## Memory, depression, insomnia—and worms?

OKLAHOMA CITY, August 5, 2008 — Researchers have spent decades probing the causes of depression, schizophrenia and insomnia in humans. But a new study may have uncovered key insights into the origins of these and other conditions by examining a most unlikely research subject: worms.

The project, which was led by Oklahoma Medical Research Foundation scientist Kenneth Miller, Ph.D., examined the way eye-less microscopic worms known as C. elegans shy away from certain kinds of light. The researchers made several key findings, chief among them that exposing paralyzed C. elegans to ultraviolet light restored normal levels of movement in the worms.

Miller's group at OMRF traced the light reaction to a tiny molecular sensor, which is encoded by a gene they named LITE-1. "This sensor doesn't resemble any other light sensors previously discovered," said Miller.

Although humans lack this ultraviolet light sensor, Miller's discovery provides a window for understanding how the molecular signals in our nerve cells allow them to talk to each other because the ultraviolet-produced signal travels down nerve pathways found in humans, C. elegans, mice and other higher organisms. Those pathways have been implicated in schizophrenia, memory, learning, depression and could be linked to sleep disorders, Miller said.

"That doesn't mean shining an ultraviolet light on people in wheelchairs will suddenly allow them to walk," said Miller. "But it does give us a tool that we can use to solve the mysteries of nerve cell communication and could ultimately help us understand the biology of everything from sleep and memory to depression."

The research appears in the Aug. 5, 2008 edition of the journal PLoS Biology.

"The new work from Ken Miller's lab has identified a new way that organisms can sense light, distinct from the previously known light-sensing mechanism used in the eye," said Michael Koelle, Ph.D., of the Yale University School of Medicine. "It will be interesting to see whether the LITE-1 light-sensing mechanism will also lead to new insights into human sensory perception."

Despite 35 years of intensive research by hundreds of labs studying C. elegans, no one had discovered that eye-less worms can respond robustly to light. Miller's group found the light response when they began studying worms that were paralyzed because of a gene mutation.

In prior studies, Miller and his OMRF colleagues showed that this mutation disrupts a molecular network of pathways that controls how nerve cells send signals to each other at synapses, the points where different neurons touch each other. Those same nerve cell pathways are all present in the human brain, where they are thought to play a role in controlling behaviors, learning and memory, and may also be involved in causing human neurological disorders.

"Without signals from this network, neurons cannot talk to each other or to muscle cells to produce movement, so the mutants just lie paralyzed on the culture plate even if you poke and prod them," Miller said.

But when Miller turned a short wavelength light—like ultraviolet rays—on the worms, it created a new signal in the neurons, allowing the animals to move as long as the light was on them. The same response had not been found previously in normal C. elegans because those worms have no trouble moving.

Miller said he thinks the worms are hardwired to avoid damaging or lethal doses of direct sunlight, which includes UV rays. "When you are only a few cells thick, getting a sunburn is fatal," he said.

More important, Miller said, is the finding out how the signal gets through pathways that were closed to the brain before the ultraviolet light was turned on.

"If we can understand how and why those nerve signals are able to get through, it could provide insight into those basic pathways in humans," he said.

Miller emphasized that the research is still in its early stages. "We're a long way from any treatments based on this research, but I think we've opened up a door that we didn't know was there before," he said. "There's a lot of work left to be done, but I'm excited to see where this discovery leads us."

*Research funding was provided through a grant from the National Institute of General Medical Sciences, an arm of the National Institutes of Health, and OMRF.*

*About OMRF OMRF (omrf.org) is an independent, nonprofit biomedical research institute dedicated to understanding and developing more effective treatments for human disease. Chartered in 1946, its scientists focus on such critical research areas as Alzheimer's disease, cancer, lupus and cardiovascular disease.*

## Stanford study uses genetic evidence to trace ancient African migration

STANFORD, Calif. - Stanford University researchers peering at history's footprints on human DNA have found new evidence for how prehistoric people shared knowledge that advanced civilization.

Using a genetic technique pioneered at Stanford, the team found that animal-herding methods arrived in southern Africa 2,000 years ago on a wave of human migration, rather than by movement of ideas between

neighbors. The findings shed light on how early cultures interacted with each other and how societies learned to adopt advances.

"There's a tradition in archaeology of saying people don't move very much; they just transfer ideas through space," said Joanna Mountain, PhD, consulting assistant professor of anthropology. Mountain and Peter Underhill, PhD, senior research scientist in genetics at Stanford's School of Medicine, were the study's senior authors. Their findings will appear in the Aug. 5 advance online edition of Proceedings of the National Academy of Science.

"We know that humans had to migrate at some point in their history, but we also know humans tend to stay put once they get someplace," Underhill said.

Instead of using archaeological evidence alone to guess whether people migrated, "all of a sudden, with genetics, you can actually address that question," Mountain said.

The researchers tracked genetic variation on the Y chromosome, the sex chromosome passed from father to son that encodes maleness, using a technique now widely used that was developed in the early 1990s by Underhill and colleagues in the lab of Luigi Cavalli-Sforza, professor emeritus of genetics. The method has given scientists a powerful window into ancient human migrations and prehistoric cultural shifts. The technique has also been adopted by some commercial genealogy services that offer Y-chromosome testing to the public.

Previous research suggested that prehistoric people in eastern and southern Africa had little contact, with only two known migrations between the regions about 30,000 and 1,500 years ago. After Bantu-language speakers migrated from eastern to southern Africa 1,500 years ago, agriculture took off in southern Africa. But the timing of the Bantu migration didn't quite match the 2,000-year-old anthropological evidence for the first sheep and cattle herds in southern Africa, so anthropologists were unsure whether the region's agricultural knowledge came from a bow-wave of ideas that spread in front of the migrating Bantu, or whether a separate migration brought the first herders.

"Africa has the most genetic diversity in the world, but it is one of the least-studied places," said Brenna Henn, a doctoral student in anthropology who was the study's lead author. "I've always felt like there were a lot of stories there that nobody's had the time or interest to look into."

The Stanford scientists picked the Y sex chromosome to examine for clues to migration because it changes very little from one generation to the next. Autosomes - the non-sex chromosomes - come in pairs, and the members of a pair can exchange bits of DNA during reproduction, making each autosome a mishmash of DNA from all of an individual's ancestors. But the Y chromosome is a singleton; males inherit one Y chromosome and one X chromosome, while women have two X chromosomes. In men, only a tiny region of the Y chromosome can swap DNA with the X chromosome. This means almost all of the Y chromosome moves intact from father to son, changing only infrequently when a new mutation arises. That allows researchers to examine several generations of ancestry by looking at the Y chromosomes of living men.

"The family tree of the Y chromosome is very, very clear," Mountain said.

The team analyzed Y chromosomes from men in 13 populations in Tanzania in eastern Africa and in the Namibia-Botswana-Angola border region of southern Africa. They discovered a novel mutation shared by some men in both locations, which implied those men had a common ancestor. Further analysis showed the novel mutation arose in eastern Africa about 10,000 years ago and was carried by migration to southern Africa about 2,000 years ago. The mutation was not found in Bantu-speakers, suggesting that a different group - Nilotic-language speakers - first brought herds of animals to southern Africa before the Bantu migration.

This new genetic evidence correlates well with pottery, rock art and animal remains that suggest pastoralists - herders who migrated to new pasture with their flocks - first tended sheep and cattle in southern Africa around 2,000 years ago. The genetic finding also helps explain linguistic similarities between peoples in the two regions.

"I like the fact that the linguistic, genetic and archaeological evidence all line up," Henn said. "When you see lines of evidence converge on a single model, it means that's probably something that actually happened."

Underhill and Roy King, MD, PhD, associate professor of psychiatry and behavioral sciences, published a similar paper in the June issue of the journal Antiquity. That study used Y chromosome evidence to examine how climate change drove prehistoric migration in the Middle East. They found that a shift in rainfall 10,000 years ago propelled a cultural split among genetically related people. Some stayed in rainy areas and grew crops, while others moved to arid regions and lived the nomadic life of pastoralist herders. The groups didn't intermingle much after the split, perhaps explaining the origins of modern Middle Eastern cultures.

Genetic evidence gives a degree of clarity to the study of prehistoric migration that's hard to achieve in other ways. "So rarely do we get to pin down the questions raised by archaeology," Mountain said.

*Henn, Mountain and Underhill collaborated with scientists at the Stanford Genome Technology Center; the University of Regensburg, in Germany; Sapienza Università di Roma, in Italy, and the University of Maryland.*
*The research was supported by grants from the National Science Foundation, the National Institutes of Health, the Wenner-Gren Foundation, the Leakey Foundation and BayGene (the Bavarian Genome Network).*

## Ancient shark had colossal bite

**By Jennifer Carpenter** Science reporter, BBC News

The great white shark may have awesome jaws but they are nothing compared with those of megalodon, its gigantic, whale-eating ancestor.

A new study of the extinct creature's skull shows it had an almighty bite, making the prehistoric fish one of the most fearsome predators of all time. All the more remarkable, scientists say, because the crushing force came from jaws made of cartilage, not bone. The researchers report their skull work in the Journal of Zoology.

The Carcharodon megalodon super-shark swam in the oceans more than a million-and-a-half years ago.

It grew up to 16m (52ft) in length and weighed in at 100 tonnes - 30 times heavier than the largest great white - and must have been one of the most formidable carnivores to have existed.

"Pound for pound, your common house cat can bite down harder, " explained Dr Stephen Wroe of the University of New South Wales, Australia. "But the sheer size of the animal means that in absolute terms, it tops the scales."

