threat just yet. So far S2 is the only star we know of that comes within 1 light day of Sagittarius A* during its orbit. To really probe the space-time around the supermassive black hole, we will need to observe many more stars this close to the galaxy's centre.

That is the aim of a team led by Andrea Ghez at the University of California, Los Angeles, which is currently upgrading the infrared interferometer at the twin 10-metre Keck telescopes in Hawaii. Meanwhile, Genzel's team is building an instrument called Gravity that will combine near-infrared light collected by the four telescopes at the Very Large Telescope in Cerro Paranal, Chile, to measure faint objects with unprecedented resolution. They hope it will let them watch stars moving within a region just a few times the diameter of the supermassive black hole's event horizon. The instrument could be in operation by 2013.

For billions of years the Milky Way has kept its best secrets hidden from view. Waiting a few more years before we finally uncloak its supermassive black hole isn't too much to ask, is it?

Marcus Chown is the author of We Need to Talk About Kelvin (Faber & Faber, 2010)

http://www.newscientist.com/article/mg20727780.900-whats-eating-the-stars-out-of-our-galaxys-heart.html?full=true&print=true

Bad breath sniffer to hunt for life on Mars

- 16 September 2010 by **David Shiga**
- Magazine issue 2778.

The Curiosity rover, formerly called the Mars Science Laboratory, will sniff for molecules associated with life as we know it (Image: NASA)

IF THERE'S life on Mars, we might smell it before we see it. A chemical involved in bad breath and flatulence in humans could lead us to alien microbes on the Red Planet.

The sulphur-containing molecule methyl mercaptan is naturally produced in significant quantities on Earth only by microbes, including some that make their pungent presence known in the human body. NASA's next Mars rover is highly sensitive to the smelly chemical, which could betray the presence of Martian microbes, says Steven Vance of NASA's Jet Propulsion Laboratory in Pasadena, California.

The instrument in question is the Tunable Laser Spectrometer, which will fly on the Curiosity rover - set to land on Mars in 2012. TLS was designed to analyse the carbon isotopes in Mars's methane to search for signs that the gas has a biological origin. But the isotope tests might produce ambiguous results, so finding methyl mercaptan would help bolster the case for Martian microbes, Vance says. TLS should be able to detect the gas at concentrations below 100 parts per billion, according to his team's tests on a similar spectrometer (*Planetary and Space Science*, DOI: 10.1016/ j.pss.2010.08.023).

The rover should be able to detect the biomarker gas at concentrations below 100 parts per billion

The researchers are also planning to check TLS's sensitivity to other gases produced by terrestrial microbes, like ethane. "We're demonstrating its ability to look at additional biomarkers and hopefully that will help us in our search for life," Vance says.

Kenneth Nealson at the University of Southern California in Los Angeles, who was not involved in the study, says finding several potential indicators of life in the same place would make it a good target for follow-up missions. "I think you'd get pretty excited," he says. "You'd want to make sure that the next lander would spend time at that site."

http://www.newscientist.com/article/mg20727784.100-bad-breath-sniffer-to-hunt-for-life-on-mars.html

Space junk: Hunting zombies in outer space

- 15 September 2010 by **Stuart Clark**
- Magazine issue 2777.

Who you gonna call? Junk busters! (Image: Julien Pacaud

If we don't deal with orbital debris, Earth will one day have rings of refuse – and we'll be cut off from space

EARTH'S rings have never looked so beautiful, you think as you look up at the pallid sliver of light arcing through the night sky. Yet unlike Saturn's magnificent bands of dust and rubble, Earth's halo is one of our own making. It is nothing but space junk, smashed-up debris from thousands of satellites that once monitored our climate, beamed down TV programmes and helped us find our way around.

This scenario is every space engineer's nightmare. It is known as the Kessler syndrome after Donald Kessler, formerly at NASA's Johnson Space Center in Houston, Texas. Back in 1978, he and colleague Burton Cour-Palais proposed that as the number of satellites rose, so would the risk of accidental collisions. Such disasters would create large clouds of shrapnel, making further collisions with other satellites more likely and sparking a chain reaction that would swiftly surround the Earth with belts of debris. Orbits would become so clogged as to be unusable and eventually our access to space would be completely blocked.

On 10 February 2009 it started to happen. In the first collision between two intact satellites, the defunct Russian craft Kosmos-2251 struck communications satellite Iridium 33 at a speed of 42,100 kilometres per hour. The impact shattered one of Iridium 33's solar panels and sent the satellite into a helpless tumble. Kosmos-2251 was utterly destroyed. The two orbits are now home to clouds of debris that, according to the US military's Space Surveillance Network (SSN), contain more than 2000 fragments larger than 10 centimetres. The collision may also have produced hundreds of thousands of smaller fragments, which cannot currently be tracked from Earth.

Such debris is a serious worry. With satellites travelling at tens of thousands of kilometres per hour, any encounter with debris could be lethal. "Being hit by a 1-centimetre object at orbital velocity is the equivalent of exploding a hand grenade next to a satellite," says Heiner Klinkrad, head of the space debris office at the European Space Agency in Darmstadt, Germany. "Iridium and Kosmos was an early indication of the Kessler syndrome."

Space junk isn't just made up of dead satellites. It also includes spent upper-stage rockets, used to loft the satellites into orbit, and items that have escaped the grasp of butterfingered astronauts, such as the glove Ed White dropped in 1965 as he became the first American to walk in space, and the tool kit that slipped from Heide Stefanyshyn-Piper's hand during a 2008 space walk. Protective covers and the explosive bolts used to separate them from uncrewed spacecraft have also been left to float away, along with a few lens caps for good measure. Some of these objects re-enter the atmosphere and burn up, but most are still up there.

The SSN has catalogued 12,000 objects in Earth orbit that are at least 10 centimetres in size, about three-quarters of which are space junk. For objects bigger than 1 centimetre, the estimates are frightening: there are anything from hundreds of thousands to millions of them, mostly in unknown orbits and each capable of smashing a satellite to smithereens. Every rocket launch creates yet more space debris, edging us ever closer to the Kessler syndrome becoming a reality.

Graveyards and zombies

So what can be done? For a start, we can try not to make the problem worse. This can be as simple as ensuring that protective covers are tethered to spacecraft rather than jettisoned. It also includes sticking to international guidelines intended to minimise new debris, drawn up by the Inter-Agency Space Debris Coordination Committee (IADC), which represents all the world's major space agencies. These require, for example, that spacecraft in low Earth orbit must be made to re-enter the atmosphere and burn up within 25 years of finishing their missions.

Communications satellites in the high-altitude geostationary orbit cannot be brought down practically. Instead, the guidelines say operators should use the last of their satellites' fuel to boost them into a "graveyard orbit" 300 kilometres higher up (see diagram). Yet even with these guidelines in place, Klinkrad says, "It is pretty common to leave your spacecraft stranded."

Twelve satellites in geosynchronous orbit failed in 2008, but only seven were boosted in accordance with the guidelines. And more than 800 of the 1200 trackable objects near the geostationary corridor are not active satellites. The most recent drama there involved the communications satellite Galaxy 15, which became widely known as the "zombie satellite" (see "March of the zombie").

Even if the guidelines were followed to the letter, the number of debris fragments would still go up. "We could even stop launching and the amount of debris would still rise," says Hugh Lewis of the University of Southampton in the UK. That's because accidental collisions would still happen.

Kessler predicted that if nothing were done to remove debris, we would begin to suffer the consequences in 2000. As it turned out, the Iridium and Kosmos collision did not happen for another nine years. The main reason for our period of grace may be that modern satellites are manoeuvrable. When a piece of space debris is seen approaching, satellite operators can move their "bird" out of the way.

Such ducking and dodging used to be rare. Not any longer. A few years ago, operators were receiving one or two warnings of space debris a month; now it can be two or three times a week. Every time a new warning comes in, they must begin a 72-hour tracking campaign using ground-based radar to refine the orbit of the object and establish whether to take evasive action or not.

A few years ago, we were receiving one or two warnings of space debris a month. Now it's three a week

As if accidents weren't bad enough, in 2007 China launched a missile that destroyed their Feng Yun 1C weather satellite. It was an ostentatious display of military capability, perhaps intended as a warning to anyone thinking of putting weapons into space, but it also sent shock waves through space operations centres around the world. That incident, in combination with the Iridium smash in 2009, created so much debris that the number of fragments in low Earth orbit large enough to be tracked from the ground almost doubled.

Some craft are more vulnerable to debris than others, says Lewis, who has developed software to model how space junk spreads and evolves over time. Take the A-train - four satellites that orbit Earth one behind the other, monitoring the atmosphere as they go. The closest pair are just 15 seconds apart, and this proximity makes the A-train especially vulnerable. Should one of the A-train's units be smashed by an incoming piece of debris, the chances are we could lose all four.

As things stand, remediation - as space engineers call it - is a necessity. In other words, someone will have to go up there and bring the stuff down. But which bits? Who will do it? How will they do it? And who is going to pay?

Initially the temptation might be to bring down as much as we can, but this will cost. "It will be so expensive to remove satellites from orbit that you will have to target which ones you want to take down," Lewis says.

He has investigated a number of approaches that aim to identify the most dangerous space junk. The most obvious strategy might be to target the biggest objects, but Lewis's analysis shows that this may not be best. Just because something presents a large target does not mean that it would imperil other satellites. It may be that a smaller defunct satellite in a particular orbit presents more danger to a greater number of live craft.

To make this idea more tangible, Lewis is treating satellites and space junk as elements in a kind of mathematical network, a network whose connections reveal how many objects a given satellite approaches in orbit (*Acta Astronautica*, vol 66, p 257). "It is like Google page-ranking. The most connected objects come up near the top of the list," says Lewis.

These orbital connections can be used to decide which objects are the most dangerous. Bring those down and you halt the Kessler syndrome in its tracks. Lewis won't be drawn on which bits of junk are the most dangerous, however; he is loath to rile their owners.

A range of new technology could be used to bring down dead satellites, Lewis says, and it would itself be satellite-based. A specialised satellite could fire a laser at a derelict craft, melting components and releasing gas that would propel it out of harm's way. Or the clearance satellite could play an orbital game of "pin the tail on the donkey", attaching tethers to the dead satellite to increase atmospheric drag and cause it to burn up in the atmosphere.

On the face of it, every country ought to welcome the development of new technology to clean up space. In reality, the picture is clouded by the obvious military applications. "If you can bring down dead satellites, you can bring down live ones too," Lewis says.

Space bounty

Then there are the legal issues around space debris. Under maritime law, anyone can remove an abandoned ship without the owner's permission. Not so for space vehicles, as stipulated in the 1967 Outer Space Treaty. "Once you put it up there, it is yours for life," says James Dunstan, a lawyer specialising in issues to do with space and founder of Mobius Legal Group in Washington DC. So the US may not remove a Russian satellite from orbit with impunity, even if that satellite were completely dead and presenting a danger to working spacecraft.

Together with Berin Szoka of the Progress and Freedom Foundation, a think-tank also based in Washington DC, Dunstan has created the outlines of an economic model that would see private industry taking responsibility for removing space debris. An international body, such as the IADC, would put a price - rather like a bounty - on every defunct satellite. Private companies can lodge bids with satellite owners for the right to buy and de-orbit their spacecraft. Once de-orbiting is successfully completed, the company could pocket the bounty, which would be funded out of a new tax that satellite operators would have to pay.

But why bring these things down just to burn up in the atmosphere when they are potentially valuable? Dunstan estimates that of the 6000 tonnes of material in Earth orbit, one-sixth is high-grade aluminium in the form of discarded upper rocket stages. These empty fuel tanks have an internal volume 20 times that of the International Space Station. If they could only be corralled, they would make an inexpensive space station or, Dunstan suggests, they could be cut into shielding material to protect other satellites. "Why not set up Joe's Shingle Shack in orbit?" he asks, only half-joking.

While the orbital equivalent of a used-car salesman selling satellite parts is some way off, the need to do more about space junk is immediate. "Our future ability to use space is directly jeopardised by space debris," says Szoka. Encouragingly, the European Space Agency has signed a contract with Spanish company Indra Espacio to develop a radar system to track space debris. In the US, Ball Aerospace and Technologies has collaborated with Boeing on the Space Based Space Surveillance satellite, a dedicated space-junk telescope awaiting launch.

"It is very urgent that we begin to remove mass from orbit," says Klinkrad. Even as we talk, his team is beginning another tracking campaign. Something is stalking ESA's ERS-1 satellite, and they have to decide in the next day or two whether or not to use precious fuel to move the spacecraft. As Klinkrad says in a resigned voice, "This is becoming an everyday situation."

March of the zombie

Galaxy 15 is a name to strike terror into the hearts of satellite operators around the world. Once an ordinary and largely anonymous telecommunications satellite, it is now a zombie. It stopped talking to its masters on 5 April, just as a solar storm battered the Earth.

The satellite's owner Intelsat is still investigating whether this caused Galaxy 15 to lose its mind. But Galaxy 15 is not only a problem for its owner. Following its malfunction, it began an inexorable march across space, bound for a natural orbital graveyard created by Earth's gravity. In its blind stumble to get there, Galaxy 15

risks colliding with other satellites. It has already menaced three and has at least three others in its path. To avert destruction, satellite operators must wait for the zombie to draw close and then manoeuvre their own satellite to "leapfrog" it.

What makes Galaxy 15 particularly annoying is that its main transmitter and receiver are still working. As it drifts across the path of another working satellite, it could interfere with communications. To avoid this, satellite operators are signalling on tighter beams with larger antennae and less power. In effect they are whispering to their satellites in the hope they won't attract the zombie's attention.

All of this is costing money - big money. "These satellites are profit centres making millions of dollars a month," says James Dunstan of Mobius Legal Group in Washington DC. Every dodge to avoid a collision eats around $10 million into a satellite's profits. That's because collision avoidance manoeuvres waste precious fuel that would otherwise be used to combat the tendency for satellites to drift off into orbital graveyards. Although companies do not divulge how much fuel they use in collision avoidance manoeuvres, Dunstan estimates that each one must shorten a satellite's lifespan by between four and 12 months. He says dealing with Galaxy 15 could easily cost the telecomms industry $100 million.

Tobias Nassif of Intelsat sees it differently. He says that constant vigilance means that most collision manoeuvres can be built into ones made fortnightly to stop satellites drifting. "Space debris is not a grave concern," he says, "but it is always on our mind."

Stuart Clark is author of The Big Questions: The Universe (Quercus, 2010). Find his blog at www.stuartclark.com

http://www.newscientist.com/article/mg20727772.300-space-junk-hunting-zombies-in-outer-space.html

Did Jupiter and Saturn play pinball with Uranus?

- 17 September 2010
- Magazine issue 2778.

A victim of planetary pinball (Image: Chuck Elliot/Getty)

URANUS may have been batted back and forth between Jupiter and Saturn before being flung out to its present location, new simulations suggest.

Previous modelling has shown that Jupiter and Saturn moved out of their initial orbits in the early solar system, scattering nearby objects.

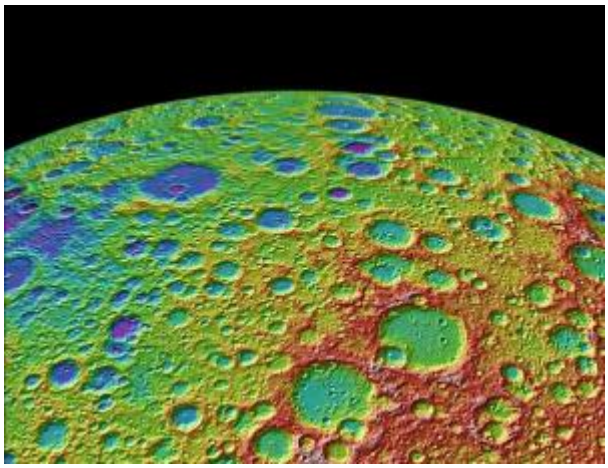
In some simulations, this led to Uranus crossing the path of Saturn, which could then have flung it towards Jupiter, which lobbed it back to Saturn. The process might have happened three times before Uranus was finally ejected beyond Saturn, to where it now resides. Hurling Uranus would have caused Jupiter and Saturn to recoil, further shifting their orbits.

New simulations led by Alessandro Morbidelli of the Côte d'Azur Observatory in France suggest this pinball game, which would have lasted just 100,000 years, fits with observations. In an alternate scenario, Jupiter and Saturn moved to their orbits over 5 million years by simply flinging away space rocks, but this would have visibly scarred the asteroid belt (*Astronomical Journal*, in press). "The evolution of the giant planets has been more violent than we thought," Morbidelli says.

http://www.newscientist.com/article/mg20727785.300-did-jupiter-and-saturn-play-pinball-with-uranus.html

Crater map rekindles debate over moon impacts

- 01:02 17 September 2010 by **Maggie McKee**



A laser altimeter aboard NASA's Lunar Reconnaissance Orbiter has mapped the topography of the moon (Image: NASA/LRO/LOLA/GSFC/MIT/Brown)

A new map of lunar craters by NASA's Lunar Reconnaissance Orbiter is stoking a long-smouldering debate about whether the moon was hit by a sudden barrage of impactors early in its life.

The moon is thought to have formed about 4.5 billion years ago, from the debris of a collision between Earth and a Mars-sized body. Its pockmarked surface records a lifetime of impacts, the rate of which, researchers agree, has fallen over time.

At issue is whether there was a sudden spike of impacts 3.9 billion years ago, and if so, what caused it. The evidence for this "late heavy bombardment" comes from rocks collected by Apollo astronauts at several lunar sites, many of which appear to have been melted by impacts at around that time.