**Measuring up**

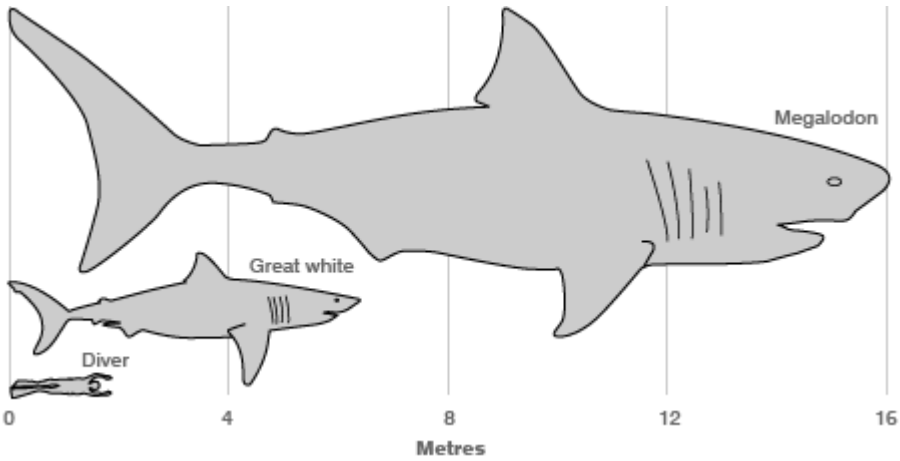
Dr Wroe's team used a technique known as finite element analysis to compare the skulls of the great white with that of the prehistoric megalodon.

The approach is a common one in advanced design and manufacturing, and allows engineers to test the performance of load-bearing materials, such as the metal in the body and wings of an aeroplane.

CT (X-ray) scans were taken of megalodon remains to construct a high-resolution digital model.

A model of a modern 2.4m-long male great white shark ( Carcharodon carcharias ) was developed for comparison. The model of Megalodon's muscles was based on those of the great white, and the simulations were then loaded with forces to see how the two skulls, jaws, teeth and muscles would have coped with the mechanical stresses and strains experienced during feeding.

**MEGALODON COMPARED WITH THE GREAT WHITE SHARK**




| | Great white shark | Megalodon |
|---|---|---|
| **Type** | Cartilaginous fish | Cartilaginous fish |
| **Size** | 6m (20ft) | 16m (52ft) |
| **Diet** | Fish, turtles, seals, sea lions, squid and crustaceans | Whales, including the now extinct Odobenocetops, seals |
| **Predators** | Occasionally caught by fishing industry as bycatch | None known |

By looking at the distribution of stress and strain on the sharks' jaws, researchers found that the largest great whites have a bite force of up to 1.8 tonnes, three times the biting force of an African lion and 20 times harder than a human bites. Megalodon, though, is more impressive. It is estimated to bite down with a force of between 10.8 to 18.2 tonnes.

The team said biting with such force was quite a feat given that the jaws of these ancient creatures were made of flexible cartilage.

In contrast to most other fish, sharks' skeletons are made up entirely of cartilage. Scientists think that cartilage, being a much lighter material than bone, is one adaptation that allows sharks to swim without the aid of a swim bladder.

**With finesse**

The Australian research team was interested in how a cartilaginous jaw performs compared with a bone jaw.

The scientists' study shows that the cartilaginous jaw is almost as strong as a bony jaw of the same size - losing only a few percent - in measures of bite force. What is more, the elasticity of the cartilage jaw increases the gape of the sharks to devastating ends.

"The shark's upper jaws can be dislocated: the whole upper and lower jaw pull out and forward as the shark twists and shakes its head from side to side to bite a chunk out of its prey," explains Dr Wroe.

These sharks feed on very large prey: the great white shark eats sea lions and the megalodon is thought to have eaten whales.

"These sharks ambush their prey and immobilise them with a bite, then wait for them to die," Dr Wroe told BBC News. "They are actually delicate feeders and take care not to damage their teeth by biting down too hard on the large bones of their prey."

To keep their teeth sharp, sharks have a battery of them that is continually replaced. It is the combination of their size, their razor-sharp teeth and the element of surprise that makes these sharks such deadly predators.

## Human brains pay a price for being big

Metabolic changes responsible for the evolution of our unique cognitive abilities indicate that the brain may have been pushed to the limit of its capabilities. Research published today in BioMed Central's open access journal Genome Biology adds weight to the theory that schizophrenia is a costly by-product of human brain evolution.

Philipp Khaitovich, from the Max-Planck-Institute for Evolutionary Anthropology and the Shanghai branch of the Chinese Academy of Sciences, led a collaboration of researchers from Cambridge, Leipzig and Shanghai who investigated brains from healthy and schizophrenic humans and compared them with chimpanzee and rhesus macaque brains. The researchers looked for differences in gene expression and metabolite concentrations and, as Khaitovich explains, "identified molecular mechanisms involved in the evolution of human cognitive abilities by combining biological data from two research directions: evolutionary and medical".

The idea that certain neurological diseases are by-products of increases in metabolic capacity and brain size that occurred during human evolution has been suggested before, but in this new work the authors used new technical approaches to really put the theory to the test.

They identified the molecular changes that took place over the course of human evolution and considered those molecular changes observed in schizophrenia, a psychiatric disorder believed to affect cognitive functions such as the capacities for language and complex social relationships. They found that expression levels of many genes and metabolites that are altered in schizophrenia, especially those related to energy metabolism, also changed rapidly during evolution. According to Khaitovich, "Our new research suggests that schizophrenia is a by-product of the increased metabolic demands brought about during human brain evolution".

The authors conclude that this work paves the way for a much more detailed investigation. "Our brains are unique among all species in their enormous metabolic demand. If we can explain how our brains sustain such a tremendous metabolic flow, we will have a much better chance to understand how the brain works and why it sometimes breaks", said Khaitovich.

***Notes to Editors: Source*** *Genome Biology (www.genomebiology.com)*

*1. Metabolic changes in schizophrenia and human brain evolution*

*Philipp Khaitovich, Helen E Lockstone, Matthew T Wayland, Tsz M Tsang, Samantha D Jayatilaka, Arfu J Guo, Jie Zhou, Mehmet Somel, Laura W Harris, Elaine Holmes, Svante Pääbo and Sabine Bahn*

*Genome Biology 'in press' During embargo, article available here:*
*http://genomebiology.com/imedia/1417661014188921_article.pdf?random=393120*
*After the embargo, article available at journal website: http://genomebiology.com/*

## Found: The hottest water on Earth

* 12:05 04 August 2008
* NewScientist.com news service

*** Catherine Brahic**

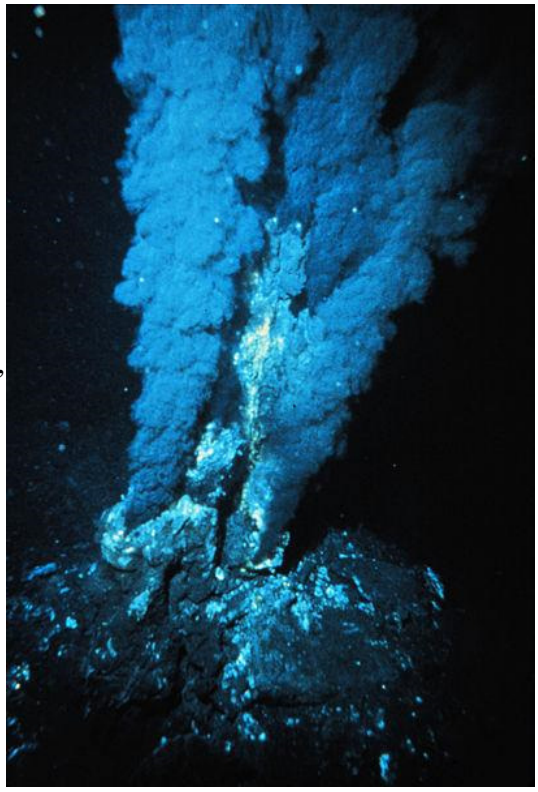
Even Jules Verne did not foresee this one. Deep down at the very bottom of the Atlantic Ocean, geochemist Andrea Koschinsky has found something truly extraordinary: "It's water," she says, "but not as we know it."

At over 3 kilometres beneath the surface, sitting atop what could be a huge bubble of magma, it's the hottest water ever found on Earth. The fluid is in a "supercritical" state that has never before been seen in nature.

The fluid spews out of two black smokers called Two Boats and Sisters Peak.

Koschinsky, from Jacobs University in Bremen, Germany, says it is somewhere between a gas and a liquid. She thinks it could offer a first glimpse at how essential minerals and nutrients like gold, copper and iron are leached out of the entrails of the Earth and released into the oceans.

Liquids boil and evaporate as temperature and pressure rise. But push both factors beyond a critical point and something odd happens: the gas and liquid phase merge into one supercritical fluid. For water, this fluid is denser than vapour, but lighter than liquid water.



*A black smoker* **(Image: NOAA)**

**Hot 'bubble'**

Water and seawater have both been pushed past this critical point in labs, but until Koschinsky and her colleagues sailed to just south of the Atlantic equator in 2006, no-one had seen supercritical fluids in nature. Geochemists suspected that if they were to find them anywhere, they would be coming out of very deep hydrothermal vents.

In 2005, a team of scientists including Koschinsky visited 5° south, as part as a six-year project to investigate the southern end of the mid-Atlantic Ridge. There, they discovered a new set of vents, which they revisited in 2006 and 2007, lowering a thermometer into them each time.

Computer models suggest that the fluid that comes out of these black smokers initially seeps down into surrounding cracks in the seabed, gradually getting deeper and hotter as it approached the Earth's magma. Eventually, at 407 °C and 300 bars of pressure, the water becomes supercritical.

Because supercritical water is far less dense than liquid water, it shoots up to the seabed like a bubble and it is spat out into the ocean through vents.

**Powering life**

From their first visit in 2005, the team found temperatures in the vents were at least 407 °C, and even reached 464 °C for periods of 20 seconds.

Supercritical water leaches metals and other elements out of rock far more efficiently than liquid water or vapour. Gold, copper, iron, manganese, sulphur and many more are brought out of the Earth's guts when the water is ejected from the black smokers.

Some, such as sulphur, provide energy to the locally adapted organisms, which have no light to power a food chain. Manganese is similarly used as an energy source by microbes higher up in the water column. Iron is essential for the growth of all phytoplankton.

Koschinsky estimates up to half the manganese and one tenth of the iron found in the oceans could come from vents. But because supercritical fluids have never been observed in nature, little is really known about how this happens.

**Melting equipment**

"We stand to greatly improve our models of fluid circulation and heat and mass transfer," says Margaret Tivey, a geochemist at the Woods Hole Oceanographic Institute (WHOI) in Massachusetts.

Because of the extreme conditions, computer models are the only way of understanding the processes that drag elements out of the seafloor at hot vents. "It's not yet possible to drill into active vents," explains Koschinsky. "Temperatures are so high, much of drilling equipment would melt and joins would not work anymore." The data from the new vents will be invaluable in testing the models.

"The findings are significant," says Dan Fornari, also of WHOI. "The high temperature of the venting is especially interesting as this [mid-ocean ridge] does not spread very rapidly."

The Pacific spreads faster than the Atlantic, bringing magma closer to the seabed. For this reason, geochemists expected to find supercritical seawater there too. "So one can presume that this portion of the south mid-Atlantic ridge is in a very magmatic phase and has been for a few years," adds Fornari.

**'Dry as a biscuit'**

In the Pacific, vents tend to cool after a year or so, but it is likely that the Two Boats and Sisters Peak have been active since an earthquake shook the region in 2002. "The magma body underneath is probably enormous," says Koschinsky.

Her colleague Colin Devey of the University of Kiel in Germany is not so sure. "The explanation could be that there's lot of magma, but after a few more years of high temperatures, it's going to get to the point where it will be embarrassing how much magma there needs to be to maintain them for that long."

He thinks the long-standing temperatures could indicate something more fundamental. The fact that vents cool much more quickly in the Pacific could indicate the crust there is much more water-logged than it is in the Atlantic, where it could be "dry as a biscuit".

"If that turns out to be the case then we will have taken down some very, very holy grails," says Devey.

*Journal reference: Geology (DOI: 10.1130/G24726A.1)*

## Bacteria were the real killers in 1918 flu pandemic

* 14:02 04 August 2008
* NewScientist.com news service
*** Ewen Callaway**

Medical and scientific experts now agree that bacteria, not influenza viruses, were the greatest cause of death during the 1918 flu pandemic.

Government efforts to gird for the next influenza pandemic – bird flu or otherwise – ought to take notice and stock up on antibiotics, says John Brundage, a medical microbiologist at the Armed Forces Health Surveillance Center in Silver Spring, Maryland.

Brundage's team culled first-hand accounts, medical records and infection patterns from 1918 and 1919. Although a nasty strain of flu virus swept around the world, bacterial pneumonia that came on the heels of mostly mild cases of flu killed the majority of the 20 to 100 million victims of the so-called Spanish flu, they conclude.

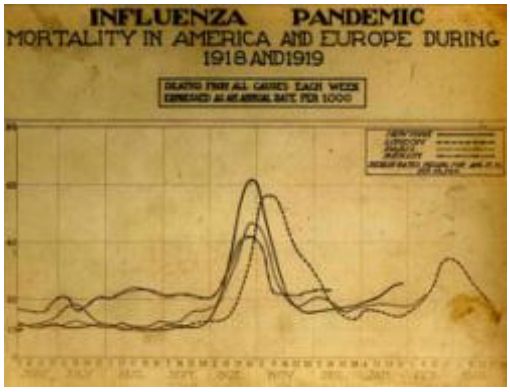



**Image: US National Museum of Health and Medicine**

"We agree completely that bacterial pneumonia played a major role in the mortality of the 1918 pandemic," says Anthony Fauci, director of National Institute for Allergy and Infectious Disease in Bethesda, Maryland, and author of another journal article out next month that comes to a similar conclusion.

**Double whammy**

That pneumonia causes most deaths in an influenza outbreak is well known. Late 19th century physicians recognised pneumonia as the cause of death of most flu victims. While doctors limited fatalities in other 20th-century outbreaks with antibiotics such as penicillin, which was discovered in 1928, but did not see use in patients until 1942.

This is not to say that flu viruses do nothing, says Jonathan McCullers, an expert on influenza-bacteria co-infections at St Jude Children's Research Hospital in Memphis, Tennessee.

McCullers' research suggests that influenza kills cells in the respiratory tract, providing food and a home for invading bacteria. On top of this, an overstressed immune system makes it easier for the bacteria to get a foothold.

However, the sheer carnage of 1918 caused many microbiologists to reconsider the role of bacteria, and some pointed their fingers firmly at the virus.

**'Unique event'**

When US government scientists resurrected the 1918 strain in 2005, the virus demolished cells grown in a Petri dish and felled mice by the dozen.

"The 1918 pandemic is considered to be – and clearly is – something unique, and it's widely understood to be the most lethal natural event that has occurred in recent human history," Brundage says.

But to reassess this conclusion, he and co-author Dennis Shanks, of the Australian Army Malaria Institute in Enoggera, Queensland, scoured literature and medical records from 1918 and 1919.

The more they investigated, the more bacteria emerged as the true killers, an idea now supported by most influenza experts.

For instance, had a super virus been responsible for most deaths, one might expect people to die fairly rapidly, or at least for most cases to follow a similar progression. However, Shanks and Brundage found that few people died within three days of showing symptoms, while most people lasted more than a week, some survived two – all hallmarks of pneumonia.

**Local bugs**

Military health records for barracks and battleships also painted a different picture. New recruits – men unlikely to have been exposed to resident bacteria – died in droves, while soldiers whose immune systems were accustomed to the local bugs survived.

And most compelling, Brundage says, medical experts of the day identified pneumonia as the cause of most deaths.

"The bottom line is we think the influenza virus itself was necessary – but not sufficient – to cause most of the deaths," he says.

As the world's health experts prepare for the next influenza pandemic, many have looked to 1918 as a guide, planning for a deadly super-virus.

The H5N1 bird flu strains jetting around the world seem to kill humans without the aid of bacteria, but those viruses aren't fully adapted to humans, McCullers says. If H5N1 does adapt to humans, bacteria may play a larger role in deaths, he adds.

"Everyone is focused exclusively on the virus, and that's probably not the best idea," he says.

Antibiotics and vaccines against bacterial pneumonia could limit deaths in the next pandemic. And while an effective influenza vaccine should nip an outbreak in the bud, such a vaccine could take months to prepare and distribute.

"The idea of stockpiling [bacterial] vaccines and antibiotics is under serious consideration," says Fauci, who is on a US government taskforce to prepare for the next flu pandemic.

At a recent summit on pandemic influenza, McCullers said health authorities were increasingly interested in the role bacteria might play, but there had been little action taken.

"There's no preparation yet. They are just starting to get to the recognition stage," he says. "There's this collective amnesia about 1918." *Journal reference: Emerging Infectious Disease (DOI: 10.3201/eid1408.071313)*

## Vitamin C jabs may combat cancer

* 22:00 04 August 2008
* NewScientist.com news service
*** Peter Aldhous**

Could injections of vitamin C help treat cancer? That's the suggestion from a new study in mice – and trials are already under way to test similar injections in people.

But some cancer specialists are sceptical, and fear that desperate patients will be prompted to start taking large doses of the vitamin. That may be dangerous, because antioxidants such as vitamin C could undermine the effectiveness of standard cancer drugs and radiation therapy.

Excitement over the idea of treating cancer with vitamin C grew in the 1970s after the Nobel prize-winning chemist Linus Pauling suggested that it helped terminally ill patients survive for longer.

However, in 1985, two placebo-controlled trials found no effect of taking vitamin C pills.

In the current study, researchers led by Mark Levine of the National Institute of Diabetes and Digestive and Kidney Diseases in Bethesda, Maryland, gave vitamin C to mice intravenously.

**Oxidation boost**

The researchers injected immune-deficient mice with cells from three aggressive human cancers – ovarian and pancreatic tumours, plus a form of brain cancer called glioblastoma – and found that vitamin C injections slowed tumour growth by up to 53%.

By injecting into the bloodstream, Levine explains, it is possible to get much larger amounts of the vitamin to a tumour than is possible with oral supplements. While vitamin C is usually an antioxidant, under these circumstances it causes the formation of hydrogen peroxide, a powerful oxidising agent that kills cancer cells.

Levine suggests that intravenous vitamin C could be a useful addition to conventional cancer therapy. His team has also found that women in a preliminary clinical trial are getting similar doses of vitamin C to those seen in the experimental mice. "It's pharmacologically achievable," Levine says.

That trial, led by Jeanne Drisko of the University of Kansas in Kansas City, aims to recruit 50 women to test the safety of giving intravenous vitamin C, plus other antioxidants given orally, on top of existing therapies for ovarian, cervical or uterine cancer.

Although there is little evidence that it works in humans, Drisko's clinic also offers intravenous vitamin C to paying patients.

**Self-medication risks**

Meanwhile, the Cancer Treatment Centers of America (CTCA) in Zion, Illinois, is testing the safety of intravenous vitamin C in late-stage cancer patients for whom there is no other treatment option. So far, 10 out of a planned 18 patients have been enrolled into the trial.

Definitive answers on the effectiveness of intravenous vitamin C will only come from subsequent larger trials. But given recent experiences with a drug called DCA, which some patients began taking without medical supervision after reading about promising results on cancer cells, there are concerns that patients may take matters into their own hands by injecting themselves with vitamin C or taking large doses of vitamin C pills.

Many cancer patients take antioxidant vitamins, often without telling their doctors. While Drisko and other backers of complementary approaches suggest that antioxidants can aid therapy and reduce side-effects,

conventional chemotherapy and radiotherapy are thought to work in part by generating free radicals which kill cancer cells.

Because antioxidant vitamins can mop up these radicals, they may interfere with cancer therapy, other researchers warn. "You want to make sure you're not taking supplemental vitamins," says David Agus, an oncologist at the Cedars-Sinai Medical Center in Los Angeles.

*Journal reference: Proceedings of the National Academy of Sciences (DOI: 10.1073/pnas.0804226105)*

## Little teeth suggest big jump in primate timeline

DURHAM, N.C. -- Tiny fossilized teeth excavated from an Indian open-pit coal mine could be the oldest Asian remains ever found of anthropoids, the primate lineage of today's monkeys, apes and humans, say researchers from Duke University and the Indian Institute of Technology.

Just 9-thousandths of a square inch in size, the teeth are about 54.5 million years old and suggest these early primates were no larger than modern dwarf lemurs weighing about 2 to 3 ounces. Studies of the shape of the teeth suggest these small animals could live on a fruit and insect diet, according to the researchers.