A 2005 study led by Robert Strom at the University of Arizona in Tucson suggested these early impactors came from a different source than what hit the moon afterwards. The researchers found a larger proportion of big craters in the moon's oldest "highlands" areas compared to those in younger areas of solidified lava.

Two populations

The team argued that the late heavy bombardment was caused by objects that were pushed out of the main asteroid belt between Mars and Jupiter – possibly dislodged by Jupiter and Saturn in their early wanderings. There is a relative abundance of large bodies in the main asteroid belt, matching the older crater population. The more recent craters may be due to a population of near-Earth asteroids, with orbits that cross that of our planet. These have relatively more small bodies than objects in the main belt, probably because sunlight preferentially pushes small bodies out of the main belt and onto near-Earth paths.

New observations by NASA's Lunar Reconnaissance Orbiter bolster the conclusions of Strom's group. LRO measured the moon's topography by bouncing laser light off the lunar surface and calculating the time it took for the light to return.

Researchers led by James Head at Brown University in Providence, Rhode Island, used the laser data to identify 5185 craters with diameters of at least 20 kilometres.

Covered up

They found that older regions of the moon had higher proportions of large craters than younger regions did. They say that strengthens the argument that there were two different populations of impactors that hit the moon, with the transition in time estimated to have occurred about 3.8 billion years ago, when the last large crater, called Orientale, formed.

But Gerhard Neukum of the Free University of Berlin in Germany disagrees. He thinks the differences in the distribution of crater sizes may instead be due to local surface processes that can cover up craters, such as lava flows and ejected debris from impacts.

These processes did not happen evenly across the moon. Regions paved over by lava, for example, differ in how much lava flowed over them and how often the flows occurred, he says. This would cover up underlying craters in complicated ways, making it impossible to equate the size distribution of craters with the size distribution of impactors. "Don't take [the crater counts] at face value. You have to apply corrections," he told *New Scientist*.

He says the reason that Apollo samples all show evidence of impacts at around the same time is because the Apollo sites lie near a giant impact basin called Imbrium, which formed about 3.9 billion years ago and blanketed surrounding areas with impact debris.

Sample return

To test the late heavy bombardment theory, "we need to have absolute dates on important events", says Jay Melosh of Purdue University in Indiana.

A sudden spike of impacts 3.9 billion years ago would have been so violent that it would have left no large parts of the moon intact. "There would be no older basin, no older structure on the moon that you could still see," says Neukum.

A mission called MoonRise aims to return samples from the 2500-km-wide South Pole-Aitken basin, thought to be the moon's oldest large crater. If its rocks turn out to be significantly older than 3.9 billion years, that would argue against the late heavy bombardment scenario. If selected for funding, the mission would launch in 2016 and return samples to Earth a year later.

Science (vol 329, p 1504)

http://www.newscientist.com/article/dn19461-crater-map-rekindles-debate-over-moon-impacts.html

M-theory: Doubts linger over godless multiverse

- 14 September 2010 by **Kate McAlpine**
- Magazine issue 2778.

Faithful to multiple universes (Image: Fredrick M. Brown/Getty)

STEPHEN HAWKING'S new book *The Grand Design* sparked a furore over whether physics can be used to disprove the existence of God. But few have noted that the idea at the core of the book, M-theory, is the subject of an ongoing scientific debate – specifically over the very aspect of the theory that might scrap the need for a divine creator.

That the laws of nature in our universe are finely tuned for life seems miraculous, leading some to invoke divine involvement. But if there is a multiverse out there – a multitude of universes, each with its own laws of physics – then the conditions we observe may not be unique.

Hawking suggests that M-theory, the leading interpretation of string theory, calls for a multiverse. Others are divided over the strength of this link. "My own opinion is that we don't understand the theory well enough to be able to say whether there is one single universe or a multitude of universes," says M-theorist Michael Duff of Imperial College London.

String theory's grand claim was that it would be able to unite quantum mechanics with general relativity. Until the mid-1990s, however, five different versions of it, each featuring 10 spatial dimensions, were vying with each other, along with a sixth model known as 11-dimensional super-membrane theory. M-theory stitched these six theories together into one overarching theory. But while these six areas are fairly well fleshed out in M-theory, other parts of the theory are threadbare.

One major gap is how and where the seven extra spatial dimensions, beyond the three we experience, are hidden. "The conventional view is that the extra dimensions are very small," Duff says. Alternatively, our universe could exist within a "bulk" that contains the extra spatial dimensions.

A multiverse is compatible with both pictures, so some versions of M-theory are constructed to include a multiverse. However, some theorists argue that being compatible with M-theory does not make a multiverse essential. Duff adds that with our current patchy understanding of M-theory, the multiverse seems plausible enough, but it might not work if we could see the bigger picture. Even then, assuming multiple universes remain mathematically possible, there would still be no proof that they are actually present.

For now, it is hard enough to test string theory, let alone M-theory. Two weeks ago, Duff and his colleagues made some progress by using string theory to make predictions about the behaviour of entangled quantum bits (*Physical Review Letters*, DOI: 10.1103/PhysRevLett.105.100507). This demonstrates that aspects of string theory can be tested in the laboratory, but won't reveal if it is "the right theory to describe all the elementary particles, the big bang – the 'grand design' as Stephen describes it", says Duff.

"It's dangerous to pin your beliefs on any theory of physics," Duff adds, "because it might turn out to be wrong. But if Stephen wants to stick his neck out, I wish him good luck."

http://www.newscientist.com/article/mg20727780.301-mtheory-doubts-linger-over-godless-multiverse.html

New pi record exploits Yahoo's computers

- 16:56 17 September 2010 by **David Shiga**

Pushing pi to 9 trillion digits (Image: Mykl Roventine)

A Yahoo researcher has made a record-breaking calculation of the digits of pi using his company's computers. The feat comes hot on the heels of a breakthrough Rubik's cube result that used Google's computers. Together, the results highlight the growing power of internet search giants to make mathematical breakthroughs.

One way to show off computing power is to calculate pi to as many digits as possible, creating a string that starts with 3.14 and continues to the *n*th digit. The more digits one wants, the more computations it takes. But it is also possible to skip ahead to the nth digit without calculating the preceding ones – for example, determining that the 10th digit is 3, without having to find the first 9 digits: 3.14159265. This is another way of testing computing power, since more computations are required to find higher values of *n*.

Now, Tsz-Wo Sze, a computer scientist at Yahoo in Sunnyvale, California, has used the company's computers to calculate the most distant digits yet.

Downtime

His computer program represents pi in binary notation, and calculated the 2 quadrillionth (2×10^{15}) binary digit, or bit, of pi. It is twice as distant as the previous record, which found a string of bits around the 1 quadrillionth bit.

Calculations that do not skip any digits have come nowhere near this remote territory. The latest record for that kind of calculation is 2.7 trillion digits in decimal notation, which works out to around 9 trillion (9×10^{12}) bits.

Sze's program was installed on 1000 Yahoo computers, each equipped with eight processors. They ran the calculations in July, when they were in low demand for regular work, doing in 23 days what would have taken half a millennium using just one processor.

The computation was made possible by open-source software called Hadoop that allows thousands of networked computers to be used as if they constituted a single extremely powerful machine, a concept called cloud computing. Yahoo programmers have done much of the work to develop Hadoop, though it draws on ideas first published by Google.

Web data

Yahoo is not the only internet giant delving into abstruse mathematics calculations. A recent result showing that any configuration of a Rubik's cube can be solved in 20 moves or less relied on distributing calculations

across many computers at Google, completing in a few weeks what would have taken a single computer 35 years.
Sze says the computing power that companies like Yahoo and Google can bring to bear on these problems is a by-product of their need to speedily process vast amounts of web-related data. "That is why we are building large-scale computation systems," he says.
"As a technology company with big data at its core, we are excited by the possibilities of distributed software systems, most notably, Hadoop," says Eric Baldeschwieler, vice president of Hadoop engineering at Yahoo.

Easily divided

Calculations of pi are especially suited to distributed computing because they are easily broken into smaller parts, says David Bailey of the Lawrence Berkeley National Laboratory in California, which is setting up cloud-computing facilities to run such problems.
"They can be divided into sections and assigned to separate computational processors, which can then operate almost completely independently of the others," says Bailey, who in 1996 co-discovered the first formula allowing one to skip ahead to compute distant digits of pi.
Distributed computing is also being used in a project called the Great Internet Mersenne Prime Search. It searches for large examples of a special class of prime numbers using computing power donated by individual volunteers via the internet.

http://www.newscientist.com/article/dn19465-new-pi-record-exploits-yahoos-computers.html

Real spray-on clothes to hit the catwalk

- 10:38 17 September 2010 by **Sandrine Ceurstemont**

Forget weaving and stitching clothes. A new material could be sprayed directly onto your body and have you ready to go out in minutes.
Particle engineer Paul Luckham and fashion designer Manel Torres from Imperial College London combined cotton fibres, polymers and a solvent to form a liquid that becomes a fabric when sprayed. The material can be built up in layers to create a garment of your desired thickness and can also be washed and worn again like conventional fabrics.
In addition to creating instant fashion, the technology could have a range of other uses – spray-on bandages, for instance. "It's a sterilised material coming from an aerosol can, and you can add drugs to it to help a wound heal faster," says Torres.
On Monday, a fashion show at Imperial will feature the first couture collection created with the material.

http://www.newscientist.com/article/dn19462-real-sprayon-clothes-to-hit-the-catwalk.html

Hendrix's soundman: How I invented Jimi's guitar sound

- 16 September 2010 by **Paul Marks**
- Magazine issue 2777.

Roger Mayer (left) with the band whose sound he helped shape

*Meet **Roger Mayer**, the navy acoustics engineer who created sound effects for the giants of the 1960s rock scene*

How did you get into sound engineering?

I joined the UK's Royal Naval Scientific Service when I left school, training as an engineer. We were working on underwater warfare, using vibrational and acoustical analysis to detect anything at all that makes a noise at sea.

What type of engineering was involved?

The navy was interested in detecting noise from enemy vessels and in the prevention of noise generation in our own ships and submarines. My work involved the mechanics of sound generation and the electronics to measure it. When a steel-hulled sub is running silent, the sound of a dropped spanner can be picked up - and the sub's position located - from up to 160 kilometres away. We could recognise the engine note of each Russian sub and work out which way they were going. It really was like the stuff of *The Hunt for Red October* [a Tom Clancy thriller and blockbuster movie].

What linked your work with music?

Everything I learned about acoustical transmission and electronics was also applicable to guitars, guitar pickups, preamplifiers and effects.

How did you get involved with guitarists?

I grew up with Jeff Beck [of The Yardbirds] and Jimmy Page [The Yardbirds and later Led Zeppelin] and we all used to go to the same pubs in Surbiton and Epsom to the west of London. We listened to the same music and I helped them out technically. I made some "fuzz boxes" for them in around 1964, improving on some American ones that Jimmy Page and Keith Richards [The Rolling Stones] had used.

Tell me about Octavia, the effects device that you developed and Jimi Hendrix used

It's quite complicated. It introduces a series of harmonics at twice the frequency you're playing at but in a way that complements your playing - doubling the frequency of the guitar sound, placing it in the octave above. An analogy is the way that a mirror placed in front of another mirror creates a series of reflections that ricochet into infinity. I used analogue mirror-imaging circuits to create a similar acoustic mirror. The guitarist can vary the effect by "viewing" it from oblique angles.

How did you get to work with Hendrix?

I met Jimi at a club in 1967. When I showed him what Octavia could do he loved it, and wanted to use it on the solos in his next singles - *Purple Haze* and *Fire* - and many more tracks after that. That started a collaboration between us that continued until Jimi died in 1970.

So he wasn't a purist about technology besmirching his art?

Absolutely the reverse. He was like an artist of old being given a new range of pigments. I was providing new colours, techniques and textures for his palette. We worked together to further the range of sounds he could possibly create. He loved breaking new ground.

Bibliography

1. Jimi Hendrix's London flat in Handel House, Mayfair, is open for viewing to mark the 40th anniversary of his death (bit.ly/dbGRJ7)

Profile

Roger Mayer makes recording consoles and music effects systems. He is a descendant of Karl Pichelmayer (1868 - 1914), an Austrian pioneer of electric motor research.

http://www.newscientist.com/article/mg20727776.400-hendrixs-soundman-how-i-invented-jimis-guitar-sound.html

Autism drug aims to balance brain signals

- 15 September 2010 by **Andy Coghlan**
- Magazine issue 2778.

No drugs just yet (Image: Anabella Bluesky/Science Photo Library)

HE first trial of a drug intended to rebalance the brain chemistry of people with autism has helped symptoms in most of the 25 volunteers who tested it - with reductions in irritability and tantrums, and improvements in social skills.

The announcement coincides with news that the US federal government has finalised its financial package for Hannah Poling. In 2008 the government concluded that vaccinations may have resulted in her autism-like symptoms. The family will receive $1.5 million, plus $500,000 annually to cover the costs of caring for her. Her case, however, is likely to be unique - she has a rare underlying genetic condition affecting her mitochondria, the powerhouses of the cell. This was judged to account for the symptoms she developed after vaccination.

As the debate over vaccination and autism rumbles on in the US, the results from the drug trial of arbaclofen are encouraging. Although doctors sometimes prescribe drugs for autism, they are usually antidepressants and anti-psychotics and aimed at specific symptoms.

Arbaclofen, by contrast, is intended to rebalance brain chemistry, said to be awry in people with autism spectrum disorders. "We are trying to normalise signalling functions within the brain," says Randall Carpenter of Seaside Therapeutics in Cambridge, Massachusetts. The firm is developing arbaclofen as a generic under the name STX209.

Previous studies suggest that people with autism produce too much of the neurotransmitter glutamate in the brain, which ramps up neural activity. They may also make too little gamma- amino butyric acid (GABA), which dampens activity down.
"Too much activation with glutamate makes people with autism very sensitive to loud noises and other, sudden changes in the environment, increasing anxiety and fear," says Carpenter. Arbaclofen normalises this imbalance. "It may stop them being oversensitive".
Too much glutamate makes people with autism fearful of loud noises. Arbaclofen corrects this imbalance
The firm released a summary of the results last week, but held the raw data back for publication. Carpenter says the results mirror those released earlier this year from a trial of arbaclofen to combat a specific form of autism linked with fragile X syndrome, which causes mental impairment.
"We've observed significant improvement in social interaction across both studies," says Carpenter, adding that a larger trial of up to 150 patients is planned. But Susan Hyman from the University of Rochester Medical Center in New York cautions against over-interpreting such a small study.
As for last week's vaccine settlement, "the payment does not acknowledge a link between autism and vaccines", says Alison Singer, president of the Autism Science Foundation in New York.
According to Salvatore DiMauro of Columbia University in New York, there are only four other cases of Poling's specific mutation worldwide, so the ruling is unlikely to apply to the other 5000 compensation cases.

http://www.newscientist.com/article/mg20727783.900-autism-drug-aims-to-balance-brain-signals.html

Cousin virus suggests HIV may be deadly for millennia

- 16:44 17 September 2010 by **Bob Holmes**
- For similar stories, visit the **HIV and AIDS** and **Genetics** Topic Guides

Immunodeficiency virus? No problem (Image: Preston Marx/Tulane University)

HIV's close cousin, the simian immunodeficiency virus, has been around for tens of thousands of years at least – much longer than the few hundred years that some earlier studies had suggested. Because SIV does not cause AIDS in its primate hosts, some have speculated that HIV too might stop being lethal within a few centuries – but the discovery that SIV has had millennia to evolve into peaceful coexistence dashes these hopes.

The age of a virus can be determined by measuring its rate of mutation, then calculating how long it would take for this to generate its current genetic diversity.

Preston Marx, a virologist at Tulane University in New Orleans, Louisiana, and his colleagues studied SIV samples from drills, close relatives of baboons. They compared SIV from drills living on Bioko Island, off the coast of Cameroon, to those on the mainland. Because the island has been isolated from continental Africa since the last ice age, 10,000 years ago, the genetic differences between the two virus samples must represent 10,000 years of evolutionary divergence.

Using their comparison of the viruses to estimate the rate of genetic change, the team reckoned that it must have taken at least 32,000 and probably 76,000 years to generate the genetic diversity seen in SIV throughout Africa.

"It hammers home the point that these viruses have been around for a long, long time," says Beatrice Hahn, an HIV researcher at the University of Alabama at Birmingham, who was not connected with the research.

Newcomer virus

If the calculated age is correct, SIV has had millennia to evolve its ability to live in its hosts without causing AIDS. That makes it highly unlikely that HIV, which seems to have first infected humans barely a century ago, will lose its virulence any time soon.

The finding may also be relevant to attempts to control the spread of HIV. If SIV is millennia old, it is likely that humans had been exposed to it off and on for many thousands of years before it made the leap to infect them, becoming HIV.

The increased mobility of the past 100 years has increased the ease with which the virus can be transmitted. Cities, steamboats, railways and roads brought people into a socially connected network that gave HIV the nudge it needed to take hold, says Michael Worobey, an evolutionary biologist at the University of Arizona in Tucson and co-author of the study.

Since digging up the roads to break up the network of transmission isn't an option today, we need to focus on other ways of knocking the virus back below the threshold of viability, he says. This would include diligent use of condoms, antiviral drugs, and other measures to reduce the transmission of HIV.