"It's certainly the oldest anthropoid from Asia and India," said Richard Kay, a Duke professor of evolutionary anthropology who is corresponding author of a report to be published online during the week of Aug. 4-8 in Proceedings of the National Academy of Sciences (PNAS).

Previous fossil evidence shows primates were living in North America, Europe and Asia at least 55 million years ago. But, until now, the fossil record of anthropoid primates has extended back only 45 million years.

"We're going back almost 10 million years before any previously described Asian anthropoid," said co-author Blythe Williams, a Duke visiting associate professor of evolutionary anthropology. "The new fossils from India are exciting because they show that the anthropoid lineage is much more ancient than we realized."

In addition to stretching the primate timeline, the specimens represent a new genus as well as a new species of anthropoid, which the researchers have named Anthrasimias gujaratensis by drawing from the Greek word for "coal," Latin for "monkey" and the Indian State of Gujarat where the teeth were found.

"Anthrasimias may be the oldest anthropoid in the world," the PNAS report said -- "may" reflecting the fact that some scientists think slightly older fossils found in a Moroccan limestone deposit also could have been anthropoid, Kay said.

The report's first author is Sunil Bajpai, an earth scientist at the Indian Institute of Technology who directed excavations at the Vastan lignite coal mine in western India that unearthed the fossils.

Bajpai's Indian team managed to find and remove the tiny Anthrasimias tooth specimens from a strata in the mine while "really gigantic trucks" scooped up coal above them, Kay said. The teeth were dated by identifying microscopic marine plankton fossils of known age in nearby rock layers, he added.

Bajpai's team was funded by India's Department of Science and Technology. Work by Williams and Kay, who are anthropoid experts, was funded the Duke Provost's Research Fund and the National Science Foundation.

Their PNAS report describes tooth structure differences that would separate Anthrasimias from two other ancient lines of primates whose remains have been found at the same level of the Vastan mine. Of the three lines, Williams and Kay believe only Anthrasimias's is part of the anthropoid lineage that evolved into modern monkeys, apes and humans.

"Most of the fossil record of ancient primates is made up of teeth, because teeth are easy to preserve and hard," Williams said. "Occasionally we get lucky enough to have a skull to work with, but in this case a few teeth is all we have." Their PNAS report described two upper molars and one lower molar.

"From the tooth size and structure we can say something about the animals' body weight and diet, because teeth have crests that are differentially developed depending on whether they ate primarily insects, leaves or fruit," he said. But without more body parts, Kay and Williams declined to deduce what the animals looked like.

*Other authors of the PNAS report were Debasis Das of the Indian Institute of Technology, Vivesh Kapur of Chandigarh, India, and B.N. Tiwari of the Wadia Institute of Himalayan Geology in India.*

## Context and personality key in understanding responses to emotional facial expressions

It is well appreciated that facial expressions play a major role in non-verbal social communication among humans and other primates, because faces provide rapid access to information about the identity as well as the internal states and intentions of others. In his song, Mona Lisa, Nat King Cole reflected on the motivations for Mona Lisa's "mystic smile" and new data by scientists in Switzerland suggests that both the social context of a person's facial expression and certain facets of the viewer's personality could affect how our brain interprets the social meaning of someone else's smile or frown.

In a new brain imaging study published in the open-access journal PLoS ONE, Pascal Vrtička and colleagues at the Swiss National Center for Affective Sciences hosted by the University of Geneva found that visually identical facial expressions can produce different patterns of responses in emotional brain areas when

context changes their social meanings, and that these patterns of social sensitivity are strongly modulated by individual attachment style (i.e. how a person emotionally perceives and responds to others during social interactions, thought to be either secure, anxious or avoidant). In this study, the specific brain substrates underlying these individual differences in reaction to emotional stimuli are identified for the first time.

Vrtička and colleagues manipulated the social significance of facial expressions by presenting them in different contexts while participants performed a pseudo-competitive game with virtual partners in the functional magnetic resonance imaging (fMRI) scanner. The virtual partners could either be from allied or opponent teams and would display either a smiling or an angry expression in response to the success (or failure) of the participant. A smile could thus be perceived either as praising an accomplishment or mocking a failure, and a frown either as a sign of reproach or frustration.

When the virtual partners were seen as allies (i.e. smiling in response to the success of the participant or looking angry when the participant failed), happy faces activated the ventral striatum and ventral tegmental area (areas of the brain associated with reward processing), but this response was much weaker in participants with an avoidant attachment style. Angry faces, on the other hand, increased the activation of the amygdala (an area of the brain implicated in fear and arousal), especially in participants with an anxious attachment style. These activation patterns were very specific, because no response in reward circuits or amygdala was found for facial expressions of virtual partners seen as opponents. Instead, opponent's expressions led to increased activity in brain regions associated with theory of mind and alertness (superior temporal sulcus and anterior cingulate gyrus).

The findings extend previous research into social emotion processing by showing that specific expressions in faces are processed differently in the human brain depending on the personality of the individual and the social context where the faces are perceived.

Moreover, the data provide novel biological support for a link between an individual's attachment style and activity in brain systems implicated in reward and threat processing. Because both the ventral striatum and amygdala are key brain structures for learning and predicting motivational outcomes, they may play a critical role for the establishment of idiosyncratic affective responses to social cues based on past experience or developmental history. Vrtička and colleagues could for the first time capture the neural signatures of such behaviours by showing that avoidant participant's brains responded much less to the rewarding value of social support, whereas anxious participants displayed increased threat- or distress-related brain activity to social punishment.

Vrtička and colleagues suggest that these data may ultimately help define appropriate intervention strategies in clinical disorders of attachment and social functioning, including social anxiety, social phobias and autism.

*Citation: Vrtička P, Andersson F, Grandjean D, Sander D, Vuilleumier P (2008) Individual Attachment Style Modulates Human Amygdala and Striatum Activation during Social Appraisal. PLoS ONE 3(8): e2868. doi:10.1371/journal.pone.0002868 (URL live from Aug 6): http://dx.plos.org/10.1371/journal.pone.0002868.*

## 'Cosmic ghost' discovered by volunteer astronomer

New Haven, Conn. — When Yale astrophysicist Kevin Schawinski and his colleagues at Oxford University enlisted public support in cataloguing galaxies, they never envisioned the strange object Hanny van Arkel found in archived images of the night sky.

The Dutch school teacher, a volunteer in the Galaxy Zoo project that allows members of the public to take part in astronomy research online, discovered a mysterious and unique object some observers are calling a "cosmic ghost."

van Arkel came across the image of a strange, gaseous object with a hole in the center while using the www.galaxyzoo.org website to classify images of galaxies.

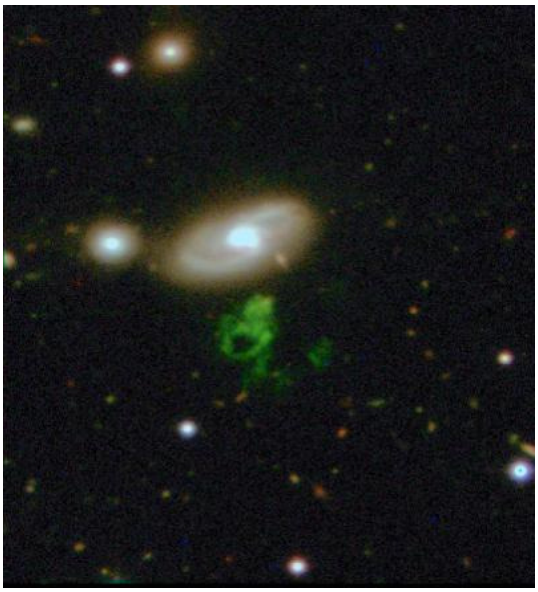
When she posted about the image that quickly became known as "Hanny's Voorwerp" ( Dutch for "object") on the Galaxy Zoo forum, astronomers who run the site began to investigate and soon realized van Arkel might have found a new class of astronomical object.

"At first, we had no idea what it was. It could have been in our solar system, or at the edge of the universe," said Schawinski, a member and co-founder of the Galaxy Zoo team.

Scientists working at telescopes around the world and with satellites in space were asked to take a look at the mysterious Voorwerp. "What we saw was really a mystery," said Schawinski. "The Voorwerp didn't contain any stars." Rather, it was made entirely of gas so hot — about 10,000 Celsius — that the astronomers felt it had to be illuminated by something powerful. They will soon use the Hubble Space Telescope to get a closer look.

Since there was no obvious source at hand in the Voorwerp itself, the team looked to find the source of illumination around the Voorwerp, and soon turned to the nearby galaxy IC 2497.

"We think that in the recent past the galaxy IC 2497 hosted an enormously bright quasar," Schawinski explains. "Because of the vast scale of the galaxy and the Voorwerp, light from that past still lights up the nearby Voorwerp even though the quasar shut down sometime in the past 100,000 years, and the galaxy's black hole itself has gone quiet."



"From the point of view of the Voorwerp, the galaxy looks as bright as it would have before the black hole turned off – it's this light echo that has been frozen in time for us to observe," said Chris Lintott, a co-organizer of Galaxy Zoo at Oxford University, UK. "It's rather like examining the scene of a crime where, although we can't see them, we know the culprit must be lurking somewhere nearby in the shadows." Similar light echoes have been seen around supernovae that exploded decades or centuries ago.

Quasars are very unusual, highly luminous objects, powered by supermassive black holes, and most are extremely distant. "The strange 'Hanny's Voorwerp' looks like it could be the nearest example of a luminous quasar," said C. Megan Urry, Israel Munson Professor of Physics & Astronomy and Chair of the Physics Department at Yale, who was not involved in the research.

***Hanny's Voorwerp and IC 2497.*** **Dan Smith, Peter Herbert, Matt Jarvis & the ING.**

"IC 2497 is so close that if the quasar was still shining today, on a good night you could probably see it with a small telescope," Schawinski added. "The nearest active quasar, called 3C 273, is 1.7 billion light years further away."