Journal reference: *Science*, DOI: 10.1126/science.1193550

JG: His conclusion is fairly obvious. Do you think it's worth keeping the last paragraph in?

http://www.newscientist.com/article/dn19464-cousin-virus-suggests-hiv-may-be-deadly-for-millennia.html

Antibiotics play hell with gut flora

- 17 September 2010
- Magazine issue 2778.

Messing with my flora (Image: Alain Pol/ISM/SPL)

ANTIBIOTICS can cause long-lasting changes in the bacteria living in the human gut. As changes in gut flora could increase the risk of some chronic diseases, such as inflammatory bowel syndrome, each course of antibiotics may represent a trade-off between short-term benefit and long-term risk.

Les Dethlefsen and David Relman of Stanford University in California collected more than 50 stool samples from three people over a 10-month period that included two courses of the antibiotic ciprofloxacin. They used gene sequencing to identify the microbial strains present in each sample. They found that each person had a unique set of microbial flora, the composition of which fluctuated around an equilibrium which was disrupted by each course of drugs.

In most cases, the composition quickly returned to its previous state, but in a few, bacterial species present before treatment were replaced by related species. One person completely lost a common genus of bacteria, which did not return for the duration of the study (*Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.1000087107).

Each round of antibiotics is a roll of the dice that could lead to lasting changes in a person's gut microbes, says Dethlefsen. The work shows that antibiotics should be used only when truly necessary, he says.

http://www.newscientist.com/article/mg20727785.000-antibiotics-play-hell-with-gut-flora.html

Chemical patterns on DNA mark out obesity genes

- 17:45 16 September 2010 by **Andy Coghlan**
-

Your genes play a big part in determining your body shape, but that role may not have been set in stone when your parents' egg and sperm got together. It now looks like chemical changes that happen to genes over a person's lifetime may influence how fat they become, without altering their inherited DNA sequences.
This is the first time that prolonged chemical changes to genes during life have been implicated in obesity and body weight.
The findings add to the mounting evidence that it's not only genes that dictate important bodily traits – environmental cues and conditions may also affect such traits by altering gene activity. These "epigenetic" changes influence whether genes are on or off, but do not change the DNA sequence.
The latest findings relate to epigenetic changes which involve methylation, the process by which the addition of chemicals called methyl groups to DNA can turn genes on or off, or moderate a gene's activity by changing the way it is read.

Icelandic obesity

A team led by Andrew Feinberg of Johns Hopkins University School of Medicine in Baltimore, Maryland, and Daniele Fallin of the Johns Hopkins Bloomberg School of Public Health, also in Baltimore, mapped methylation in the DNA of 74 adults with a range of body types, looking for patterns that seemed likely to have been prolonged and set early in life, or even in the womb.
To do this, they first screened the volunteers' DNA in 1991, and picked out 227 regions with methylation patterns that varied between the individual members of the group by an unusually large amount. They then screened the same people in 2002 to distinguish which methylation patterns had not changed over the 11 years, reasoning that the variation in these patterns must have occurred early in life, then become fixed, having a persistent effect on traits such as body weight or intelligence.
Of the 227 methylated sites, 119 were found to be the same in 2002 as they had been 11 years earlier. Feinberg and Fallin then matched these groups to the body type of the individual. They found 13 methylated genes that were more likely to be present in the participants who were overweight or obese.
These chemical changes could have arisen in response to environmental conditions, such as the childhood diet of the individual or even of their mother during pregnancy.
"We don't know yet the degree to which genes and environment add up to give these stable methylation changes, but we believe both are important," says Feinberg.

Usual suspects

The 13 methylated genes include those that make metalloproteinase enzymes, which have already been implicated in obesity through studies on mice. Another, called *PRKG1*, plays a role when insects and nematodes forage for food.
The researchers caution that it is not yet possible to say whether the methylation changes are a result of environment influence, perhaps in the diet, or whether they are ultimately genetic because they are orchestrated by other genes.
But if specific methylated genes linked with obesity can be identified, they may provide new ways to screen people for risk of becoming overweight or obese. "The results do suggest the importance of including epigenetic analysis with genetic analysis in personalised medicine research to predict risk," says Feinberg.
"Relationships between epigenetic markers such as methylation patterns and particular disease or body states are hard to establish with confidence," says Bryan Turner, a geneticist at the University of Birmingham, UK.
Journal reference: *Science Translational Medicine*, DOI: 10.1126/scitranslmed.3001262

http://www.newscientist.com/article/dn19458-chemical-patterns-on-dna-mark-out-obesity-genes.html

Blood disorder cured – a first for gene therapy

- 16 September 2010 by **Andy Coghlan**
- Magazine issue 2778.

A 21-YEAR-OLD Frenchman is the first person in the world to be cured of the blood disorder beta-thalassaemia through gene therapy. But there is some confusion over what made the treatment work.
Before gene therapy he needed monthly blood transfusions to provide him with beta-globin, a key component of the haemoglobin molecule that carries oxygen around the body. He has now been transfusion-free for over two years.
Philippe Leboulch of the University of Paris, France, and Harvard Medical School in Boston, infected stem cells from the man's bone marrow with a harmless virus, which transferred perfect copies of the *beta-globin* gene into the DNA of the extracted cells.
Returned to the patient, these cells now contribute about a third of his beta-globin, with his body producing the rest. Although the treatment had the desired effect, the proliferation of the altered cells could be down to the activation of a different gene, *HMGA2*, switched on by accident during the DNA transfer (*Nature*, DOI: 10.1038/nature09328).
His beta-thalassaemia is cured but a gene switched on by accident may be at least partly responsible
One worry throughout the history of gene therapy is that viruses transferring beneficial genes will accidentally activate other genes that could trigger cancer. This happened in four French boys treated for the immune deficiency, X-SCID, who developed leukaemia. One died and the others recovered after treatment.
"We must be very cautious, but the signs are that the impact of the *HMGA2* gene will be benign," says Leboulch.
After more detailed analysis, the team found other cells producing beta-globin that do not have the *HMGA2* gene switched on. Leboulch concludes that it is unlikely the *HMGA2* gene by itself is responsible for the survival of the beta-globin-producing cells.

http://www.newscientist.com/article/mg20727784.300-blood-disorder-cured--a-first-for-gene-therapy.html

Graveyard DNA rewrites African American history

- 13:43 16 September 2010 by **Shanta Barley**
-

From Africa to Hispaniola (Image: T. Douglas Price/University of Wisconsin-Madison)

Two of Christopher Columbus's shipmates were the first Africans to set foot in the New World, a study has found.

Using DNA analysis of human bones excavated from a graveyard in La Isabela, Dominican Republic – the first colonial town in the Americas – the new study adds weight to the theory that Africans crossed the Atlantic at least 150 years earlier than previously thought.

"African Americans have come to believe that their history began when the first slave ships docked in the mid-17th century, but our results suggest that it actually started far earlier, at the same time as the Europeans' history on the continent did," says Hannes Schroeder of the Centre for GeoGenetics at the University of Copenhagen, Denmark, who did the analysis.

La Isabela was founded in 1494 on Columbus' second voyage to the New World. Seventeen ships deposited 1700 people – including farmers, builders and priests – on the part of the island of Hispaniola that today is the Dominican Republic. Within two years, all but 300 had died of starvation and disease, and in 1498 the town was abandoned.

Last year, one of Schroeder's collaborators, Douglas Price, from the University of Wisconsin-Madison, suggested that up to seven of the 49 skeletons exhumed from La Isabela's 15th-century graveyard had belonged to Africans. The carbon and strontium isotope ratios in their tooth enamel, which give clues to an individual's diet, pointed at possible African origins for the seven.

Talking bones

To investigate whether Africans were indeed among those buried in La Isabela, Schroeder studied a thigh bone and a premolar tooth from each of 10 skeletons dug up between 1983 and 1991, including the seven earmarked as African by Price's analysis.
After extracting DNA, Schroeder searched for key segments of mitochondrial DNA that differ between people of African and non-African descent, and found that two of the individuals carried DNA segments that are most frequently found in sub-Saharan Africans. Schroeder concludes that two of Columbus' crew almost certainly hailed from Africa.
Tina Warinner of the Institute of Anatomy at Zurich University, Switzerland, says Schroeder's rigorous methods mean the result is unlikely to be an artefact. Schroeder plans to analyse a new set of La Isabela skeletons to be exhumed next year.
DNA analyses will never reveal whether the Africans who were laid to rest at the church of La Isabela were slaves or free men who joined Columbus' expedition of their own volition, says Schroeder. But by studying their nuclear DNA, he hopes to find out exactly where in sub-Saharan Africa their families came from. "Now that would be pretty cool," he says.
The team presented their findings at the Fourth International Symposium on Biomolecular Archaeology in Copenhagen, Denmark, last week.

http://www.newscientist.com/article/dn19455-graveyard-dna-rewrites-african-american-history.html

Receding gums: What ails Australia's iconic trees?

- 16 September 2010 by **Wendy Zukerman**
- Magazine issue 2777.

A friendly fire might help (Image: Melanie Stetson Freeman/Getty)

Eucalyptus trees are dying all over Australia. To save them, we might have to learn to play with fire

PICTURE an Australian landscape and the scene you conjure up will almost certainly be one graced by gum trees. Eucalyptus has colonised just about every corner of the country, from the forests that fringe the sandy beaches of Australia's southern shores, to the baking heat of the outback.

Which makes it all the more alarming that across the country, swathes of gum trees are dying without obvious cause. In forests from Western Australia to the island state of Tasmania, trees that should be living for more than 400 years are mysteriously dying before reaching their 100th birthday.

If the gums are lost, the outcome would be dire for a whole suite of plants and animals. "Old trees are keystone species that support a disproportionate amount of species," says Dugald Close, a plant ecologist at the University of Tasmania. Gum leaves feed local birds and their hollows provide shelter for endangered species such as Leadbeater's possum.

The premature death of gum trees was noted as far back as the 1970s, when eucalypts started succumbing to a disease known as Mundulla Yellows. The leaves of affected trees would gradually turn yellow, until the tree finally died. It took until 2004 for the culprit to be identified - lime, or calcium hydroxide, used in road-making, was washing into nearby eucalypt forests, making the soil alkaline (*Australasian Plant Pathology*, vol 36, p 415). Eucalyptus tree roots need neutral or acidic soil to suck up nutrients such as iron and manganese. When iron was injected back into affected trees, they made a full recovery.

Today's dieback extends far beyond just a few roadside trees. By 2000, large tracts of eucalypts were dying along Australia's east coast. In many places, the decline coincided with a booming population of native birds called bell miners, and their partners in crime, sap-sucking native insects called psyllids.

These insects sit on the vein of tree leaves, sucking their sap and excreting a sugary solution known as lerp. "The bell miners suck off the lerp, but leave the insect, which keeps working its way around the leaf," says Paul Meek, executive officer of the bell miner associated dieback (BMAD) working group. In return for their sugary meal, the aggressive bell miners ward off any other bird or insects that would eat the psyllid itself.

This duo are long-time inhabitants of Australian forests, but disturbances to the ecosystem, such as removing trees through logging, can seemingly tip the balance dramatically in their favour. Logging opens up the forest canopy, allowing growth of the understorey of shrubs and other low-level plants where the bell miners nest.

Meek's team has confirmed that 187,000 hectares of eucalyptus forest are dying from BMAD, but the real figure could much higher. In New South Wales alone, up to 2.5 million hectares of forest are wasting away.

However, Vic Jurskis of the Institute of Foresters of Australia says tree foliage can start looking sick before any sign of psyllids or bell miner outbreaks - or, indeed, any other obvious factor that might kill the trees. So it looks like the problem runs deeper than bell miners.

The mystery has revived a radical old theory, proposed over 40 years ago by ecologist William Jackson of the University of Tasmania. According to one of his former students, David Bowman, an ecologist also at the University of Tasmania, Jackson presented his work to the Ecological Society of Australia in 1968. Bushfires had ripped through his home town of Hobart, Tasmania, in 1967, prompting questions over frequency of natural fires.

Friendly fire

Jackson proposed that the number of fires sweeping through the bush dictate what type of vegetation grows there. Very frequent fires favour grassland, an intermediate number would support eucalyptus forest, while infrequent fires produce a forest of dense, shade-tolerant plants, an ecosystem dubbed the "dry rainforest" for its structural similarity to the classical tropical rainforest. So, according to Jackson's theory, without regular bushfires, many eucalyptus forests will die out, leaving species-poor dry rainforests devoid of gums.

The idea might have seemed radical at the time, but four decades later, the scenario that Jackson predicted is exactly what now seems to be happening across Australia, says Close. In parts of Australia's south coast, free of forest fires for at least 90 years, she-oaks (*Allocasuarina*) have choked out the manna gum (*Eucalyptus viminalis*) and swamp gum (*Eucalyptus ovata*). The same is happening to the Tuart trees (*Eucalyptus gomphocephala*) in the Yalgorup National Park in Western Australia. Since fires were suppressed in 1976, the West Australian peppermint tree (*Agonis Flexuosa*) has flourished at the expense of the gums (*Botanical Review*, vol 75, p 191).

Why would fires be so important to lowland gum forests? Without low-level fires certain gum trees can't thrive, so the theory goes, because those are the conditions in which they have evolved. In the past, lightning strikes would have triggered fires, and we know from anecdotal and archaeological evidence that Australia's indigenous people also practised regular burning for millennia. Across swathes of the country, indigenous Australians used fire to improve access across forests, encourage plant growth, and remove leaf litter to avoid uncontrollable wildfires during long hot summers. But since European settlement these practises have largely stopped, and the gums are beginning to pay the price.

There are many reasons why gums rely on fire. In the absence of regular fires, dry rainforest species grow up beneath the eucalyptus canopy, competing with the gums for water - and winning. These species also contribute a thick litter layer that changes the soil chemistry, further stressing the gums.

This situation is not unique to Australia - a similar phenomenon is happening to the North American pine, *Pinus ponderosa*. Before 1900 there was a long history of frequent, low-intensity fires in Yosemite National Park, but after 1900 the fires stopped. As a result, pines in this region are dying prematurely - coinciding with a growth in "midstorey" vegetation.

The question is, should we intervene in the process by reintroducing regular burning, or let nature take its course? That is a question for policy-makers, not scientists, says Close. "We aren't saying [Jackson's theory] is good or bad, just that it's an explanation for the forest decline that we are seeing across Australia." However, the dry rainforests emerging throughout Australia are not thriving with biodiversity, Meek points out. "You are getting particular rainforest elements coming in," he says, resulting in "very simple ecosystems."

Jackson's theory is an explanation for the forest decline we are seeing across Australia

Reintroducing regular burning should also help control bell miners, says Meek. His BMAD working group is now experimenting with low-intensity fires on small plots of land around south-east Australia, hoping to remove the dry-rainforest species in which the bell miners nest.

Over-burning can be just as damaging as not burning enough, though, says David Lindenmayer at the Australian National University in Canberra. "There are different forests, with different climates and different historical fire regimes," he says. Over-burning is responsible for gum dieback in some areas of Australia, such as the extremely dry Kakadu region, where frequent low-level fires are killing savannah gums which haven't adapted to these blazes (see map). In southern Australia's wet alpine forests it's a similar story. There is one natural major fire every 100 to 300 years, says Lindenmayer. "It is extremely detrimental to be burning there."

So saving the eucalypt will mean finding the fire regime that was in place before white settlement, and mimicking it (*Biological Conservation*, vol 143, p 1928). In many regions, this knowledge has been lost, but Lindenmayer and other ecologists are taking a multi-pronged approach to reconstruct it, from examining archaeological evidence, to theoretical modelling, to experimenting with different burning patterns.

After all, who can picture an Australia without its forests of gum trees?

Wendy Zukerman is an Asia Pacific reporter for New Scientist

http://www.newscientist.com/article/mg20727772.200-receding-gums-what-ails-australias-iconic-trees.html

Transgenic fish swimming towards a plate near you

- 15 September 2010 by **Peter Aldhous**
- Magazine issue 2778.

We're the wild one (Image: Paul Nicklen/National Geographic Stock)

If the US approves genetically modified fish for human consumption, the implications will be global

AT AN undisclosed location in the highlands of Panama, 68 water tanks sit behind a code-protected door. The building's ground-floor windows are barred, motion detectors are deployed inside and the exterior steel doors are dead-bolted. To reach this citadel, an intruder would have to breach a fence topped with barbed wire and dodge motion-activated cameras.

What sounds like the lair of a James Bond villain is actually a fish-rearing facility owned by AquaBounty Technologies, based in Waltham, Massachusetts. It was set up to win the world's first approval to sell a genetically modified (GM) fish for human consumption. Whether or not the safety measures are sufficient will be debated next week, when the US Food and Drug Administration (FDA) holds public meetings on AquaBounty's proposal to sell a variety of Atlantic salmon that is engineered to grow about twice as fast as normal fish.

Regulators worldwide have been looking to the FDA to take a lead on the issue of GM fish. If, as seems likely, it gives the green light, engineered fish being developed in labs from China to Cuba could follow (see table). "This is precedent-setting, not just in the US but internationally," says Eric Hallerman, a fish geneticist at the Virginia Polytechnic Institute and State University in Blacksburg.

AquaBounty's salmon owes its rapid growth to a hormone gene from the chinook salmon. It would be the first GM animal to be approved for human consumption. The main scientific controversy relates not to the safety of eating its flesh, which was given a clean bill of health by the FDA's scientists. At issue are the potential ecological consequences should fish escape.

The salmon would be the first GM animal of any type to be approved for human consumption

Farmed fish can wreak havoc if they get into the wild. Large numbers of Atlantic salmon have escaped and are breeding with their wild cousins, producing animals that are less likely to survive. Farmed Atlantic salmon have also escaped into Pacific waters, and there are fears that they may compete with native species of salmon.
Add genes from other species into the mix, and the potential risks become even greater, which explains why AquaBounty has faced formidable hurdles in bringing its salmon to market. The original plan, hatched more than a decade ago, was to grow the fish in conventional salmon farms, using net pens in coastal waters. The risks of escape were deemed unacceptable.
That led to the company's current proposal. It states that the salmon will be produced in secure, land-based facilities. Fish will be hatched and grown in Panama, where Atlantic salmon would be unlikely to survive even if they did somehow escape. All-female eggs will be flown in from a similarly contained facility on Prince Edward Island in Canada. Shortly after fertilisation the eggs will be subjected to high pressure, which makes them retain a set of chromosomes that is normally expelled, resulting in sterile "triploid" fish.
"AquaBounty has gone to unprecedented lengths to provide a product that can address people's concerns," argues Ron Stotish, the company's president.
Ecological risk-assessment experts agree that the measures are impressive. But AquaBounty's set-up will be just the beginning of the GM fish market. If it is to turn a profit, it will have to sell eggs to other salmon producers, who will need their own facilities. Without knowing their locations and precise safety measures, it's hard to judge the likelihood of fish making it into the wild, says Anne Kapuscinski of Dartmouth College in Hanover, New Hampshire, who studies the risks posed by GM fish.
Should any fish escape and survive, the risks are uncertain. Hallerman's team has found that AquaBounty's salmon seem more susceptible to stresses including extremes of temperature and shortages of food. While that suggests that they may struggle in the wild, work on GM coho salmon by Robert Devlin of Fisheries and Oceans Canada in Vancouver and Fredrik Sundström of the University of Gothenburg in Sweden has shown that the consequences of carrying a foreign growth-hormone gene can vary.
For example, raised in a typical hatchery environment, the GM coho salmon grew bigger, were more voracious predators and took risks that could expose them to being eaten if they were in the wild. But when raised in a simulated natural stream, these differences were much reduced. This makes it difficult to calculate the risks posed by GM fish. "If the environment changes you don't know how they will respond," Sundström warns.
What's more, AquaBounty's system for producing sterile fish is only about 98 per cent reliable, so there is a small chance of escapees breeding with wild fish. That is a concern, given the "Trojan gene" hypothesis, which states that a gene which boosts reproductive success but is ultimately harmful to the species can rapidly spread through a wild population if just a few genetically modified fish escape. Studies simulating natural populations suggest that this could cause them to crash.
Beyond the questions surrounding AquaBounty's salmon is the precedent that would be set if it is approved for sale. Many more GM fish are being developed in the US and beyond. Rex Dunham of Auburn University in Alabama is developing GM channel catfish that grow more quickly or resist bacterial diseases (see table). He is still perfecting techniques to ensure sterility, by knocking out genes vital for reproduction, but he hopes to bring the fish to market within three or four years. FDA approval for AquaBounty's fish would be a significant step towards making that happen, he says.
Others are itching to move straight away. Zuoyan Zhu of the Chinese Academy of Sciences' Institute of Hydrobiology in Wuhan has developed a growth-enhanced common carp that he says has been ready to market for a decade, held back only by regulatory concerns in China. FDA approval of AquaBounty's salmon would improve the prospects for Chinese GM fish, says Zhu. If that happens his team will "definitely" make an application to the Chinese authorities.
China accounts for about half of the world's aquaculture, so any approval could open up an enormous market - and raise significant questions about how to prevent escapes. As Kapuscinski puts it: "It seems to me that achieving multiple confinement, and assuring it, would be very challenging in China."
Salmon go against the flow

The genetically modified salmon created by AquaBounty Technologies (see main story) are not the only fish raising eyebrows right now. This month a Canadian government commission begins hearing evidence on why wild sockeye salmon populations are plummeting in British Columbia's Fraser river. Yet in a stunning ironic twist, the number of sockeye heading upriver to spawn this year is the greatest in 97 years: salmon prices are falling and wholesalers are running out of ice to store the catch. Didn't the salmon get the memo?

In fact, the bumper crop doesn't eliminate the long-term problem. This year is the peak of the Fraser sockeye's four-year cycle, so fish biologists were predicting a healthy run of about 11 million fish. It looks like about 34 million will actually make the trip.

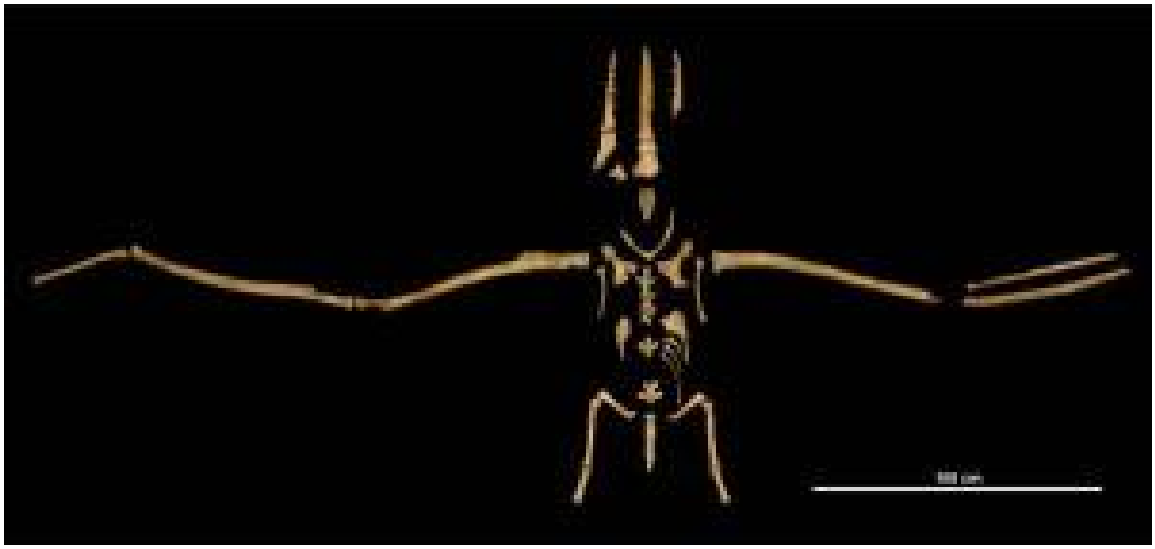
Young salmon do poorly in warmer waters, which could explain the long-term decline. This year's bounty is likely the pay-off from lower temperatures in 2008, when this year's returning spawners first entered the ocean as juveniles, says Barry Rosenberger of Canada's Department of Fisheries and Oceans. Such luck is unlikely to be repeated very often in a warming world, so this year's abundance of salmon may be a rare treat.

Bob Holmes

http://www.newscientist.com/article/mg20727783.800-transgenic-fish-swimming-towards-a-plate-near-you.html

Ancient South American megabird had 6-metre wingspan

- 15 September 2010
- Magazine issue 2778.



As if in flight (Image: S. Tränkner/Forschungsinstitut Senckenberg)
Enlarge image

IT WAS a bird that really lived up to its dinosaur heritage.

For decades, fragmentary fossils had hinted that extinct birds once had wingspans of 6 metres, more than twice that of the wandering albatross, which now holds the record. Now we finally have proof for such giants: a 70 per cent complete skeleton of *Pelagornis chilensis*, a sea bird that lived 5 to 10 million years ago in Chile.

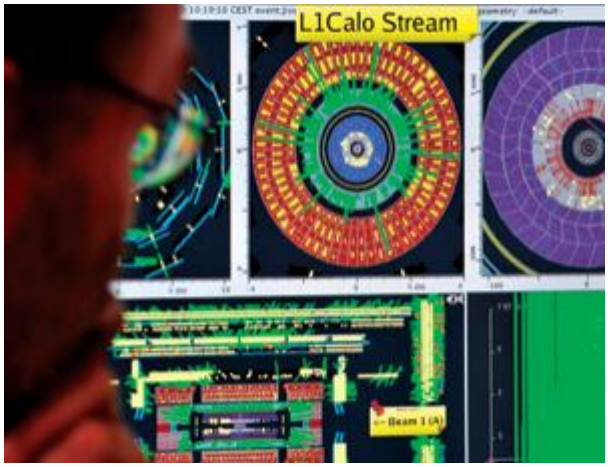
The bones suggest its wingspan was at least 5.2 metres, says David Rubilar of the National Museum of Natural History in Santiago, Chile, who led the analysis of the fossil. The work will appear in the *Journal of Vertebrate Paleontology*.

The bird had thin-walled bones, and previous fossils had been crushed, making it hard to determine their original size. The new fossil is intact, says Rubilar, and shows that estimates of pelagornithid wingspans beyond 6 metres were too high.

http://www.newscientist.com/article/mg20727784.800-ancient-south-american-megabird-had-6metre-wingspan.html?full=true&print=true

Quark excitement: LHC surpasses rivals for first time

- 15:39 14 September 2010 by **Kate McAlpine**
-



Searching for elusive particles (Image: Fabrice Coffrini/epa/Corbis)

The Large Hadron Collider is flexing its muscles. A team at the collider in CERN, near Geneva, Switzerland, is set to publish the first result that surpasses the abilities of rival particle smashers.

The result concerns the search for an elusive "excited" quark. Quarks are not thought to be composed of anything smaller, but if one was found in an excited state, it would show this to be wrong. This is because an excited state only arises when there is a change in the way the smaller particles within are bound together.

Experiments at the Tevatron collider at Fermilab in Batavia, Illinois, have previously searched for excited quarks, and ruled out their existence at masses up to 870 gigaelectronvolts. Now the ATLAS detector at the LHC has extended this range by over 40 per cent, counting out excited quarks up to 1260 GeV.

Due to the LHC's high energy, ATLAS achieved this with less than four months of data, compared with the four years needed for the Tevatron result. "Obviously we're all very excited because we built this machine to get into a certain energy regime," says Tom LeCompte of ATLAS.

"We're already competitive with, if not better than, the Tevatron's reach for a number of searches," adds Albert De Roeck of the CMS experiment, another detector at the LHC.

Kurt Riesselmann, a spokesperson for Fermilab, says that despite this result, the Tevatron still leads the race to find other particles, such as the Higgs boson, because it has collected more data to sift through. "That's where the Tevatron will hold the edge for a few more years," he says.

Journal reference: *Physical Review Letters*, in press

http://www.newscientist.com/article/dn19445-quark-excitement-lhc-surpasses-rivals-for-first-time.html

Light trapped on curved surfaces

- 17 September 2010 by **Rachel Courtland**
- Magazine issue 2778.

Glow with the flow (Image: Physical Review Letters)

LIGHT, which in everyday experience travels in straight beams, has been trapped on complex curved surfaces. The feat is not just a parlour trick - it could help people visualise how light travels in the curved fabric of space.

According to Einstein's general theory of relativity, gravity is the result of an object's mass deforming space itself, like a bowling ball on a trampoline. To model how light's path would change in space curved by gravity, Ulf Peschel of the University of Erlangen-Nuremberg in Germany and colleagues constructed smooth 3D objects and sent laser beams shooting along their surfaces (*Physical Review Letters*, in press).

They took advantage of the fact that light bends, or refracts, when it moves from one medium to another. In their simplest experiment, they shot laser light at the edge of a solid glass sphere. The angle of the beam was chosen so that the light - initially travelling in air - would be bent just enough when it entered the glass that it would keep reflecting off the inside surface of the sphere, and so travel along it. When the light inside the sphere reflected off its inner surface, some was also transmitted through the glass, creating a glowing ring on the outside surface (see image).

The team also constructed an object shaped like two trumpet bells stuck end to end - called a hyperbolic surface. The object was made out of aluminium and then coated with oil. Light sent into the oil layer was confined there, bouncing between the metal and air boundaries. The beam spread out ever more quickly, generating a trumpet-shaped glow (see image).

For the light to be trapped in two dimensions, the object's surface needed to be smooth enough to cleanly reflect most of the light into the oil layer rather than scattering it at all angles. That required diamond polishing machines that have only become available in the last 10 years or so, Peschel says.

The experiments help visualise how light travels in space warped by gravity. The sphere, for instance, represents how space is bent around a star or other mass - light passing through this warped space bends in an effect called gravitational lensing. The hyperbolic surface, which has so-called negative curvature because its surface curves up and down at the same time, like a saddle, just might represent the shape of the universe.

"It's a beautiful fundamental experiment," says Ulf Leonhardt of the University of St Andrews in the UK, who was not involved in the work. "It's just fun, good physics."

http://www.newscientist.com/article/mg20727784.400-light-trapped-on-curved-surfaces.html

Electron vortex could trap atoms

- 18:00 15 September 2010 by **Miriam Frankel**
-

Set a beam of electrons twisting, and the resulting vortex could be just the tool to manipulate atoms.
"This is a fundamentally new state that we can bring electrons into," says Jo Verbeeck from the University of Antwerp, Belgium.
Optical vortices, made of twisting beams of light, have been used to spin or move micrometre-sized particles like cells. But electron vortices could potentially trap much smaller particles, says Verbeeck.
To create such a beam, Verbeeck and his colleagues used platinum foil bearing a specific pattern of holes. This "mask" partially blocks a beam of electrons shone at it, though those that get through corkscrew to form a vortex between 1 and 100 nanometres in diameter.

Size of an atom

By redesigning the mask, the vortex could be shrunk further, in theory down to the size of an atom. The researchers hope they can one day use it to trap individual atoms or molecules inside the beam and move them around.
"This is more or less a method of nano-manipulation," says Peter Schattschneider from the Vienna University of Technology, who is a co-author of the study.
Another advantage of using electrons is that, unlike photons, they are charged and so might be used to probe the magnetic properties of a material, say the researchers.
This is not the first electron vortex to be made: earlier this year a team led by Masaya Uchida from the Japan Science and Technology Agency in Saitama created one using thin-film graphite as a mask.

Platinum is better

However, the platinum masks created by Verbeeck and colleagues are more likely to lead to practical applications as these masks are much easier to make. Uchida calls the latest study "very good" and says "it will promote various possible studies using vortex electron beams".
Journal references: *Nature*, DOI: 10.1038/nature09366; *Nature*, DOI: 10.1038/nature08904

http://www.newscientist.com/article/dn19452-electron-vortex-could-trap-atoms.html

Do Egyptian mummies have a right to privacy?

- 10 September 2010 by **Jo Marchant**
- Magazine issue 2777.

Treat a mummy just like a patient (Image: South Tyrol Museum of Archaeology)

SHOULD we consider the privacy or reputation of the individual when analysing an Egyptian mummy? The assumption that ancient corpses are fair game for science is beginning to be challenged.
Though strict ethical guidelines apply to research on modern tissue samples, up until now there has been little discussion about work on ancient human remains. In a recent paper in the *Journal of Medical Ethics* (DOI: 10.1136/jme.2010.036608), anatomist Frank Rühli and ethicist Ina Kaufmann of the University of Zurich, Switzerland, argue that this is disturbing because research on mummies is invasive and reveals intimate information such as family history and medical conditions. And, of course, the subjects cannot provide consent.

"The human body, alive or dead, has a moral value," says Rühli, who is himself involved in mummy research. He says that no matter how old a body is, researchers must balance the benefits of their research against the potential rights and desires of the deceased individual.

For example, the release of information about the medical history of an ancient Egyptian ruler such as Tutankhamun could violate his wish to be remembered as strong and healthy. On the other hand, it could increase his fame, which would fit with his desire to be remembered after death.

Others in the field take a different view. Franco Rollo of the University of Camerino, Italy, has worked on Ötzi the iceman (pictured), who died around 3300 BC and whose mummified remains were found in the Alps in 1991. Rollo argues that ethical considerations are minimal if remains are "old enough to belong to an historical and social epoch that is felt sufficiently different and far from the present one by most people". Likewise, Helen Donoghue of University College London, who has analysed human remains for signs of infectious disease, says she has no qualms about research on mummies as long as it is carried out for valid scientific reasons and is not opposed by any descendants.

But Søren Holm, the editor-in-chief of the *Journal of Medical Ethics*, says ethical considerations do apply to ancient remains, especially where the individuals are identifiable. "In a certain sense these people still have a life," he says. "We still talk about them. There are pieces of research that could affect their reputation."
In a certain sense mummified people still have a life. We still talk about them

Holm, a philosopher and bioethicist at the University of Manchester, UK, wants researchers to think about whether their work is motivated by scientific inquiry or simply by curiosity. "Do we really need to sort out the intricate details of Tutankhamun's family history?" he asks. Even when bodies are not identifiable, he argues that we should still take the dignity of the dead into consideration by treating remains with respect. Rühli agrees. "I try to treat mummies like patients," he says. "I don't like it if researchers make fun out of them, or show them to gruesome effect."

So are ethical guidelines needed? Holm says it would be difficult to devise a universal policy, but a checklist of questions to consider would be useful. Rühli would rather scientists took personal responsibility. "If a researcher is planning to work on a mummy, I would like to see that he thinks about it."

http://www.newscientist.com/article/mg20727774.600-do-egyptian-mummies-have-a-right-to-privacy.html

Solar on the Cheap: Thanks Purple Pokeberry!