"This discovery really shows how citizen science has come of age in the Internet world," commented Professor Bill Keel of the University of Alabama, a galaxyzoo.org team member. "Hanny's attentiveness alerted us not only to a peculiar object, but to a window into the cosmic past which might have eluded us for a long time otherwise. Trying to understand the processes operating here has proven to be a fascinating challenge, involving a whole range of astrophysical techniques and instruments around the world and beyond. This has also been some of the most rewarding astronomy I've done in years!"

The Galaxy Zoo project was imagined and begun by Schawinski and his colleague Chris Lintott at Oxford. While working on his PhD thesis, Schawinski classified and catalogued nearly 50,000 galaxies. Knowing that the human eye is sometimes more sensitive than a computer at picking out unusual patterns, he mused that it would be wonderful if there were amateur astronomers who were interested in doing some of the "scanning."

"When we launched Galaxy Zoo we were overwhelmed — as was the internet portal, initially — with the outpouring of public interest and volunteer input," said Schawinski. During the last year, over 150,000 armchair astronomers from all over the world volunteered their time and submitted over 50 million classifications for a set of one million images online. They then could follow the progress of the science they made possible at www.galaxyzooblog.org .

"It's amazing to think that this object has been sitting in the archives for decades and that amateur volunteers can help by spotting things like this online," said Hanny van Arkel. "It was a fantastic present to find out on my 25th birthday that we will get observational time on the Hubble Space Telescope to follow-up this discovery."

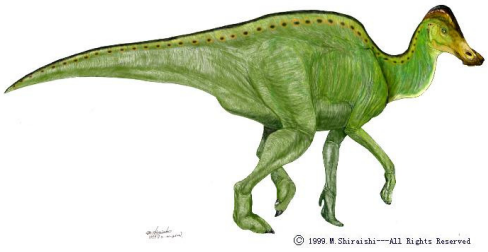
The next stage of Galaxy Zoo will ask volunteers to search for more unusual astronomical objects. But, "Hanny's Voorwerp" remains a mystery. It's huge central hole is over 16,000 light years across and Galaxy Zoo astronomers are still puzzling over what caused it.

*The new digital images used in Galaxy Zoo were taken using the robotic Sloan Digital Sky Survey telescope in New Mexico. More on the Sloan Digital Sky Survey is at www.sdss.org . For full details of those involved see www.sdss.org/collaboration/credits.html.*

## Duck-billed dinosaurs outgrew predators to survive

### *New study on hadrosaur bones shows fast growth, reproduction rates*

ATHENS, Ohio (Aug. 5, 2008) – With long limbs and a soft body, the duck-billed hadrosaur had few defenses against predators such as tyrannosaurs. But new research on the bones of this plant-eating dinosaur suggests that it had at least one advantage: It grew to adulthood much faster than its predators, giving it superiority in size.




In a study published online today in the Proceedings of the Royal Society of London B: Biological Sciences, scientists compared

growth rate data from the hadrosaur, Hypacrosaurus, to three predators: the tyrannosaurs Albertosaurus and its gigantic relative Tyrannosaurus rex, as well as the small Velociraptor-like Troodon.

The research suggests that it took 10 to 12 years for Hypacrosaurus to become fully grown. Tyrannosaurs, however, reached adulthood after 20 to 30 years, said Drew Lee, a postdoctoral fellow in Ohio University's College of Osteopathic Medicine who co-authored the paper with Lisa Noelle Cooper, a doctoral student at Kent State University and a researcher with the Northeastern Ohio Universities College of Medicine.

"Our duck-billed dinosaur grew three to five times faster than any potential predators that lived alongside it," Lee said. "By the time the duck-billed dinosaur was fully grown, the tyrannosaurs were only half grown – it was a huge size difference."

Hypacrosaurus also reached sexual maturity early, at only two or three years of age, Cooper said.

"That's another added bonus when facing predators – if you can keep reproducing, you're set," she said. "It's the stuff of evolution."

Cooper conducted the original analysis of the hadrosaur while an undergraduate student at Montana State University. Working with scientists Jack Horner and Mark Taper, Cooper looked at thin sections of the long leg bones of a specimen of Hypacrosaurus and counted and measured the growth rings, which each represent one year of life.

"We were shocked at how fast they grew. If you look at a cross section of the bone of a nestling or even from within the egg, there are huge spaces in which blood supply was going through the bone, which means they were growing like crazy," she said.

Hypacrosaurus was one of three common prey for the meat-eating tyrannosaurs, but was the most vulnerable, Lee said. He described the animal, which lived 67 million to 80 million years ago, as the "Thomson's gazelle of the Late Cretaceous." The other two had horns or had stout, tank-like bodies that would have provided some physical protection from their enemies. But even those creatures show faster growth rates than the predators, Lee noted, with the hadrosaur boasting the quickest growth spurt.

At least one study suggests that living animals employ this survival strategy as well, Lee said. Scientists have found that killifish, a tiny freshwater fish found mainly in the Americas, mature faster when predators lurk. Anecdotal evidence suggests that creatures such as African ungulates grow big to create an advantage over lions, cheetahs and hyenas, he said. And researchers also see signs of this phenomenon in butterflies, toads, salamanders, guppies and some birds, Cooper added.

"Over evolutionary history, this pattern seems to be prevalent," she said.

Though scientists are careful to preserve dinosaur fossils, they've also learned much more about growth rates, life spans, behavior and sexual reproduction of dinosaurs in the past decade by cutting up the bones and taking a closer look at the clues they contain, Lee and Cooper noted. Such research has offered a much more detailed picture of the relationships between different dinosaur species, including predator and prey. Cooper also has used the same bone analysis techniques to confirm the ancestor of whales, a study she co-authored last year in Nature.

Lee, who recently published a study in the Proceedings of the National Academy of Sciences on the sexual maturity rates of dinosaurs, hopes to conduct more research on communities of dinosaurs, such as those of Allosaurus, Stegosaurus and Apatosaurus, to draw further conclusions on the fast growth survival strategy.

"This study is a stepping stone to a larger comparative study on community changes that impacted dinosaur evolution," Lee said.

*The work was supported by grants from the Dinamation Society, the MONTSUS Undergraduate Scholars Grant from Montana State University, the Undergraduate Scholars Program of Montana State University, the Paleontology Department of the Museum of the Rockies and the Charlotte and Walter Kohler Charitable Trust.*

## Revolutionary technique could reduce lifelong drugs for transplant patients

### *Ground-breaking research using tailor-made regulatory cells shows promising findings*

Researchers have developed a ground-breaking procedure that could avoid the need for transplant patients to spend the rest of their lives taking a cocktail of drugs to stop their system from rejecting their new organ, according to a series of papers in the August issue of Transplant International.

The team, led by Professor Fred Fandrich from the University of Schleswig-Holstein in Kiel, Germany, has developed a technique based on tailor-made regulatory cells.

This involves taking infection-fighting white cells from the blood of the transplant recipient and subjecting them to a highly complex procedure involving cells taken from the living or deceased donor. The tailor-made cells are then administered back to the patient.

In the two clinical trials described in Transplant International this was done in two ways, either after the transplant, as an addition to the traditional drug therapy to stop the patient's immune system rejecting the kidney, or before the transplant surgery was carried out.

"Until now the only option for transplant patients has been to take a cocktail of drugs for the rest of their lives" explains lead author Dr James A Hutchinson from the University's Division of Transplantation Medicine and Biotechnology. "These drugs can cause severe side effects and cannot always prevent the slow destructive process of chronic rejection which often leads to the failure of the transplanted organ.

"That is why our use of transplant acceptance-inducing cells (TAICs) in kidney transplant patients is such an exciting development, as it could eventually offer patients who have had transplant surgery a much higher quality of life, free from complex drug regimes.

"Although our use of TAICs is still in the preliminary stages, the results of our clinical trials on 17 kidney transplant patients are promising."

During stage one of the clinical trials 12 patients received kidneys from deceased donors and were give the TAICs in addition to the traditional drug therapy used to prevent organ rejection. Nine men and three women aged between 30 and 61 took part in the trial.

Ten of the 12 patients were weaned off conventional immunosupression drugs over a period of eight weeks, starting in the fourth week after transplantation. Medical staff were then able to wean six of them down to low-dose tacrolimus monotherapy, which is a much less intrusive drug regime with fewer side effects.

"We concluded that although the stage one trial showed that TAIC therapy was both safe and clinically practicable, the trial was unable to provide evidence that postoperative TAIC administration has a beneficial effect" says Dr Hutchinson.

Stage two comprised five patients who were transplanted with kidneys from live donors and received TAICs before their surgery was carried out.

Four men and one woman aged between 39 and 59 took part in the trial. Two received a kidney from their brother, one from his daughter and two from a spouse.

One patient was able to go eight months without any immunosuppression drugs and a further three were successfully weaned from a conventional immunosuppression regime to low-dose tacrolimus monotherapy.

"Although our stage two clinical trial did not provide conclusive evidence of a beneficial effect of pre-operative TAICs treatment, the results were encouraging" says Dr Hutchinson.

"They suggest that TAICs promote a physical state that might allow us to minimise the drugs we use to stop the patient's immune system from rejecting their new organ."

None of the patients in either trial experienced acute or delayed adverse events as the result of the TAIC infusion.

"Our research clearly shows that infusing TAICs into patients before they have a kidney transplant, or after the procedure has been carried out, is a practical and safe clinical option. "Although this procedure is still being developed and refined, it poses an exciting possibility for clinicians and patients alike."

Four papers on the research are included in the August issue of Transplant International – the results of the first and second clinical trials, a detailed case study of a living-donor kidney transplant and an expert commentary by Professor Lucienne Chatenoud from Universite Paris Descartes.

***Notes to editors***

** This press release is based on two papers 1) Transplant acceptance-inducing cells as an immune-conditioning therapy in renal transplantation. Hutchinson et al. Transplant International. 21, 728-741 (August 2008). 2) A cell-based approach to the minimization of immunosuppression in renal transplantation. Hutchinson et al. Transplant International. 21, 742-754. (August 2008).*

## Arctic Map shows dispute hotspots

British scientists say they have drawn up the first detailed map to show areas in the Arctic that could become embroiled in future border disputes.

A team from Durham University compiled the outline of potential hotspots by basing the design on historical and ongoing arguments over ownership.