A dye made from the purple pokeberry — a common weed — proves uncommonly effective at juicing up the prospects for solar power.
By Arnie Cooper

The omnipresent purple pokeberry "weed" will soon play a role in improving solar power. (Liz West / Flickr.com)

"A valueless plant growing wild…" might be dictionary.com's definition of purple pokeberries, but David Carroll, director of Wake Forest University's Center for Nanotechnology and Molecular Materials, says the omnipresent "weed" will soon play a role in improving solar power in places ranging from residential green building in the United States to areas in the developing world cut off from the power grid.
Carroll says a red dye made from pokeberries can be used to coat a new type of solar cell that's produced from millions of tiny plastic fibers. Unlike traditional solar units, fiber cells — thanks to a patented design that exposes more surface area to the sun's rays — can produce a usable amount of power even at sunrise and sunset. (Carroll has created a spin-off company, FiberCell Inc., which is producing the first prototype cells.)
"This adds to the power a solar panel can generate during the day, but it also brings a number of dyes into commercial viability that could not be considered previously, such as the pokeberry dye," he says. "Before our technology, this dye would have produced too low of a performance to warrant putting it in a solar cell structure, but using the fiber cell makes for an efficient system."
The dye acts as an absorber helping the cell's tiny fibers trap significantly more sunlight during the day, compared to current solar systems, that then gets converted into energy. The technology is especially promising because it is able to generate twice the total kilowatt-hours per day than traditional silicon-based units. Additionally, because of its "unique angular capture profile," the material can be mounted at oblique angles on a structure yielding extremely high performance — great for architects seeking Leadership in Energy & Environmental Design, or LEED, certification. In any event, the result is a winning combo: the cost advantage of thin-film photovoltaics with the efficiency of silicon cells.
To create the cells, the plastic fibers are stamped onto plastic sheets, using the same process employed to attach the tops of soft-drink cans. Then the pokeberry-dyed absorber is sprayed on. And because the plastic

makes the cells lightweight and flexible, a manufacturer could roll them up and ship them at low cost to developing countries, where locals could actually grow and harvest the pokeberries and apply the dye themselves. FiberCell also envisions employing its technology for large-area manufacturing installations and military applications.

Carroll, who serves as chief technology officer of the new company, says the product represents a new class of agricultural product — *agra-solar* crops. "Not only are they renewable and sustainable, they also add to a value-added microeconomic expansion by displacing high-value crops such as tobacco." Moreover, pokeberry is highly drought tolerant and because it's so robust, it doesn't require petrochemical fertilizers.

Says Carroll, "From developing communities in Asia and Africa, to the guy in North Carolina with 40 acres and a tobacco barn, agra-solar crops like pokeberry can be a game changer. They are a way of replacing refined oil products or the high processing costs of silicon with locally sourced resources that can be produced over and over and yield a substantial profit per acre."

Look for these solar cells to hit the market by 2012.

http://www.miller-mccune.com/environment/solar-on-the-cheap-thanks-purple-pokeberry-20900/?utm_source=Newsletter126&utm_medium=email&utm_content=0914&utm_campaign=newsletters

Ten Ways the Feds Are Leading the Green Charge

How exactly is the U.S. federal government leading by example on reducing greenhouse gas emissions? A collection of reports lists a zillion specific items, from double-sided printing to thousands of solar panels.
By Emily Badger

The U.S. federal government is greening by example. Recent reports reveal efforts to reduce its carbon footprint from double-sided printing to thousands of solar panels (stockxpert.com)

President Obama issued an executive order last October requiring every government agency to spell out how it plans to "lead by example" in environmental sustainability. He wanted to hear about waste management and water use, smart meters in federal office buildings and alternative-fuel vehicles in public fleets.
The Strategic Sustainability Performance Plans were finally due last week, and embedded in the dense documents — no one should print these things, even on recycled paper — are hundreds of small ideas. The relatively obscure Corporation for National and Community Service, for one, is promising to set all its printers to double-sided default mode and to check the tire pressure every time a government vehicle leaves the lot.
The federal government is the largest consumer of energy in the U.S. economy, and the president is aiming for a 28 percent reduction in direct greenhouse gas pollution by 2020. But will all the ideas add up? Here's a look at what many departments have in mind.
1. The U.S. Department of Agriculture used an estimated 1.737 billion gallons of water in its buildings during fiscal year 2009, all of which cost about $8.1 million (the president also wants taxpayers save money while the government is at it conserving energy). The USDA has actually cut its water consumption since 2007 by about 20 percent, and it hopes to wring future savings through new water meters, better rainfall management and using native plant species in landscaping.
2. Inside the Department of Defense, the Air Force is planning to certify (click here for PDF) all of its aircraft against a 50-50 alternative fuel blend by 2011, and by 2016, the Navy expects to field a carrier strike group of nuclear vessels and ships powered by biofuel. Permanent military installations are also already generating their own renewable energy. Nellis Air Force Base in Nevada has 72,000 solar panels producing 30 million kilowatt-hours of electricity per year.
3. The Department of Education is planning to cut down on the physical paperwork most college students know well — federal student loan applications. The program will be administered almost entirely online,

saving both paper and the energy required to transport it. The department also anticipates that as it brings on about 500 new full-time employees, it will find new ways to put them to work, either through satellite offices or telecommuting.

4. The Department of Energy squats in about 10,000 buildings and trailers across the country, covering more than 126 million square feet of office space, warehouses and laboratories. As the department builds more modern facilities, it will adhere to a "one-for-one" policy: For every square foot of new construction, one square foot of similar building must be decommissioned and disposed of. At the beginning of this fiscal year, the department also generated 0.16 percent of its power from on-site renewables. That figure should reach 5.1 percent by the end of fiscal year 2012.

5. The Department of Interior has a similarly expansive footprint: It manages 20 percent of the country's land, while operating 47,000 buildings and 33,000 vehicles. It wants all of its new buildings by the end of 2030 to achieve net-zero energy (generating as much as they consume). Among programs already underway, Zion National Park is phasing out the sale of water bottles in favor of reusable "bottle filling stations" (water fountains?). And a new 18-kilowatt photovoltaic system will offset 30 percent of the electricity used at the Grand Canyon's South Rim visitor center.

6. The Department of Housing and Urban Development is giving energy retrofits to 126,000 public-housing units in 2010 and 2011. The department is spending about one-third of is $4.86 billion in Recovery Act funds on "greening" public housing stock. Inside its own offices, HUD has also nearly doubled its monthly employee transit subsidy (now $230). Seventy-six percent of employees at the department's headquarters now commute to work by transit.

7. The Department of State admits to a unique problem: "The concept of effective diplomacy is inherently about people-to-people relationships and contacts" — in other words, long-distance travel. Last year, State bought 142,370 tickets for domestic travel, producing more than 92 million pounds of greenhouse gasses. To get around some of that pollution, the department plans to look at alternatives in digital video and Web conferencing, in the process scrutinizing "one of the Department's fundament business models."

8. A slew of Environmental Protection Agency offices have sprouted green roofs, including a laboratory in Rhode Island, an annex in Cincinnati, regional offices in Denver, Seattle, Boston and a headquarters satellite in Arlington, Va. The EPA also has its first carbon-neutral laboratory building in Oklahoma and an all-electric office in Kansas City, Kan.

9. The Peace Corps is reducing the square footage — and associated energy use — at its headquarters by 10 percent through more efficient space design. And it has cut down on electricity consumption by 16 percent at the Washington headquarters by shutting down HVAC systems on weekends and holidays.

10. The Army Corps of Engineers is renovating two office spaces in Seattle to use eco-friendly carpeting, furniture and countertops. The Louisville District plans to replace 21 non-hybrid government vehicles with new energy-efficient ones. And the Sacramento District is placing solar electric systems on nine dams, where they're expected to satisfy about 40 percent of each office's electricity needs.

http://www.miller-mccune.com/blogs/the-idea-lobby/ten-ways-the-feds-are-leading-the-green-charge-22639/

Roving Herds of Grazing Climate Helpers

A smarter way of raising herd animals, known as holistic management, may be a catalyst to helping the soil reclaim its role as a global carbon sponge.
By Judith D. Schwartz

It's all about the soil: Utilizing grazing herd animals, also known as holistic management, could help reduce carbon in the atmosphere from the ground up. (Jeff Bettens / stockxchange.com)

In reports of rising CO2 levels, there's an impression that the carbon-and-oxygen molecule is some kind of toxin, an alien vapor coughed up by a century-plus of heedless industrialism that's come back to haunt us. On closer inspection, it seems the problem isn't carbon dioxide's presence, but that there's too much in the air and not enough in the ground where it lends fertility to agricultural soil.
How do we get that carbon back in the soil? Some suggest placing calcium carbonate or charcoal (aka "biochar") directly into agricultural soil, as Miller-McCune examined last year.
But according to some who study how agricultural practices affect the environment, the catalyst for reducing atmospheric CO2 *and* restoring soil fertility is by bringing back the roving, grazing animals that used to wander the world's grasslands. Not to diminish saving the rain forest or setting emissions caps, but what takes place in the digestive system and under the hooves of ruminants might be the crucible of climate change. In other words, a climate-friendly future might look less like a geo-engineered landscape with faux parasols than like, well, "Home On the Range."
While the automobile and the fruits of industry are often the focus in bemoaning our CO2 predicament, a greater culprit has been agriculture: Since about 1850, significantly more atmospheric CO2 has come from poor farming practices as from the burning of fossil fuels. It's not, says Christine Jones, a soil ecologist in Australia, because of exhaust-spewing tractors but rather from the depletion soil quality. Jones estimates that between 50 to 80 percent of organic carbon in the topsoil has vanished into the air in the last 150 years due to mismanagement, with about 7 tons of topsoil lost for every ton of grain produced.
According to the agricultural model known as "holistic management," developed by biologist and environmental advocate Allan Savory, global soil depletion and excess atmospheric CO2 are flip sides of the same problem, and both can be resolved by the same solution: livestock — not cattle crammed into feedlots, but rather "planned grazing," with herds of well-managed grazing animals nibbling on native grasses and

roaming from place to place to elude predators and seek fresh pasture. Savory, based in Southern Africa, was awarded the 2010 Buckminster Fuller Challenge for his program Operation Hope, which trains African communities in holistic management.

Holistic management of rangeland has been on the academic radar for at least a decade and a half and, for example, has been credited with increasing biodiversity. But rangelands' role in ever more far-reaching ecological benefits (as opposed to its harms) is less well studied outside of Savory's work and those in his orbit, even as more ranchers use it. Still, the idea that agricultural land-use decisions impact broader ecosystems and even climate change is better understood.

Savory has "observed the beneficial relationship between grazing wildlife and cattle and the grass," says Steven Apfelbaum, founder/chairman of Applied Ecological Services, Inc., a landscape restoration company based in Brodhead, Wis. The strategy, he says, builds on "the wonderful long-standing relationship between wildlife that eat grasses — their teeth, the ruminant system and digestive system — and the plants that develop their growth system to be eaten and continue growing. In nature, animals walk around the landscape. They chew down an area, move to another, maybe return in a month or two. It's really simple: The grazing of elk, deer, buffalo or antelope stimulates more growth in the plant."

Time now for a quick biochemistry refresher course: The carbon cycle is essential to all life forms. Through photosynthesis, plants take sunlight and CO2 from the air and create sugars and other carbon compounds. Plants are eaten or die and decompose, which enriches the soil by adding organic carbon.

"Over the eons, it's the carbon cycle that's built the soil, through photosynthesis, which generates sugars and soil biological decay that drives the cycling of nutrients," says Abe Collins, whose new firm, New Soil Security, Inc. advises on soil-building and is developing software tools to support accelerated topsoil formation. "Atmospheric carbon is a basic building block of life."

The problem, he says, is when carbon is not taken up by plants and entered into the soil system or when too much of it in the soil is oxidized — exposed to oxygen. The upshot is that the carbon goes into the atmosphere as CO2 rather than doing its work in the ground. And right now, the carbon cycle is out of whack.

The main offender, it seems, is bare ground. "For soil to form, it needs to be living, and to be living, soil needs to be covered" with plants in various stages of growth and decomposition, Jones says. Uncovered soil not only is biologically stagnant, it is more prone to erosion and does not hold water the way it does when carpeted with plant life.

"When the surface is bare, photosynthesis isn't happening, soil biodiversity is compromised, carbon is oxidizing and water is evaporating or running off," says Collins. "With bare ground, you can have a drought even when it rains." The result is lowered productivity, wildfires, water shortages and desertification, which now threatens the livelihoods of people, particularly in poorer nations, around the world. By looking at the workings of the biosphere through the lens of holistic management, says Collins, one sees that climate change, biodiversity loss and desertification are really the same thing. "All we're saying is that the carbon cycle is broken," he says.

Now for the hopeful part: Biological processes can bring carbon into balance. Think of the dreary climate predictions you read in the news and compare that with what Ian Mitchell-Innes, a South African rancher and trainer in holistic management, has to say: "If we improve 50 percent of the world's agricultural land we could sequester enough carbon in the soil to bring atmospheric CO2 back to pre-industrial levels in five years."

According to Collins, a 1 percent increase in soil carbon on 5 billion acres of agricultural land would not only relieve our atmosphere of some 200 billion tons of CO2 — the equivalent of 100 parts per million — but also enhance food production, and, because its covered, carbon-rich soil infiltrates and holds significantly more water than its dried-out counterpart, aids stream and river flow, and protects against flooding and drought.

The role that grazing mammals play in this transformation, says Collins, is as "biological accelerators." They enrich the soil in numerous ways: When they trample around, their hoofs break up the soil and aerate it; they eat grassland plants and stimulate their growth; they cycle dead plants back to the surface, which allows sunlight to low-growing parts of grasses; their waste provides fertilizer. And because they bunch together and move as a herd, all the plants get nibbled but none are overgrazed, which would leave the ground bare. (On

the debit side, grazing animals' flatulence is a source of greenhouse gases, but studies routinely find that livestock grazing on native grasses are less gassy than those munching on non-grass foodstuffs like corn.)
"Accelerated topsoil formation [is] the great work of our time – the centerpiece for addressing the environmental security and economic development issues of our time in one fell swoop," says Collins. "It won't happen magically or instantly, or if it's just placed on the shoulders of farmers and graziers. Country folks and city folks are going to have to work very closely together on this."
Does rapid soil-building through biological processes work? Scroll around websites about holistic management and you'll see "before-and-after" shots that would put a Park Avenue plastic surgeon to shame. Mitchell-Innes says that after three to four years, dormant springs began to run again, and streams that flowed only during the summer were flowing year-round. Depending on the area, conventional farming requires 6 acres to sustain one animal for a year; holistic management methods can cut that to 1.5 acres per head, which, Mitchell-Innes notes, "lowers capital costs dramatically."
At Dimbangombe, the Savory Institute ranch in Zimbabwe, poor, mostly bare ground after five years was turned into perennial grassland with springs and stream flow re-established. In the United States, Tony and Jerrie Tipton have restored abandoned gold mining tailings in Nevada's high desert with a single dose of animal impact and hay — something that seeding, irrigation and other technological treatments had repeatedly failed to "fix."
Though managed livestock grazing is the core strategy, there are many ways to bolster land health. For example, by simply using a device called a "Keyline" subsoil plow, which loosens dirt without turning it over, neglected farmland on the Whirlwind ranch in southwestern New Mexico — with its 7 inches of rain a year — went from nearly totally caked earth to 80 percent perennial grass coverage in one year. (The Keyline system, which aerates deep soil in combination with planned grazing, was developed by Australian P.A. Yeomans in the 1950s.)
"When I travel, I see bare fields, and I despair," says Ridge Shinn, a Massachusetts cattle rancher and breeder trained in holistic management. He then thinks of what bringing in cattle could do for such land: "A few years isn't a long time to go from desolation to thriving."
Resolving the CO2 *and* soil fertility crises at the same time? Sounds too good to be true. Why hasn't the environmental movement grabbed onto this?
"People have been distracted by mantras like 'plant trees and save the rain forest,'" Apfelbaum says, adding that it's easy to "get lost in nuances. You need to understand the whole system."
Awareness of agriculture's potential in addressing climate change is growing among environmentalists, says Collins, noting that even dropping fossil fuel emissions to zero would not be enough without bringing much of the carbon already in the air back into the soil.

http://www.miller-mccune.com/environment/roving-herds-of-grazing-climate-helpers-22521/

Solar Power: America Hangs Its Head

John Perlin, sitting on a solar energy panel at the European photovoltaics conference, laments America's lost lead in the field.
By John PerlinL

John Perlin, at the European photovoltaics conference, laments America's poor showing in the field of solar energy. (Johan Bolhuis / stockxpert.com)

At the world's most prestigious conference on photovoltaics, the 25th EU Photovoltaic Solar Energy Conference in Valencia, Spain, I had the honor of being selected as one of the participants in its "PV Policy Debate 2010."
The panel was moderated by BBC environmental analyst Roger Harrabin and included Giovanni Federigo De Santi, director of the European Commission's Institute for Energy Joint Research Center; Heinz Ossenbrink, director of the center's photovoltaics section; Marcello Raimondi, Councilor of Environment, Energy, and Networks for Italy's Lombard region; Karin Feier, director of Germany's Market Introductory Programs for Solar Energy; Harry Lehmann, general director of Environmental Planning and Sustainable Strategies for Germany's Federal Environments Agency; and Winfried Hoffman, vice president of the European Photovoltaic Industry Association.