Russian scientists caused outrage last year when they planted their national flag on the seabed at the North Pole.

The UK researchers hope the map will inform politicians and policy makers.

**Back on the agenda**

The issue of defining national boundaries in the Arctic was brought into sharp relief last summer when a team of Russian explorers used their submarine to plant their country's flag on the seabed at the North Pole.

A number of politicians from the nations with borders within the Arctic, including Canada's foreign minister, saw it as Moscow furthering its claim to territory within the region.

"Its primary purpose is to inform discussions and debates because, frankly, there has been a lot of rubbish about who can claim (sovereignty) over what," explained Martin Pratt, director of the university's International Boundaries Research Unit (IBRU).

"To be honest, most of the other maps that I have seen in the media have been very simple," he added. "We have attempted to show all known claims; agreed boundaries and one thing that has not appeared on any other maps, which is the number of areas that could be claimed by Canada, Denmark and the US."

The team used specialist software to construct the nations' boundaries, and identify what areas could be the source of future disputes.

"All coastal states have rights over the resources up to 200 nautical miles from their coastline," Mr Pratt said. "So, we used specialist geographical software to 'buffer' the claims out accurately."


The researchers also took into account the fact that some nations were able to extend their claims to 350 nautical miles as a result of their landmasses extending into the sea.

Mr Pratt said a number of factors were driving territorial claims back on to the political agenda.

"Energy security is driving interest, as is the fact that Arctic ice is melting more and more during the summer," he told BBC News. "This is allowing greater exploration of the Arctic seabed."

Data released by the US Geological Survey last month showed that the frozen region contained an estimated 90 billion barrels of untapped oil.

Mr Pratt added that the nations surrounding the Arctic also only had a limited amount of time to outline their claims. "If they don't define it within the timeframe set out by the UN Convention on the Law of the Sea, then it becomes part of what is known as 'The Area', which is administered by the International Seabed Authority on behalf of humanity as a whole."

## Scientists identify possible cause of endometriosis

***Scientists at the University of Liverpool have identified an enzyme that could be responsible for a condition called endometriosis -- the most common cause of pelvic pain in women***

Endometriosis is a condition whereby patches of the inner lining of the womb appear in parts of the body other than the womb cavity. It can cause severe pain and affects approximately 15% of women of reproductive age. Endometriosis is also associated with infertility, with 50% of infertile women affected by the condition.

Researchers discovered that an enzyme, called telomerase, is released by cells in the inner lining of the womb during the latter stages of the menstrual cycle in women who are affected by endometriosis. Telomerase is not commonly found in the cells that make up the body, but is uniquely found in the inner lining of the womb and in some special cells, such as sperm and egg cells. The enzyme is also found in cancer cells and is thought to be responsible for replicating DNA sequences during cell division in chromosomes.

Dr Dharani Hapangama, from the University's Department of Reproductive and Developmental Medicine, explains: "Endometriosis occurs when cells of the inner lining of the womb are found growing outside of the uterus. At the time of a woman's menstruation cycle these cells, called endometrial cells, are shed and can be expelled into the abdominal cavity. If these cells continue to live and are implanted in the pelvis and abdomen it can cause severe pain and in serious cases can lead to infertility.

"We found the telomere – a region at the end of all chromosomes that prevents the chromosome destroying itself during cell division – is abnormally long in women with endometriosis. During menstruation telomeres normally shorten in length with each cycle of cell division until they reach a certain length at which they can no longer divide. An enzyme called telomerase can extend the length of the telomeres so that they can continue to divide and this can happen in some special cells such as sperm and egg cells, but not normally in cells that make up the organs of the body.

"Our research shows, however, that cells in the lining of the womb are unique in that they can express this enzyme in the early stages of the menstrual cycle when cell division is important, but not during the latter stages when implantation of the fertilised embryo becomes a priority.

"Women who have endometriosis express this enzyme in both the early and late stages of the menstrual cycle which means that the cells will continue to divide and lose their 'focus' in supporting the establishment of a pregnancy. As a result the lining of the womb may be more hostile to an early pregnancy, and the cells that are shed at this late stage in the menstrual cycle may be more 'aggressive' and more able to survive and implant outside the uterus, causing pain in the pelvic or abdomen area."

*The research, published in Human Reproduction, will help scientists develop new techniques for diagnosing and treating the condition.*

## Sesame seed extract and konjac gum may help ward off Salmonella and E. coli

A new study in SCI's Journal of the Science of Food and Agriculture shows that konjac gum and sesame seed extract may offer protection against different strains of E. coli and Salmonella bacteria.

The study by Dr Petra Becker et al from Wageningen University and Research Centre, the Netherlands, shows that these foodstuffs act as binders for E. coli and Salmonella bacteria. The bacteria attach themselves to the fibrous foods instead of the gut cells of the host.

Dr Becker says that eating a diet full of these foodstuffs may offer protection from gastro-intestinal infections or reduce the severity of symptoms caused by E. coli or Salmonella.

Other foods that were shown to have a beneficial effect included yeast, tomato, and pumpkin.

In the lab study which also included negative controls, the scientists looked at 18 food-related products including coffee beans, carrot, mango, fermented soya, and food stabilizers such as locust bean gum and konjac gum. All were subjected to in-vitro exposure to various bacteria which were allowed to attach themselves to the test products. The levels of bound bacteria were determined in a microplate-based method specifically developed for this purpose.

The results showed that sesame seed extract and konjac gum had the greatest number of adhered bacteria, leading to the conclusion that they may have a part to play in preventing certain E. coli and Salmonella from latching onto the host.

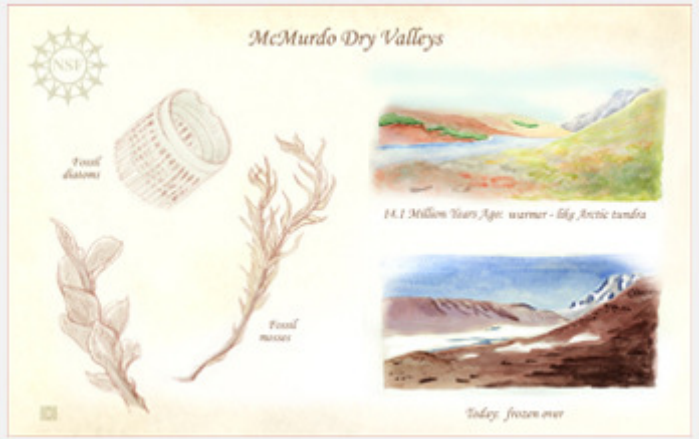
Dr Becker said: 'The importance of fibre, particularly from certain foodstuffs, in maintaining a healthy gut and digestion cannot be underestimated. The study shows that these foods bind certain bacteria and may be a means of stopping bacteria from entering host cells thereby preventing disease.'

*For more information or a full copy of the article, contact: Meral Nugent, Press and Public Relations Manager, T: +44 (0)20 7598 1533, F: +44 (0) 20 7598 1545, Mob: 07931 315077 E: meral.nugent@soci.org*

## Antarctic Fossils Paint a Picture of a Much Warmer Continent

### *Insects, ferns flourished, then flickered out millions of years ago as the tundra retreated*

*View a video interview with earth scientist David Marchant of Boston University.*




National Science Foundation-funded scientists working in an ice-free region of Antarctica have discovered the last traces of tundra--in the form of fossilized plants and insects--on the interior of the southernmost continent before temperatures began a relentless drop millions of years ago.

An abrupt and dramatic climate cooling of 8 degrees Celsius, over a relatively brief period of geological time roughly 14 million years ago, forced the extinction of tundra plants and insects and tranformed the interior of Antarctica into a perpetual deep-freeze from which it has never emerged.

The international team of scientists headed by David Marchant, an earth scientist at Boston University and Allan Ashworth and Adam Lewis, geoscientists at North Dakota State University, combined evidence from glacial geology, paleoecology, dating of volcanic ashes and computer modeling, to report a major climate change centered on 14 million years ago. The collaboration resulted in a major advance in the understanding of Antarctica's climatic history.

NSF, in its role as the manager of the United States Antarctic Program, supported Ashworth's, Lewis', and Marchant's research as well as U.S. researchers from Lamont-Doherty Earth Observatory, Ohio State University and the University of Montana.

Their findings appear in the Aug. 4 edition of the Proceedings of the National Academy of Sciences.

"To me, the most interesting part of the whole story is that we've documented the timing and the magnitude of a tremendous change in Antarctic climate: the transition marks a shift from warm, temperate glaciers with patches of fringing tundra to today's cold-polar glaciers set within in a barren polar desert," said Marchant. "The contrast couldn't be more striking. It is like comparing Tierra del Fuego today with the surface of Mars--and this transition took place over a geologically short interval of roughly 200,000 years."

The discovery of lake deposits with perfectly preserved fossils of mosses, diatoms and ostracods, a type of small crustacean, is particularly exciting to scientists, noted Lewis. Fossils are extremely rare in Antarctica, especially those of terrestrial and freshwater plants and animals.

"They are the first to be found even though scientific expeditions have been visiting the Dry Valleys since their discovery during the first Scott expedition in 1902-1903," said Lewis. Robert Falcon Scott was a British Antarctic explorer who perished during an attempt to the first to reach the South Pole in 1912.

For Ashworth the fossils are a scientific treasure trove.

He said he was particularly struck that some species of diatoms and mosses are indistinguishable from living creatures. Today, these species occur throughout the world, except in Antarctica.

"To be able to identify living species amongst the fossils is phenomenal. To think that modern counterparts have survived 14 million years on Earth without any significant changes in the details of their appearances is striking. It must mean that these organisms are so well-adapted to their habitats that in spite of repeated climate changes and isolation of populations for millions of years they have not become extinct but have survived" said Ashworth, the principal paleoecologist in the research.

What makes the fossils especially valuable is that their context is known following years of detailed mapping of ancient glacial deposits in the western Olympus and Asgard mountain ranges of Antarctica by Marchant and Lewis. As part of their research, they discovered volcanic ashes which have been dated at Lamont-Doherty geochronology labs by researchers Sidney Hemming and Malka Machlus, coauthors in the study.

Lewis added that the fossils are the best dated so far to come from Antarctica.