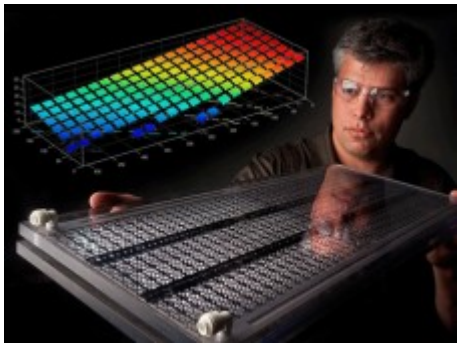
Our John Perlin is attending the 25th annual European Photovoltaic Solar Energy Conference in Valencia, Spain. He will be providing updates throughout the meeting. Check back with our By the Way blog to see more reports from this conference.
My fellow panelists proudly talked about Europe having an accumulated installed photovoltaic capacity approaching in 2010 more than 21 gigawatts — the equivalent of 21 nuclear power plants. They addressed the expectation of at least 90 gigawatts of photovoltaics installed by 2020 and perhaps almost 400, with Germany contributing the majority.
What could I say when it came my turn?

I could only reply that their unanimous comment that the sunnier climates were the poorest and therefore had the fewest photovoltaic installations was not true. The last time I had been in California, it was still part of the developed world. As are Arizona, Nevada, New Mexico, Texas, etc. (Or even Spain and Italy.)
I also commented that I came from the Persian Gulf of Solar Energy, but no one has yet gone drilling for photons with as much enthusiasm as have my sun-poor Northern European colleagues. I could only add that practical solar cells — silicon photovoltaics, which continue to rule the solar power market — were invented in 1954 at Bell Laboratories in New Jersey, that America produced 100 percent of all photovoltaics until Reagan was elected and continued to dominate that niche into the 1990s. And yet despite all these advantages and its head start, America today only produces 5 percent of the world's photovoltaics and has installed even less.
What else could come out of my mouth, but the Spanish, "*vergueñza, vergueñza, vergueñza*," or "shame, shame, shame."
And the same shameful story continues as President Barack Obama, amid hailing additional spending on renewable energy projects, has cut the funding to the National Renewable Energy Laboratory, America's premier solar energy research facility (and which helped send me to this conference). Please, someone tell me, why is my country solar-phobic?

http://www.miller-mccune.com/environment/solar-power-america-hangs-its-head-22423/

Air Conditioning Using 90 Percent Less Power

A U.S. government project combining two well-known technologies — swamp coolers and water-absorbing compounds — generates an amazingly efficient air conditioner.
By Michael Haederle



NREL senior engineer Eric Kozubal examines a prototype air flow channel of the DEVap air conditioner. (Pat Corkery/NREL)

We often take air conditioning for granted as we escape from the sweltering summer heat in our climate-controlled homes, but it is an expensive, energy-intensive technology. By some estimates, it accounts for about 14 percent of the electricity consumed by American households.
That current comes largely from coal- and gas-fired power plants — bad news as we look for ways to cut carbon emissions to soften the impact of global climate change.
Now, engineers at the National Renewable Energy Laboratory in Golden, Colo., have developed an innovative air conditioning concept that promises to cut electrical demand by up to 90 percent — and it works well in both Gulf Coast humidity and desert heat.
It goes by the not-very-mellifluous moniker of DEVap (for "desiccant-enhanced evaporative") cooling. But with major air conditioning manufacturers showing interest, it could soon be an attractive alternative to conventional technology.
"We've discovered what we think is a new concept in air conditioning," says Ron Judkoff, the principal program manager on the project. "We recognize its potential, but it has a ways to go before it's out of the lab and available to consumers."
The new, patented system abandons the power-hungry compressor-driven refrigeration process used in many domestic (and virtually all commercial) air conditioners in favor of a couple of high-efficiency pumps and fans. But it also uses water for evaporative cooling — a concept familiar to many people living in the arid West who have roof-mounted "swamp coolers."
Swamp coolers work well when the outside air is dry, as evaporating water carries away heat, cooling and moistening the air that is re-circulated into the house.
But Judkoff identifies a few shortcomings of traditional evaporative cooling. He says the evaporation happens on wetted pads that are susceptible to mineral buildup and even bacteria growth. And if the outside air is both hot and humid, evaporation alone can't lower the air temperature to comfortable levels.
He says that in Phoenix, where the annual monsoon and human activities like irrigation raise summertime humidity levels, there might be as many as six weeks each year where evaporative cooling won't work.
Evaporative cooling also introduces moistened air into the building, which might be an advantage in a very dry climate, but isn't always desirable, Judkoff says.
In a warm, humid climate, like Houston's, most people turn to vapor compression cooling because it can cool (albeit somewhat inefficiently) with moist air.
At NREL, engineers talk about "sensible" cooling loads – the dry bulb temperature shown by a thermometer — and "latent" loads, which reflect uncomfortable humidity. "The problem with normal vapor compression air conditioning is if most of your load is latent," Judkoff says, "you've got to accomplish a little bit of

cooling to make people comfortable, but you've got to accomplish a lot of drying to make people comfortable."

Vapor compression machines run warm, humid air by a chilled coil. "The coil is cold enough that that humid air goes to the dew point and it drops moisture. But as soon as you satisfy the thermostat — let's say you've got the temperature down to 70 or 72 degrees — well, it stops. The humidity is still there."

This problem is usually solved by chilling the air to a much colder temperature, wringing out the moisture, he says. Then the air is warmed back up to a comfortable room temperature, a brute-force solution that wastes a lot of electricity.

Going back to the drawing board, NREL engineers turned to desiccants — water-absorbing compounds that dry the surrounding environment. Desiccants have been used on a commercial scale in manufacturing processes that required strict moisture control, Judkoff says. (They are also in the little sugar-packet-sized sachets — clearly marked "DO NOT EAT" — found in the packaging for many consumer electronics.)

In building a prototype, the NREL researchers used a calcium chloride salt solution as a desiccant and relied on a technical breakthrough from a company that had found a way to keep tiny, corrosive desiccant droplets from leaking into the metal ductwork of the device.

They turned to another vendor for a high-tech membrane that prevents liquid water from crossing from one side to the other but allows water vapor to freely move through it. The desiccant solution is contained on one side of the membrane, but as air is drawn through from the other side, it is cooled through evaporation and dried as the desiccant absorbs water, Judkoff says.

"We've designed all that into a single core, in which the drying and the cooling are accomplished sort of instantaneously as the air passes through," Judkoff says. "We got rid of all the disadvantages of evaporative cooling, but we kept all the advantages — evaporative cooling is a very efficient form of cooling."

In modeling how the DEVap system would perform in Phoenix, "we get on the order of 90 percent savings" in electrical demand, Judkoff says, when compared with a high-efficiency 18 SEER vapor compression air conditioner.

The system sees a 50 percent power savings even in swampy Houston-like conditions, Judkoff says.

While others have proposed somehow combining evaporative and desiccant cooling, Judkoff says NREL is the first to come up with a practical, cost-effective approach. "We've proved it out thermodynamically in some testing and have now written some more careful models to see how it actually behaves in some typical buildings and climates," he says.

One caveat is that DEVap air conditioners require a low-temperature heat source (in the range of 160 to 180 degrees Fahrenheit) to warm the desiccant so that it releases the water it has absorbed. Judkoff says that could be accomplished through solar heating in some configurations, reducing power requirements even more.

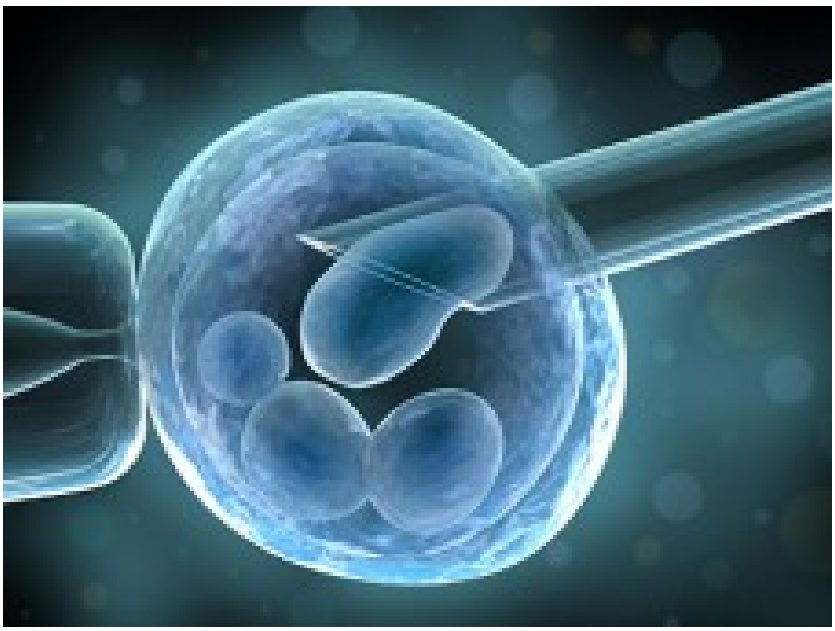
In addition to reducing the load on the electrical grid, which should translate into lower carbon emissions, DEVap cooling eliminates the need for ozone-depleting CFC and HCFC refrigerants. Judkoff notes these compounds are actually worse greenhouse gases than carbon dioxide. For each unit of mass, "they can be 10,000 times more debilitating to the atmosphere," he says.

It could be two to three years before DEVap coolers become commercially available, Judkoff says. "We've gotten calls from a lot of major players out there," he says. "The size of the potential market is very large and the size of the potential energy savings worldwide is very large."

http://www.miller-mccune.com/environment/air-conditioning-using-90-percent-less-power-20071/

Gauging the 'Yuck Factor' of Synthetic Biology

A poll tries to get a handle on how far Americans are willing to take a chance on the brave new world of synthetic biology.
By Emily Badger



How far are Americans willing to go with the often scary new world of synthetic biology? A poll shows the numbers correlate with the "yuck factor." (Alex Mit / istockphoto.com)

Much of the cutting edge of science today — stem cell research, synthetic biology, genetic modification — suffers from a vague creepiness, a sense among many non-scientists that this stuff just sounds *unnatural* (if not unethical).
David Rejeski, describes it as the "yuck factor," offering a slightly more technical term.
Part of the challenge for the scientific community, though, is that public perception matters; it can influence investor confidence, government policy, research priorities and public debate. And suddenly, such front lines of science seem everywhere.
A federal appeals court on Thursday lifted the ban on government funding of embryonic stem cell research. And next week, the Food and Drug Administration prepares to hold public meetings on the first genetically engineered animal likely to appear on your dinner plate — an Atlantic salmon tweaked with the fast-growing genes of an ocean pout and the growth hormone of the Chinook salmon.
That case comes with a messy set of risks and benefits. Can we feed more people with genetically modified animals? What if they get out into the wild? Would that cause ecological damage and, if so, is it worth the benefit?
How many of us, instead of thinking through that mind-bender or any of the others associated with biotechnology or stem cell research, might just reach for the "yuck factor"?
"I think it's very hard to imagine a scenario where that goes away," said Rejeski, who directs the Science and Technology Innovation Program at the Woodrow Wilson Center. "The problem with synthetic biology, it's hard to imagine you could pick a worse combination of words. 'Synthetic' was cool in the '50s — we had nylon stockings and vinyl records. Nobody talks about 'synthetic' now. It's all about 'locavores' — locally grown, organic and natural."

In focus groups, Rejeksi has actually watched the non-scientist's mind work through the concept of synthetic biology by analogy.
"They go from synthetic biology to artificial life to, 'Is that like cloning, GMOs, stem cells?'" he said. "They very quickly touch on just about all the third-rail subjects they could hit."

The Woodrow Wilson Center has been tracking such opinion to understand how the public perceives cutting-edge science (and government's relationship to it), but also how scientists might better explain what they're up to.
This week, Rejeski released new polling data on what people think about synthetic biology, defined by the center as "the application of engineering principles to the fundamental components of biology." Looking at the results, Rejeski places most of us into three categories.
One group opposes synthetic biology on moral or ethical grounds (and this correlates strongly with religion). No matter the application, these people object, and their moral misgivings may be an "immovable object," Rejeski said.
The second group contains people — young, white men, for instance — who are not particularly risk-averse and feel optimistic about technology in general. Most of us fall into the larger third group, where our opinions are heavily swayed by the precise application of the science and the way it's presented to us.
Based on what they knew about synthetic biology, 16 percent of the thousand adults surveyed thought its risks would outweigh the benefits (compared to 19 percent of people who felt the opposite).
They were then told some of the possibilities: Synthetic biology might one day craft new microorganisms that could lead to cancer treatments, cheaper drugs, cleaner fuels or substances that could break down pollution. But the field also carries moral concerns about how life is defined and fears that organisms could behave in unexpected, harmful ways, or fall into the wrong hands as weapons.
After told all of that, twice as many people decided the risks were probably too great.
The poll also presented two potential real-life applications. A majority was in favor of using synthetic biology to produce a flu vaccine, but three-quarters were uneasy with harnessing it to speed the growth of livestock from birth to butcher.
This raises another question: Can we have the one without the other? Can we get the vaccines without the weapons, the cleaner fuels without the moral ambiguity?
"I don't think people are assuming there's a no-risk scenario," Rejeski said. "But most people have better things to do in their lives than make risk-benefit calculations on new technologies. They drive their kids to soccer, whatever. Who wants to do that? The general tendency of most people is to hope and believe somebody is going to cover their back on this one."
That might be where government steps in. Surprisingly, the poll showed a greater faith in federal agencies than private businesses to keep an eye on this.

http://www.miller-mccune.com/science/gauging-the-yuck-factor-of-synthetic-biology-22365

Young Artists, Scientists Think Logically, Creatively

The "two cultures" are one: New research finds no significant differences in the problem-solving patterns of arts and science students at one British university.
By Tom Jacobs

Researchers found no differences in the problem-solving skills of arts and science students. (Theprint Photography/istockphoto)

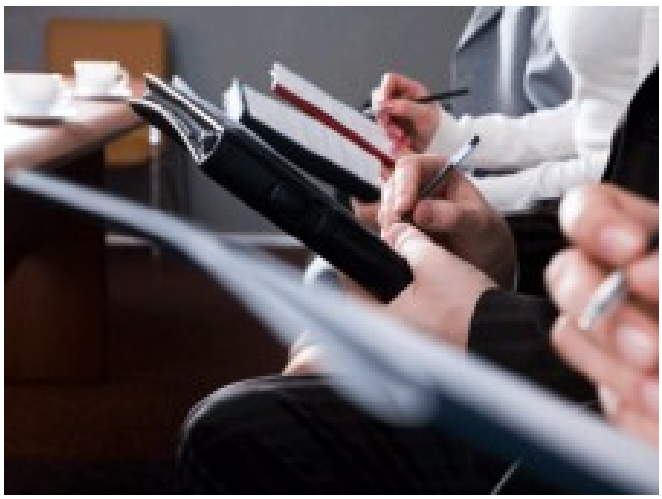
Do scientists and artists think differently? Fifty years ago, novelist/physicist C.P. Snow famously fretted that the two disciplines were drifting apart, and subsequent research suggested he was onto something. Science students tended to excel at logical, analytical thinking, while budding artists scored highest in tests measuring imagination and creativity.
But a newly published study of seniors at one British university reports that distinction has virtually vanished over the past five decades. Writing in the journal *Thinking Skills and Creativity,* Peter K. Williamson of the University of Derby reports "no differences were found in the problem-solving skills of arts and science students."
For Williamson's study, 116 final-year undergraduates — 51 focused on the arts and 65 on science — took a series of tests measuring their skill at convergent (logical) thinking and divergent (creative) thinking. These experiments, which asked the participants to solve "novel and imperfectly defined problems in the fields of management and public policy," gauged their ability to come up with imaginative solutions and revealed their preferred learning styles.
"The findings of this study were in marked contrast to earlier published results, in that no differences were found in the problem-solving skills of arts and science students," Williamson reports. "Differences were found in preferred learning styles, but these were much smaller than reported previously.
"This research indicates that modern graduates are likely to have a more balanced educational profile than their specialized predecessors."
How do we account for this shift? Williamson points to a number of U.K.-specific reasons, including a 1990 requirement that all students study science up to age 16. This means "it is now not possible in the U.K. for a student to be a pure artist studying only arts and humanities subjects," which is hardly an issue in most U.S. school districts.
But he also notes some wider changes in educational policy, such as an increase in interdisciplinary studies and a move away from formal lectures to a more flexible teaching style.
In follow-up interviews with 13 of the study participants, Williamson found clichés about the professions remain surprisingly potent, even if the differences they describe are no longer valid. "Students mainly

supported the traditional stereotypes of analytical, logical, detached and formal scientists, and emotional and imaginative artists," he reports.
This is somewhat surprising, given such recent high-profile collaborations as the conference/concert featuring physicist Stephen Hawking and cellist Yo-Yo Ma. As Williamson notes, success in either discipline usually requires "an imaginative leap, as well as the careful use of the available data or materials." If this study is any indication, that combination of thinking styles is rapidly becoming the norm in both the lab and the practice studio.

http://www.miller-mccune.com/science/young-artists-scientists-think-logically-creatively-22068

The Scientist and the Journalist Can Be Friends

Nancy Baron's new book is an excellent guide for academic researchers on how to effectively communicate with the press, public and policymakers.
By Tom Jacobs



"Escape from the Ivory Tower" could serve as a useful linguistic bridge between scientists, journalists and policymakers. (PressFoto/istockphoto)

"With high certainty" isn't going to top anyone's list of favorite three-word phrases, but as Nancy Baron notes in her important new book *Escape from the Ivory Tower*, it could serve as a useful linguistic bridge between scientists, journalists and policymakers.
Researchers, she notes, are hesitant to make definitive statements. Aware that knowledge is gained incrementally and always subject to revision, they tend to hedge their answers even to the most direct questions. This can frustrate both reporters, who are looking for facts, and politicians, who want solid information that can inform policy decisions.
This clash of attitudes has real-world consequences — most recently in the climate-change debate, where scientists' hesitation to make sweeping predictions has been both misinterpreted and willfully misconstrued. For political leaders reluctant to make tough choices, the experts' understandable tendency to avoid absolutes has become, in Baron's words, "an excuse to do nothing."
Barry Noon, a professor at Colorado State University's Department of Fish and Wildlife Biology, faced this dilemma in the 1990s. When his research about the declining spotted owl population was disputed by the timber industry, he felt a need to express the urgency of the situation without pretending he had all the answers.
His solution, as Baron quotes him, is as eloquent as an Einstein equation:
"Address scientific uncertainty by talking about the degree of certainty that accompanies our scientific conclusions, not the degree of uncertainty," he states. "For example, 'our research allowed us to state that the species was in decline with high certainty.'"
What a phrase: It's definitive enough for journalists, but allows enough wiggle room to keep scientists comfortable. We don't have to know precisely how acidic the oceans are becoming, or exactly how this will impact the life that lives within them, to know with high certainty that we face a serious problem.
That language is one of many nuggets of practical wisdom provided by Baron, who has spent much of the past decade coaching scientists on how to communicate the implications of their findings to the press and public. As a scientist and science journalist, she is uniquely qualified to help these professionals understand and accommodate each other's needs.

In her book, which is aimed at experts who want to become authorities or activists (or fear they will be thrust into such roles), she shares ideas she has picked up over the years and provides room for smart journalists to demystify the writing and editing process. (Full disclosure: One voice represented is that of Miller-McCune Online Editor Michael Todd.)

Baron speaks to scientists in their own language, declaring that "learning to communicate effectively is really no different than learning a new methodology and applying it." She then details that methodology, which essentially consists of reversing the way academics are trained to think and write.

"Journalists literally want to know your bottom line first," she writes. "To talk with them, you must turn what you normally do on its head and begin with the conclusion." Scientists, she notes, are often interested in knowledge for knowledge's sake. Journalists and policymakers — reflecting the needs of their readers and constituents — are focused on practical consequences.

"Why are you telling me this?" is the book's informal mantra, and for good reason: A good answer to that question is essential, if a researcher hopes to get his or her work noticed by the media. (Sure, scientists can skip the middle man and blog — Baron has a chapter on that practice — but bloggers, like all other writers, need to know how to attract and hold readers.)

"The most basic way to make people care," she writes, "is to form an association between something they don't yet care about and something they do care about." If you're not sure what that might be, think of Abraham Maslow's famous pyramid, or Doug Kenrick's recent recasting of it — a piece of research that got media attention because it cleverly played on an already-familiar image and addressed issues that hit home in a direct way.

"Keep in mind that nearly every citizen puts the highest priority on economic prosperity and public safety," Baron writes. If you can frame your research to address one or both of those bottom-line concerns, the chances of it getting noticed by journalists and politicians increases exponentially.

To purists who bristle at such suggestions, Baron has some blunt advice: "You can work with human nature and what audiences will find interesting about a story, or you can resist it." Tap into some basic human drive — say, fairness — and people with little inherent interest in your area of specialization will stop and take notice.

To get scientists to step back from their habitual linear way of thinking, Baron has devised a "message box." The central issue they are researching is placed in the middle; it is surrounded by crisp answers to four one-word questions: *Problem?* (That's shorthand for: What the specific aspect of this large topic I am addressing?) *Solutions? Benefits?* And, most critically, *So What?*

"If a conversation (with a journalist or policymaker) opens with a question about solutions, you can start there," she notes. "The quadrant layout mentally prepares you to circle back to your main point, no matter where you begin."

Baron's writing is substantive but breezy; at many points of the book, she stands aside and lets such veteran science writers as *The Washington Post's* Juliet Eilperin or National Public Radio's Christopher Joyce contribute their own pithy comments. Such asides give the volume — the third book on the subject of scientists, media and society to be published this year — a unique multiplicity of perspectives, which coalesce into a crucial message.

Baron's bottom-line advice to scientists entering the public sphere: "Sum it up, simplify, and tell us what it means … or someone else will do it for you, and may get it wrong." Or, worse, your work will be ignored, which will effectively kill any chance it might make a difference. And that's something we can say with high certainty.

http://www.miller-mccune.com/media/the-scientist-and-the-journalist-can-be-friends-21717/

Volunteer Work Prolongs Lives of Frail Elderly

New research finds that among the elderly, functional limitations are associated with an increased risk of dying — but only for those who don't do volunteer work.

By Tom Jacobs

New research finds that volunteerism among elderly prolongs their lives. Here, seniors are seen volunteering during a yearly program designed to teach Spanish to Baylor College of Medicine Physician Assistant students. (Neighborhood Centers)

If you're getting up in years, and the basic activities of daily living have become something of a struggle, doing volunteer work is probably the last thing on your mind. But new research suggests there's an excellent reason to make the effort.

You may actually live longer.

That's the conclusion of a study just published in the journal *Social Science and Medicine*, which examined death rates of a representative sample of American seniors. It found difficulties with basic daily activities, including those caused by decreased mobility or upper-arm strength, "are associated with an increased risk of dying only among participants who almost never or never volunteered."

The study adds to the mounting evidence linking volunteering with health, well-being and longevity, and suggests this association may be particularly significant toward the end of life. "Although it may be more difficult for older adults with functional limitations to volunteer," the researchers conclude, "they may receive important benefits from doing so."

A research team led by Arizona State University psychologist Morris Okun looked at data on 868 participants in the Later Life Study of Social Exchanges. The participants, who participated in 70-minute-long interviews in the year 2000, were all "cognitively functional" U.S. residents between the age of 65 and 91.

Sixty-nine percent of the seniors said they had volunteered "never or almost never." The others reported they volunteered somewhere between once a day and once a month. They were also asked 15 questions regarding the level of difficulty they experienced with the activities of daily living.

Six years later, 25 percent of the participants had died. The researchers used a variety of statistical methods to compare death rates, functional limitations and volunteer activity.

They found that “among older adults with high functional limitations, the risk of death is approximately three times greater for those who did little or no volunteering, relative to those who volunteer more frequently.” Volunteer work, they concluded, “buffers the association between functional limitations and the risk of dying.”

Why does volunteering have such a positive effect? Okun and his colleagues present several possible explanations. “Volunteering may offset the loss of purpose in life that occurs with aging and that may be amplified by functional limitations,” they write. It appears that a sense of purpose not only makes younger people more attractive; for older adults, it “has been shown to postpone mortality.”

Seniors may also get a health boost from the sense of personal competence and accomplishment that volunteer work can provide. As the researchers note, “It may be that the threat to feelings of competence posed by functional limitations is mitigated by the esteem-boosting effects of engaging in volunteer activities.”

Either way, “strategies should be identified to encourage older adults with mild or moderate functional limitations to volunteer,” the researchers conclude. Perhaps the ingredients for a long life can be found in the appreciative faces of the people we’ve helped.

http://www.miller-mccune.com/health/volunteer-work-prolongs-lives-of-frail-elderly-21763

Do School Lunches Plump Up Poor Kids?

A program to ensure all American children get at least one good meal a day may lie behind their expanding waistlines. Oddly, a breakfast program does not.
By Emily Badger

Are school lunches contributing to childhood obesity? Research supports that theory, but finds that school breakfasts do not. (Shorrocks / istockphoto.com)
Students who participate in the National School Lunch Program are more likely to come from lower-income families or families with two working parents who don't have time to pack a brown-bag lunch the night before. Those same students, as a quick glance around many school cafeterias this fall will show, are also more likely to be overweight.
The challenge for researchers and policymakers has been to sort out the relationship between the two.
"When you just look at those groups [who participate in school lunch], those are groups also more likely to not be the healthiest kids," said Daniel Millimet, an economist at Southern Methodist University. "Then there's a question of whether or not there's actually something causal going on, or does the perception just reflect people who are self-selecting into the program?"
In other words: Does the National School Lunch Program make children obese, or are obese children simply more likely to sign up for the program in the first place?
This riddle is deeply relevant for policymakers trying to mine a solution to the country's obesity epidemic – an epidemic that may even have national security implications — in the school cafeteria.
Millimet, alongside Georgia State economist Rusty Tchernis and Muna Husain of Kuwait University, now believe school lunches are partly to blame.
"When we try to isolate causal effect," Millimet said, "it's surprising that there's still something there."
In their paper "School Nutrition Programs and the Incidence of Childhood Obesity," published in the *Journal of Human Resources*, the authors rely on data on 13,500 students taken from the Early Childhood Longitudinal Study, which tracked children who entered kindergarten in the fall of 1998 through the eighth grade. The survey includes annual data on height and weight, which the researchers used to calculate body mass indexes (they define obesity as above the 95th percentile in BMI).
The original survey also asked parents for data on the birth weight of their children, allowing the researchers to assess weight gains from birth through kindergarten, isolating the health status of children before they entered the school lunch program. The researchers also accounted for the likely meals children received from their parents at home.

Controlling for those two factors, they found that children who participate in the school lunch program are

more likely to become obese than those who don't. In a surprising twist, though, the federally subsidized School Breakfast Program has the opposite effect. (And children who eat both school breakfast and lunch are less heavy than those who participate in neither program.)

Millimet has a few theories to explain this. Breakfast is, as nutritionists say, the most important meal of the day. "In general, even if breakfast weren't in compliance with federal nutrition guidelines, even if they were close," Millimet said, "I think a lot of nutritionists would argue that's still a good thing."

He also points to one difference between school breakfast and lunch – the latter has more a la carte options, which are not subject to the USDA nutrition guidelines because they are not reimbursable by the federal government.

The a la carte tray comes with a unique set of economics. Schools are reimbursed a set amount for each meal on the cafeteria line they sell.

"But then if on your way out, you pick up an extra ice cream sandwich, paying that out of pocket, the government doesn't know about it, schools don't get reimbursed," Millimet said, "and whatever profit the schools earn on that is revenue they can spend on whatever they want." Like teacher salaries or classroom supplies.

Schools may be conflicted in wanting — and needing — to offer the items kids will buy. And most kids, untethered from the benevolent influence of the grownup who dishes out the lunch tray, will go for the a la carte ice cream sandwich over the plate of broccoli.

The answer may not be so simple as removing the a la carte tray.

"We need to think about how to make school lunches more healthy as well as profitable to schools," Millimet said. "Health is important, but it's only one issue that schools are dealing with. Before we go overboard one way or another, we have to think through the full ramifications."

http://www.miller-mccune.com/health/do-school-lunches-plump-up-poor-kids-21822/

That Was No Accident. My Martini Told Me So.

New research on alcohol and aggression finds intoxicated people are more likely to believe an ambiguous act is intentional.
By Tom Jacobs

Was it an unfortunate accident or a deliberate provocation? The answer depends on how much you've had to drink. (Juanmonino/istockphoto)

So you're sitting at a bar, and some guy shoves your arm as he walks past, causing you to spill your cocktail. You can respond in one of two ways: Shrug it off and order another, or get angry, exchange heated words and risk escalating a minor incident into a violent confrontation.

The key factor in making that choice is how you view the incident: Was it an unfortunate accident or a deliberate provocation? It turns out your answer to that question depends largely on whether you're on your first drink, or your fourth.

That's the conclusion of a French study just published in the *Personality and Social Psychology Bulletin.* It reports intoxicated people are more likely to assume an ambiguous act is intentional rather than accidental. "This finding helps explain why alcohol increases aggression," writes the researchers, led by psychologist Laurent Begue of the University of Grenoble.

Begue and his colleagues conducted an experiment on 92 French men between the ages of 20 and 46. They were recruited, via newspaper advertisements, to participate in a "taste-test study." All sampled a grapefruit juice and grenadine cocktail; for half, the drink was spiked with two ounces of pure alcohol.

The participants then read 50 sentences describing simple actions. Fifteen of the actions were clearly done on purpose ("She looked for her keys"); 15 were obviously random ("She tripped on the jump rope"): and 20 could have been either ("He deleted the mail"). For each sentence, they were instructed to indicate whether they thought the action was intentional or accidental.

"Intoxicated participants perceived more actions to be intentional than did sober participants," the researchers report. While some were told their drinks contained alcohol and others were not, this information had no significant impact on the results.

So what's the link between imbibing and ascribing blame?

"Recent research suggests that adults have a default explanatory bias to interpret all acts as intentional," Begue and his colleagues write. According to this line of thinking, our initial impulse in evaluating a situation is to assume it's the result of intentional behavior. It requires additional mental processing to factor in the possibility that the outcome was the result of an accident.

"The key to avoiding the intentionality bias is to inhibit the inclination to make intentional attributions when explaining the behavior of another person," the researchers write. "To avoid this bias, one must pay close attention to, and accurately process, subtle external factors."

Intoxication not only impairs this ability, it also "has the myopic effect of drawing attention to more salient internal factors," such as, say, your own anger or frustration. "Alcohol consumption," the researchers conclude, "contributes to a hostile interpretation of events, and therefore to aggression."

After a certain number of drinks, there are no perceived accidents — just perceived slights. So steer clear of the man with a beer in his hand: There's a strong chance he also has a chip on his shoulder.

http://www.miller-mccune.com/culture-society/that-was-no-accident-my-martini-told-me-so-22600/

Happiness Is on the Rise. Thanks, Freedom

Despite the belief that happiness has remained constant in modern societies, recent research says otherwise, citing rising democracy and increased basic freedoms as the cause.
By Brad Wittwer

Researchers say economic development doesn't just mean a bigger wallet; it also furthers happiness through increased freedom, opportunities and equality. (LiseGagne/istockphoto)

Is economic development the key to national happiness? Once nations have covered the bases for most of their citizens — checking off the basic necessities of food, water, shelter and safety — what is left? Do we stop measuring success by our GDP and tell government to stop pursuing happiness and focus on its capture, á la Bhutan?

A standard government response to such mandates might be to ladle out cash, but recent research suggests more money alone doesn't make us happy — what makes us happy is having more than our neighbors. So with Western nations having established an economic pecking order since World War II, perhaps it's no surprise to see studies that find no net increase in European or American happiness over the last half century. This "Easterlin paradox" argued that richer people within a country are happier, but as a developed country itself grows richer, there is no corresponding aggregate increase in happiness.

But a group of researchers, citing data from 1981 to 2007, says that's not true, and that happiness rose in 45 of the 52 countries for which extensive data was available, including the U.S., Japan, Spain, France, Germany and Britain.

Furthermore, the cause wasn't income but freedom.

In the researchers' words, "Since 1981, economic development, democratization, and increasing social tolerance have increased the extent to which people perceive that they have free choice, which in turn has led to higher levels of happiness around the world."

Economic development doesn't just mean a bigger wallet; it also furthers happiness through increased freedom, opportunities and equality, argue Ronald Inglehart and Christopher Peterson of the University of Michigan, Robert Foa of Harvard University and Christian Welzel of Jacobs University in Bremen, Germany.

They correlated happiness and freedom data from the World Values Survey and European Values Study, representing almost 90 percent of the world's population. Interestingly enough, the data ends in the year of the financial crisis, right on top of the bubble of American and European economic success.

The team credits increased freedoms and equality, not more material goods, for the rise in happiness. Perhaps the movement away from pursuing a larger piggy bank is already under way as people seek more balanced lives, self-expression and utilizing free choice.

The authors speak of the transition, that once economic prosperity has been reached, people emphasize "quality of life concerns rather than continue the inflexible pursuit of economic growth,"; further economic growth brings minimal gains to subjective well-being. Beyond survival, people focus on a "broader pursuit of happiness by maximizing free choice in all realms of life. The belief that one has the free choice and control over one's life is closely linked with happiness."

But it isn't a matter of just distinguishing freedom from economic status for the two are reciprocal; income increases freedom. Increased economic muscle doesn't just entail a four-car garage. It also means more freedom to pursue what makes us happy.

http://www.miller-mccune.com/culture/happiness-is-on-the-rise-thanks-freedom-20761

Anti-Gay Attitudes Undeterred by Golden Rule

Invoking the golden rule — the adage of "do unto others" — has no effect on Christians' anti-gay attitudes, according to a new study.
By Tom Jacobs

Reminders of the golden rule are utterly ineffective at changing the minds or hearts of Christians who have anti-gay attitudes. (Cstar Enterprises/istockphoto)

It seems, on the face of it, a clever retort to conservative Christians who express prejudicial attitudes toward gays and lesbians. Respond by quoting the words of Jesus Christ — specifically, his admonition, "Do unto others as you would have them do unto you."
There's just one problem: According to a new study, such reminders of the golden rule are utterly ineffective at changing minds or hearts. And if you emphasize the universality of this message of tolerance by quoting the leader of a different religion, anti-gay attitudes actually harden.
That's the conclusion of researchers led by York University psychologist Oth Vilaythong Tran. Writing in the *Journal for the Scientific Study of Religion*, they describe a study of 966 self-described Christians or Buddhists who volunteered on the website of Harvard University's Project Implicit.
To begin the experiment, the participants filled in missing words from a series of quotations. For one-third of of the participants, two of the five quotes were variations on the golden rule, which were attributed to Jesus. Another third were presented with the same golden rule-related quotations, only in their case, the sayings were attributed to the Buddah. The final third filled in words from unrelated quotes.
Their explicit and implicit attitudes toward gay people were then measured in a series of tests. In addition, they reported their political ideology and level of religiosity.
"We predicted that priming the golden rule would decrease negativity toward gay people, especially when it was attributed to the leader of one's own religion," the researchers write. "Instead, the golden rule priming had no effect when communicated by one's own religious leader.
"However, when the golden rule messages were attributed to the Buddha, Christians self-reported being more explicitly negative toward gay people and more likely to believe that homosexuality is a choice," they add. "The results suggest that when a tolerant message comes from a religious out-group figure, it does not increase, but may decrease tolerance toward another out-group."