The fossil location today high in the mountains is a completely frozen landscape.

Marchant, Lewis and Ashworth, who often spend months living in tents in the Dry Valleys doing their research, all said that the fossil finds stretch their imagination about how the Antarctic continent once looked.

"The fossil finds allow us to examine Antarctica as it existed just prior to climate cooling at 13.9 million years ago. It is a unique window into the past. On land, there are very few places on Earth that contain sediment of this age, and none are as well preserved as those found in the Dry Valleys," Marchant said. "The sediments allow reconstructions of alpine glaciers, tundra and lakes, all in remarkable detail. To study these deposits is akin to strolling across the Dry Valleys 14.1 million years ago."

"What we're basically looking at," Lewis added "is the last hint of vegetation in the Dry Valleys." "The fossil finds and dating of volcanic ash show that roughly 14.1 million years ago, the area was home to tundra, "wet" glaciers typical of those of the mountains of Tierra Del Fuego in the high southern latitudes, and seasonally ice-free lakes. The beds of those long-gone lakes contain layers of sediments where detritus such as dying plants and insects would have settled and been preserved."

"And it's within these ancient lake beds that we found the fossils," said Lewis.

Ashworth's and the other paleoecologists' research shows that the lakes supported mosses and diatoms, and the surrounding margins were ‘minimally colonized' by insects and shrubby vegetation."

At 14.1 million years ago, the Dry Valleys were relatively warm. By 13.9 million years ago, everything was different. The transition brought the Dry Valleys from a climate like that of South Georgia to one that has Mars as a close analog.

Tom Wagner, program director for Antarctic Earth Sciences in NSF's Office of Polar Programs, added that "Lewis, Marchant and Ashworth discovered the last bit of life on the Antarctic continent. It was hanging on by its fingernails--just a few simple plants and bugs in a small pond, everything else around them frozen over--and then, wham!, they went too. And it must have happened quickly because these fossils are literally freeze dried. When I visited the scientists in the field, they showed me how the moss was still green and leafy."

"It is one of the most dramatic and long-lasting changes that one can imagine," Marchant said. "I don't know of any other place on Earth where such an enduring change has been documented; the fact that it is associated with the extinction of tundra plants and insects helps provide quantitative estimates for the magnitude of this change."

The mean summertime temperatures would have dropped in that period by as much as 8 degrees Celsius. On average, the summertime temperatures in the Valleys during this temperate period would have been as much as 17 degrees warmer than the present-day average. What caused the change, Marchant said, "Is really a big unknown", though theories abound and include phenomena as different as the levels of carbon dioxide in the atmosphere and tectonic shifts that affected ocean circulation.

According to Lewis, the freshness of the crystals and glass in the volcanic ash and the preservation of cellular detail in the fossils argues that they have been permanently frozen since 13.9 million years ago. The climate changed during those millions of years but the temperatures in the mountains never rose high enough to allow groundwater to flow and microorganisms to become active.

This conclusion suggests that even when global atmospheric temperatures were warmer than they are now, as occurred--approximately 3.5 million years ago during the Pliocene Epoch--and as might occur in the near

future as a consequence of global warming, there was no significant melting of the East Antarctic ice sheet inland of the Dry Valleys, nor were there dramatic changes in environmental conditions in the fossil region.

If this conclusion stands the test of time, it suggests a very robust ice sheet in this sector of Antarctica, and stresses the complex and potentially non-uniform response of Antarctica's ice sheets to global change.

Wagner also noted, "Other scientists had been to this area before, but hadn't noticed anything unusual. It took the trained eye of this team to make the discovery."

*Part of the study in the Dry Valleys is captured in the documentary "Ice People," by Emmy-award winning director Anne Aghion. NSF's Antarctic Artists and Writers program supported Aghion in the field for four months in 2006 to document the work of scientists there. The film is being released to coincide with the International Polar Year 2007-2009 (IPY), a global scientific deployment, and is scheduled to air on the Sundance Channel in 2009. -**NSF**-*

## Wildlife Conservation Society discovers 'Planet of the Apes'

### *New census shows massive gorilla population in Northern Republic of Congo*

The world's population of critically endangered western lowland gorillas received a huge boost today when the Wildlife Conservation Society released a census showing massive numbers of these secretive great apes alive and well in the Republic of Congo.

***A western lowland gorilla silverback among members of a group.***
**Thomas Breuer/Wildlife Conservation Society-Max Planck Institute for Evolutionary Anthropology.**

The new census tallied more than 125,000 western lowland gorillas in two adjacent areas in the northern part of the country, covering an area of 18,000 square miles (47,000 square kilometers). Previous estimates from the 1980s placed the entire population of western lowland gorillas, which occur in seven Central African nations, at less than 100,000. Since then, however, scientists had believed that this number had at least halved, due to hunting and disease.

The census data were released at a press conference at the International Primatological Society Congress in Edinburgh, Scotland. The WCS scientists who worked on the census include Fiona Maisels, Richard Malonga, Hugo Rainey, Emma Stokes, and Samantha Strindberg.

The new census was the result of intensive field work carried out by the Bronx Zoo-based WCS and the Government of Republic of Congo, where researchers combed rainforests and isolated swamps to count gorilla "nests" to accurately estimate the population. Gorillas construct nests each night from leaves and branches for sleeping. Population densities ranged as high as eight individuals per square kilometer in one particularly rich forest patch, which ranks as among the highest gorilla densities ever recorded.

WCS says a combination of factors led to such high numbers of gorillas including: successful long-term conservation management of the Republic of Congo's protected areas; remoteness and inaccessibility of some of the key locations where the gorillas were found; and a food-rich habitat, particularly in some of the swamp forests and the herb-rich "Marantaceae" forests.


***This map depicts the areas of census work conducted by the Wildlife Conservation Society and the government of the Republic of Congo in the northern portion of that country.*** **Wildlife Conservation Society**

WCS has worked with the Government of Republic of Congo in the northern area of the country for nearly 20 years, helping establish the Nouabalé-Ndoki National Park and manage the Lac Tele Community Reserve while working with logging companies outside of protected areas to reduce illegal hunting.

"These figures show that northern Republic of Congo contains the mother lode of gorillas," said Dr. Steven E. Sanderson, President and CEO of the Wildlife Conservation Society. "It also shows that conservation in the Republic of Congo is working. This discovery should be a rallying cry for the world that we can protect other vulnerable and endangered species, whether they be gorillas in Africa, tigers in India, or lemurs in Madagascar."

In all, the researchers estimated a total of 125,000 gorillas in just this northern Congo area. Seventy three thousand came from the Ntokou-Pikounda region and another 52,000 from the Ndoki-Likouala landscape—including a previously unknown population of nearly 6,000 gorillas living in an isolated Raphia swamp. WCS cautioned that many of the gorillas live outside of existing protected areas, though the Government of Congo has committed to creating a new national park in the Ntokou-Pikounda region.

"We knew from our own observations that there were a lot of gorillas out there, but we had no idea there were so many," said Dr. Emma Stokes, who led the survey efforts in Ndoki-Likouala. "We hope that the results of this survey will allow us to work with the Congolese government to establish and protect the new Ntokou-Pikounda protected area."

Mr. Claude Etienne Massimba of the Government of Republic of Congo's Department of Wildlife and Protected Areas said, "We hope that these results will speed up the classification of the Ntokou-Pikounda zone into a protected area."

Across Central Africa, gorillas face the looming threats of hunting for bushmeat and the spread of the Ebola virus, which is lethal to gorillas as well as humans. WCS is working with partners to combat Ebola, eliminate commercial hunting, and secure this last stronghold for Africa's apes.

Many gorilla conservation projects are funded through two primary programs of the federal government—the Congo Basin Forest Partnership at the U.S. Agency for International Development and the Great Apes Conservation Fund at the U.S. Fish and Wildlife Service. Both of these programs are at risk of being cut in the Fiscal Year 2009 federal budget. Although the budget process in Washington has stalled, WCS is calling for Congress to restore and grow these programs by completing work on the Fiscal Year 2009 budget before the end of September.

*Western lowland gorillas are one of four recognized gorilla sub-species, which also include mountain gorillas, eastern lowland gorillas, and Cross River gorillas. All are classified as "critically endangered" by the IUCN, except eastern lowland gorillas, which are endangered. The Wildlife Conservation Society is the only conservation group working to safeguard all four subspecies. WCS's conservation work in Central Africa was funded in part from admission fees to the Bronx Zoo's Congo Gorilla Forest exhibit, which has raised more than $8.5 million for conservation in Central Africa since the opening in 1999. The Wildlife Conservation Society saves wildlife and wild places worldwide. We do so through science, global conservation, education and the management of the world's largest system of urban wildlife parks, led by the flagship Bronx Zoo. Together these activities change attitudes towards nature and help people imagine wildlife and humans living in harmony. WCS is committed to this mission because it is essential to the integrity of life on Earth.*

## VCU Massey Cancer Center and VCU Institute of Molecular Medicine Researchers Publish Findings of a New Chemoprevention Gene Therapy That Kills Pancreatic Cancer Cells

Researchers at the Virginia Commonwealth University Massey Cancer Center and the VCU Institute of Molecular Medicine have published findings that implicate a new chemoprevention gene therapy (CGT) for preventing and treating pancreatic cancer, one of the most lethal and treatment-resistant forms of cancer.

In the July issue of Molecular Cancer Therapeutics, the researchers showed that combining a dietary agent with a gene-delivered cytokine effectively eliminates human pancreatic cancer cells in mice displaying sensitivity to these highly aggressive and lethal cancer cells.

Cytokines are a category of proteins that are secreted into the circulation and can affect cancer cells at distant sites in the body, including metatases. The cytokine used in this study was melanoma differentiation associated gene-7/interleukin-24, known as mda-7/IL-24.

The dietary agent, perillyl alcohol (POH), was combined with mda-7/IL-24, which is already used in other cancer treatments. POH is found in a variety of plants, including citrus plants, and has been well-tolerated by patients who have received it in clinical studies.

The results indicated that the CGT approach not only prevented pancreatic cancer growth and progression, but it also effectively killed established tumors, thereby displaying profound chemopreventive and therapeutic activity.