The researchers concede that the reasons for this are not obvious. “An out-group member’s message of tolerance may be perceived as a negative judgment of the perceiver’s present moral status, rather than as a universal message of compassion,” they note. “Perceivers might be especially sensitive to an implied moral criticism when an out-group member delivers a moral message.”

As to the larger issue of the golden rule’s ineffectiveness, it’s helpful to view these results in the context of Jonathan Haidt’s notion of distinct spheres of morality. In his map of our ethical worlds, fairness and justice occupy one sphere, while anti-gay sentiments fall under another, purity/sanctity. In other words, they stem from deep-seated negative feelings associated with impurity or uncleanliness.

In Haidt’s framework, it’s not surprising that appeals to fairness have no effect. For people such as Christian conservatives who resonate strongly with the notion of purity/sanctity, fairness is not the primary issue when it comes to gay rights. When you perceive something as a threat — however irrational those feelings may be — appeals for tolerance fall upon deaf ears.

http://www.miller-mccune.com/culture/anti-gay-attitudes-undeterred-by-golden-rule-22454

Busting Myths About Photovoltaics

Fresh from the European Union photovoltaic conference, our John Perlin takes on some of the misconceptions clouding the solar power movement.
By John Perlin

Myths abound around solar power and photovoltaics. Our man on the scene at the European Union Photovoltaic Solar Energy Conference, John Perlin, busts several of them. (Phil Heger / flickr.com)

The European Union Photovoltaic Solar Energy Conference I just attended stressed the need for public education about photovoltaics — the silicon-based solar cells that turn sunlight into usable electricity — to increase acceptance of the solar-power technology.
Myths abound about photovoltaics that hinder their growth, and I'd like to burst some of those misconceptions right here:
Myth: Because solar cells are only a few microns thick, they produce weaker electricity.
Fact: All electrons are created equal. Hence, the movement of electrons that make up electricity are no different from those generated by the sun striking "wimpy" solar cells than from those generated by huge turbines powered by steam. Our minds have become so accustomed to electricity generated by large power plants that it is hard to adjust to the concept that extremely thin material can do the same work.
Myth: Photovoltaic cells require much more area to generate power than do power plants run on fossil fuels or nuclear.
Fact: If the extraction and transportation of fossil fuels and nuclear is accounted for as well, then the area required for the production and generation of the three energy sources is about the same.
Myth: Photovoltaics, unlike other power generators, can only survive with subsidies.
Fact: While subsidies do matter, as shown in Germany, other common power sources also receive major support. Fossil fuels and nuclear receive about $500 billion in subsidies worldwide every year. If not for the Price-Anderson Act, which limits liability of nuclear power plants in the U.S., they would be unable to operate since insurance costs would be too expensive.

Our John Perlin is attending the 25th annual European Photovoltaic Solar Energy Conference in Valencia, Spain. He will be providing updates throughout the meeting. Check back with our By the Way blog to see more reports from this conference.
Myth: Photovoltaic-generated electricity is more costly than electricity generated by fossil-fueled or nuclear-powered electricity.
Fact: All economic models focus on initial investment, higher for photovoltaics and solar energy in general, than the expenses for running them. Since photovoltaic technologies work with minimal maintenance and no power requirements over many decades receiving free energy from the sun, the electricity itself eventually costs nothing (although human administration, property taxes, etc., will cost something). Also, few present economic models factor in the risk of fuel costs rising or of their diminished availability over the long term, nor do they usually include externalities such as the military cost of guaranteeing continued access to fossil fuels or America's continued armed presence in oil- and gas-producing regions even in peacetime.
Myth: Photovoltaics require full sun to operate and therefore do not work in cloudy regions.
Fact: Photovoltaics work both with direct radiation (full sun) and diffuse sun (cloudy skies). Germany, for example, not known for its sunny climate, produces more electricity from sunlight than any other nation.
Myth: Solar cells can only work when the sun shines.
Fact: That's true, but with the smart grid, many means of power storage exist. For example, when wind power produces excess electricity in Denmark, it goes to hydro-electric plants in Norway where they pump water uphill. When the Danes require more power than the wind machines can produce, the water stored uphill flows downward through the hydro power plants, sending the electricity produced immediately to Denmark.
Myth: Solar cells require more energy for their production than they generate.
Fact: Under the most trying conditions, it takes no more than three years of operation for solar cells to pay back the energy that goes into making them. As they will last for many decades, their energy payback is extremely short. Changes in technology, such as plastics or paint-ons, may change the time frames but not the underlying equation.

http://www.miller-mccune.com/environment/busting-myths-about-photovoltaics-22718/?utm_source=Newsletter127&utm_medium=email&utm_content=0921&utm_campaign=newsletters

Saving Sub-Sahara Africa a Drip at a Time
Rural electrification using solar energy may find a match made in heaven when linked to drip irrigation.
By John Perlin

Thanks to photovoltaic drip irrigation, women farmers in the rural villages of northern Benin, for the first time, are able to grow vegetables and fruits during the six-month dry season. (SELF.org)

SELF.org

SELF engineers developed a 2.1kW solar electric power supply (using photovoltaic cells, pictured) that provides 100 percent of the energy for the pumps.

The hundred thousand people of the Kalalé District in northern Benin, a country in West Africa, like billions in the developing world, are not connected to power lines. All but one out of 20 rely on farming for their livelihood, and most just scrape by. During the dry season from November through April, many suffer from malnutrition, a condition so common it gets its own name, *kwashiorkor.*
One Kalalian, Mamoudou Setamou, teaches about insects and integrated pest management at Texas A&M. He hasn't forgotten his roots and returns to Kalalé to participate in local community functions including district council meetings. At one such gathering in 2006, the council discussed ways of generating electricity when it became clear that the central government had no intention of bringing electrical lines into the district anytime soon. For his part, Setamou believed that photovoltaics best fit his countrymen's needs.
Back in America, he stopped at the headquarters of the Solar Electric Light Fund, a Washington, D.C.-based nongovernmental organization that traditionally focuses on using solar to bring electricity to poor, remote or rural areas — like Kalalé.
Robert Freling, SELF's executive director, answered the phone the day Seamou called. "We have to turn down most requests," Freling recalled, "but we were intrigued with doing not just a one-off village but an entire district. We'd done the one-offs, but this was a chance to do 44 villages and 100,000 people."
After talking with the professor, SELF developed a master plan to solarize much of the infrastructure in the 44 villages, bringing the region things like street lighting and wireless Internet, and improving education and health care.
But when a SELF team visited Kalalé, their priorities changed; the overwhelming need in the area was having enough to eat. As SELF staffers would later write, "Despite its great potential, agricultural production in Kalalé remains weak and easily influenced by natural conditions. Rainfall is the sole source of water supply for crop production, which is limited to only a six-month rainy season each year."
So the focus turned to irrigation. SELF sought the help of Dov Pasternak, an Israeli agronomist based in Niger who had created a low-pressure drip irrigation system that brings to poor farmers in sub-Sahara Africa the advantages of that technology at a fraction of the cost.
Though Pasternak had overseen the installation of thousands of such systems, his clients had used pumps powered by diesel engines and not photovoltaics. SELF and Pasternak discussed the advantages of photovoltaics for such projects, looking at data from sources as disparate as the U.S. National Renewable Energy Lab to on-the-ground work in dry Namibia. Over 20 years, for example, running a diesel generator would cost nearly four times as much as using the more-expensive photovoltaics.

Reliability was also an issue. Thousands of diesel generators have broken down in this part of the world, never to run again due to scarce parts and few mechanics, while service also grinds to a halt for lack of fuel. A 10-year study of PV water pumping systems in Mexico found that after a decade, 60 percent of the systems were still working — and when they weren't, the problem usually arose from the pump, not the PV. Photovoltaics, meanwhile, work best during dry weather in full sun — when crops need water most. In Namibia, where water use focuses more on farm animals and less on crops, South African researchers also noted that the PVs produced no carbon dioxide emissions, didn't erode the borehole water was pumped from and allowed better rangeland conservation — all advantages over diesel.

"We cannot and will not use diesel generators to pump water," Freling said. "Dov was skeptical at first, but now he has become a huge convert when it comes to using solar."

The systems, by Third World standards, weren't cheap — $18,000 each to install and almost $6,000 a year to maintain. But with help from the Association pour le Developpement Economique Social et Culturel de Kalalé, $100,000 from a World Bank's Global Development Marketplace grant, and private donors, SELF put in three solar-powered irrigation systems, each serving 2.1 kilowatt system irrigating 1.25 acres.

SELF.org

The farmers, all women, have grown enough to feed themselves and their families, and to produce a large surplus of vegetables to sell at local markets.

Since 2007, when the pilot systems went in, results have been amazing. The farmers, all women, have grown almost 2 tons of produce per month per system. That's enough to feed themselves and their families and to produce a large surplus (80 percent of what they grow) of highly valued vegetables ranging from tomatoes and carrots to amaranth and moringa to sell at local markets. Money derived from sales has allowed them to purchase staples and protein sources to hold them over during the dry season. Previously, they had to ration their supplies until the next harvest. They also increased their intake of vegetables significantly, amounting to 1 pound per day per person, equal to the daily recommended five servings for each individual.

"The photovoltaic irrigation drip system could potentially become a game changer for agricultural development over time," researcher Jennifer Burney of Stanford University's Program on Food Security and the Environment told her school's Ashley Dean. A paper by Burney, program director Rosamond Naylor, Pasternak, Lennart Woltering and Marshall Burke is scheduled to appear in the Proceedings of the National Academy of Sciences strongly supporting the use of PV in combination with drip irrigation.

And as an impressed researcher remarked, most of the change took place during the dry season. Freeing farmers from enslavement to the whims of weather, those studying the SELF projects concluded, "Widespread adoption of photovoltaic drip irrigation systems could be an important source of poverty alleviation and food security in the marginal environments common to sub-Saharan Africa."

Meanwhile, the project continues for SELF, which is still working on the solarization of the entire district. In February, said Freling, the project is solar-powered pumping of drinking water in Kalalé, since the existing pumps are dedicated to drip irrigation right now.

http://www.miller-mccune.com/business-economics/saving-sub-sahara-africa-a-drip-at-a-time-7308/

The Tree That Changed the World

Two planets diverged in a solar system, and the successful one took a path more wooded.
By John Perlin

Trees are really what make life possible. The carbon dioxide transfer from the atmosphere to the land is the result of the rapid global spread 400 million years ago of the first (or among the first) true trees, Archaeopteris.

The author of A Forest Journey: The Story of Wood and Civilization*, begins a series of articles on the world's first energy crisis: peak wood.*
Part I: The Tree That Changed the World
Part II: Wood and Civilization
Part III: Peak Wood and the Bronze Age
Part IV: Peak Wood Brings on the Industrial Revolution and the Age of Fossil Fuels
Astronomers for the longest time have regarded Venus as the planet most resembling Earth. Having almost the exact size as Earth and being almost as close to the sun has led many to call it Earth's twin.
The clouds always covering the Venusian landscape are another compelling example of Venus' affinity to Earth. Pioneering astronomer Svante Arrhenius hypothesized great rains pouring from these clouds nurtured lush rain forests below. But when various space probes penetrated the Venusian atmosphere, this belief burst. Astronomers found an inferno rather than a tropical paradise.
Here they discovered the ultimate greenhouse effect: Although the carbon dioxide-laden atmosphere allowed sunlight to pass through, when the solar rays hit the surface of Venus and changed into heat waves, they could not escape the carbon dioxide cover. So the heat had nowhere to go and accumulated at the surface, where temperatures exceed 800 degrees Fahrenheit.
Earth has as much carbon dioxide as Venus. But instead of the gas blanketing the sky as happened on Venus, much of the carbon dioxide on Earth has been locked up inside and on the surface. This has made all the difference in the story of the two planets — one, a heaven bountiful with life, the other a hellish place where nothing animate as we understand it can survive.
Credit much of this carbon dioxide transfer from the atmosphere to the land to the rapid global spread 400 million years ago of the first (or among the first) true trees, Archaeopteris.
Its dense canopy photosynthetically absorbed carbon dioxide. As its fernlike leaves shed, they would have given back the carbon dioxide to the air — had the tree's deep and powerful root system not broken down rock through which it dug into soil, where chemical reactions eventually locked the carbon dioxide into sediment. Mud buried much of the remaining dead leaves, branches, twigs, trunks and roots.

With the passing of millions of years under great pressure deep in the bowels of the earth, the plant material ended up as rich beds of fossils and coal. Once again, natural forces denied returning to the atmosphere what the trees had devoured.

Archaeopteris prepared the soil for smaller plants to flourish and assist in removing carbon dioxide from the air. Its root system turned rock into rich, soft earth. Their leaves shielded the newly formed soil from erosive rain and wind, and fertilized it as they fell and decomposed. Debris from the growing number of plants filled waterways, promoting plankton, which also feeds on atmospheric carbon dioxide.

Buried by sediments these consumers of carbon dioxide could not release this greenhouse gas to the air. The plunging carbon dioxide levels in the atmosphere caused temperatures on land to drop. The change made it possible for large creatures to amble about the land without overheating. They no longer had to remain immersed in water — which heats more slowly than land surfaces, and which also better conducts heat away from animals than does air — to maintain healthy body temperatures.

At the same time, declining amounts of atmospheric carbon dioxide enlarged the ozone layer above the Earth. Such protection shields land animals from lethal doses of ultraviolet radiation. Previously, creatures of any significant size had to remain underwater for protection from the unfiltered sun's harmful rays. Of equal importance, the injection of more oxygen into the air by Archaeopteris and smaller plants provided enough of the life-giving gas to make it possible for animals to breathe.

Scientists find charcoal for the first time during the reign of Archaeopteris, suggesting that with the trees' appearance came sufficient amounts of oxygen to support combustion.

As logs and large branches started to clutter the bottom of shallow waterways, fishlike creatures with limbs could better propel themselves through the plant debris than those with fins. The increasing organic debris finding its way into waterways would rob them of their oxygen as it decomposed. Creatures that could breathe as well as walk could escape sure death by making their ascent to land where a relatively mild climate, sufficient oxygen, protection from ultraviolet radiation, and plenty of food provided by plants made survival possible.

So began the chain of events that has permitted vertebrates to flourish on land so that 400 million years later I can write this, and you can read it.

While Archaeopteris is now extinct, nature kept buried the remains of ancient organic debris of algae, plankton, plants and trees. Their entombment helped keep the carbon dioxide they captured through photosynthesis out of the atmosphere.

But people started to dig up and burn the early trees, ancient plants and plankton first as coal and then as oil and natural gas. The seemingly unlimited availability of long-buried organic material, aptly named fossil fuels, ushered in a new technological era qualitatively separating those living since the middle of the 19th century from the rest of history. This new age of unprecedented growth, the Industrial Revolution, also accelerated the rate of deforestation as growing markets and population require more and more clearing for agriculture, livestock and biofuels, and the consumption of trees for fuel and for timber.

True, deforestation has occurred throughout world history. Plato, for example, saw deforestation turn a fertile piece of Attica into rock. He compared this butchered slice of earth to a carcass stripped of all its meat with only the bones remaining.

"What now remains compared with what then existed is like the skeleton of a sick man, all fat and soft earth having wasted away, and only the bare framework of the land being left," he wrote in *Critias*. "… There are some mountains which have nothing but food for bees, but they had trees not very long ago …"

Since the beginning of the Industrial Revolution, Plato's compelling description of a particular place in Greece has become universal.

The growing loss of trees has allowed ever increasing amounts of carbon dioxide to return the to atmosphere. So have the engines of commerce and industry by burning fossil fuels. Scientific investigations have proven that since the beginning of the industrial revolution carbon dioxide levels have increased as well as the temperature of the Earth.

Unless drastic changes occur socially and technologically, increasing amounts of carbon dioxide will enter the atmosphere as the burning of fossil fuels continues to accelerate along with deforestation. Deforestation alone accounts for the release of more greenhouse gases than do all the vehicles throughout the world!

Bad forestry practices help hasten the pace of carbon released into the atmosphere. Following a clear-cut, for example, the formerly forested soil releases tremendous amounts of carbon dioxide into the atmosphere.
In North America, for example, 60 percent of all carbon resides within the earth of the forest floor. Replanting does capture carbon dioxide as new organic matter grows. The losses of carbon dioxide to the atmosphere continue to exceed the removal of carbon in the replanted clear-cut for 15 to 25 years depending on the type of tree, climate and soil. Then the trees and the soil underneath start to store more carbon dioxide than released.
Conversely, forests can become a weapon in our arsenal to break global warming if foresters practice enlightened stewardship. Sustainable forestry will need to become the standard on all forest lands globally. Replanting formerly forested land helps if trees are not selectively harvested until the seedlings reach an age where they have taken in more carbon dioxide than has been exhaled. Trees cut down in cycles of 50, 75 and 100 years store only 38 percent, 44 percent and 51 percent, respectively, of the carbon that an old-growth stand retains.
Indeed, trees can play a vital role in reducing atmospheric carbon dioxide. A recent study shows that saving the Amazon can be a cheaper and faster way to mitigate the consequences of global warming than replacing coal-fired power plants with renewable energy.

http://www.miller-mccune.com/science-environment/the-tree-that-changed-the-world-11656/