Paul B. Fisher, Ph.D., was principal investigator of the study, which was supported by the National Institutes of Health and the Samuel Waxman Cancer Foundation. Fisher, who recently joined VCU from Columbia University, is professor and interim chair of VCU's department of human and molecular genetics; holds the Thelma Newmeyer Corman chair in cancer research at Massey; and is director of the VCU Institute of Molecular Medicine.

"Our hypothesis was that certain non-toxic dietary agents that had the ability to promote reactive oxygen species (ROS) would break down pancreatic cancer cell resistance to therapy following administration of mda-7/IL-24 and be safe for human use," said Fisher. "We are very excited at the prospect of this chemoprevention gene therapy as a means of both preventing and treating pancreatic cancer, and it has significant potential to move rapidly into human clinical trials."

Pancreatic cancer has a five-year survival rate of less than 5 percent, and currently there is no effective chemotherapy or radiation therapy for it. About 37,000 new cases are diagnosed in the United States each year.

*To read an abstract of the study, visit http://mct.aacrjournals.org/cgi/content/abstract/7/7/2042.*

## Study: Spices may protect against consequences of high blood sugar

**Writer: Sam Fahmy**, 706/542-5361, sfahmy@uga.edu

Athens, Ga. – Herbs and spices are rich in antioxidants, and a new University of Georgia study suggests they are also potent inhibitors of tissue damage and inflammation caused by high levels of blood sugar.

Researchers, whose results appear in the current issue of the Journal of Medicinal Food, tested extracts from 24 common herbs and spices. In addition to finding high levels of antioxidant-rich compounds known as phenols, they revealed a direct correlation between phenol content and the ability of the extracts to block the formation of compounds that contribute to damage caused by diabetes and aging.

"Because herbs and spices have a very low calorie content and are relatively inexpensive, they're a great way to get a lot of antioxidant and anti-inflammatory power into your diet," said study co-author James Hargrove, associate professor of foods and nutrition in the UGA College of Family and Consumer Sciences.

Hargrove explained that when blood sugar levels are high, a process known as protein glycation occurs in which the sugar bonds with proteins to eventually form what are known as advanced glycation end products, also known as AGE compounds. The acronym is fitting because these compounds activate the immune system, resulting in the inflammation and tissue damage associated with aging and diabetes.

The researchers found a strong and direct correlation between the phenol content of common herbs and spices and their ability to inhibit the formation of AGE compounds. Spices such as cloves and cinnamon had phenol levels that were 30 percent and 18 percent of dry weight, respectively, while herbs such as oregano and sage were eight and six percent phenol by dry weight, respectively. For comparison, blueberries – which are widely touted for their antioxidant capabilities – contain roughly five percent phenol by dry weight.

Study co-author Diane Hartle, associate professor in the UGA College of Pharmacy, said various phenols are absorbed differently by the body and have different mechanisms of action, so it's likely that a variety of spices will provide maximum benefit.

"If you set up a good herb and spice cabinet and season your food liberally, you could double or even triple the medicinal value of your meal without increasing the caloric content," she said.

She added that controlling blood sugar and the formation of AGE compounds can also decrease the risk of cardiovascular damage associated with diabetes and aging. She explained that high blood sugar accelerates heart disease partly because AGE compounds form in the blood and in the walls of blood vessels. The AGE compounds aggravate atherosclerosis, which produces cholesterol plaques.

The UGA researchers tested for the ability to block AGE compounds in a test tube, but animal studies conducted on the health benefits of spices lend support to their argument. Cinnamon and cinnamon extracts, for example, have been shown to lower blood sugar in mice. Interestingly, cinnamon lowers blood sugar by acting on several different levels, Hargrove said. It slows the emptying of the stomach to reduce sharp rises in blood sugar following meals and improves the effectiveness, or sensitivity, of insulin. It also enhances antioxidant defenses.

Hargrove said their findings suggest it's likely that the herbs and spices they studied will provide similar benefits in animal tests. He points out that because humans have been consuming herbs and spices for thousands of years, they come without the risk of possible side effects that accompany medications.

"Culinary herbs and spices are all generally recognized as safe and have been time-tested in the diet," he said. "Indeed, some of spices and herbals are now sold as food supplements because of their recognized health benefits."

Study co-author Phillip Greenspan, associate professor in the College of Pharmacy, noted that most people don't get their recommended five to nine servings of fruits and vegetables a day. Rather than seasoning their food with salt – which provides no beneficial phenols and has been linked to high blood pressure – he recommends that people use a variety of herbs and spices to help boost the nutritional quality of their meals.

"When you add herbs and spices to food, you definitely provide yourself with additional benefits besides taste," Greenspan said.

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## Five scientific discoveries that got the wrong name

* 10:30 05 August 2008 * NewScientist.com news service *** Michael Marshall**

Apart from iconic figures like Darwin and Einstein, most scientists labour in obscurity. One of the few ways in which they can gain lasting recognition is by having a scientific discovery named after them.

However, the system does not always work smoothly. Indeed, naming disputes are so common that there is even a rule of thumb called the Zeroth theorem, which states that eponymous discoveries are, more often than not, wrongly attributed.

Appropriately enough, the theorem is also known as Stigler's law of eponymy even though it was originally formulated by Robert Merton of Columbia University in New York.

Here are five examples that you might not have heard of.

**Salmonella**

This bacterium, most noted for the vicious food poisoning it causes, is actually a complex group. There are two species of bacteria called Salmonella, and a great many subtle sub-divisions. The first species to be discovered was Salmonella enterica, in 1885.

The discovery took place in the lab of Daniel Elmer Salmon, a major figure in veterinary medicine.

Salmon was evidently superb at running his lab and, in particular, he had a knack for picking the best assistants. In 1883, he recruited a young researcher named Theobald Smith (read a tribute to Smith, pdf format).

Smith focused his efforts on ways to vaccinate pigs, especially against classical swine fever (also known as hog cholera).

He succeeded in isolating a bacterium from samples of diseased pigs, which he took to be the cause of the disease. In this he was incorrect, but he can hardly be blamed: classical swine fever is actually caused by a virus, and viruses would not be discovered until 1892.

In 1885, the discovery of this new bacterium, then known as Salmonella cholerae-suis, was announced. It was credited solely to Salmon, despite the fact that he contributed nothing to the work.

It was a classic case of the Matthew syndrome, in which a more eminent scientist gets more credit than a lesser-known colleague. Salmon was also an early example of a modern affliction: heads of lab taking credit for the work of junior staff.

In 1887, Smith's work led to a vaccine for classical swine fever, for which Salmon also claimed sole credit.

**Hansen's disease**

More commonly known as leprosy, Hansen's disease was first recorded around 600 BC, though many of the references to it in the Bible are apparently the result of a mistranslation, and actually refer to other skin conditions.

The popular image of leprosy is of rotting flesh and hideous disfigurement, but these are actually secondary symptoms. The underlying problem is damage to the peripheral nervous system. As a result, patients do not feel pain when they suffer injuries, and even minor cuts can become seriously infected. So patients must continually inspect themselves to avoid disfigurement.

Leprosy is officially known as Hansen's disease, in honour of the Norwegian physician Gerhard Armauer Hansen, who discovered the bacterium responsible. Hansen identified Mycobacterium leprae in 1873, but did not manage to cultivate it, or show that it was truly linked to leprosy.

That fell to Albert Neisser, who would later achieve fame as the discoverer of the gonorrhoea bacterium.

Neisser visited Hansen, who generously gave him a large set of samples from people with leprosy. Neisser succeeded in staining the bacterium and, in 1880, announced that he had discovered the cause of leprosy.

Hansen was infuriated, and fought back with a lengthy article describing how his research had progressed since 1870. Ultimately, the decision was taken, at a conference on leprosy, to give Hansen the credit and leprosy became known as Hansen's disease.

Nevertheless, while Hansen indubitably discovered the bacterium, it was Neisser who showed that it was the cause of leprosy. Had he maintained a cordial relationship with Hansen, they might have shared the credit – but Neisser's arrogant behaviour was, in the end, his downfall.

**Benford's law**

In the late 19th century, the mathematician and astronomer Simon Newcomb took a break from measuring the speed of light and other astronomical constants (tasks that occupied much of his life) and spent some time playing with logarithm books. He noticed that the earlier pages were more worn than later ones.

In 1881, he published a short paper (American Journal of Mathematics, vol 4(1), p 39-40) in which he showed that, in lists of numbers drawn from real-life sources, the numbers are disproportionately likely to begin with the lower digits, particularly 1. He also put forward an equation describing the probability of a number starting with a given digit, although he did not have a good explanation for the strange fact.

Newcomb's discovery was subsequently forgotten for almost 60 years.

It was then independently rediscovered, in 1938, by the optical physicist Frank Benford. Benford checked it against a great many data sets, but an explanation eluded him too. He published his results in Proceedings of the American Philosophical Society (vol 78, p 551).

The evidence Benford accumulated was enough to establish the law, and also to get it permanently associated with his name. Nevertheless, Newcomb unquestionably discovered it first.

Benford's law was not properly explained until 1996, by the mathematician Theodore Hill, who showed that it applies throughout the universe, and even to alternative counting systems like base eight.

Nowadays it is widely used in forensic accounting because accounts that do not conform to Benford's law are more likely to have been faked.

**The Arrhenius equation**

Every high-school chemistry student is supposed to know this equation: $k = Ae^{-E\alpha/RT}$

It describes how the rate constant (k) of a chemical reaction varies with temperature (T) and the reaction's activation energy Eα. But it can also be applied to a great many diverse phenomena – famously, the Arrhenius equation even allows you to tell the temperature by counting cricket chirps.

It is commonly called the Arrhenius equation after the Swedish chemist Svante Arrhenius, one of the key figures in physical chemistry, and the first person to predict that increasing levels of carbon dioxide in the atmosphere would cause global warming.

However, Arrhenius was not the first person to propose the equation. It was put forward by the Dutch chemist Jacobus Henricus van 't Hoff in 1884, in his book Studies in Chemical Dynamics based on studies of many different chemical reactions.

Some five years later, Arrhenius provided a physical explanation for van 't Hoff's discovery when he came up with the concept of activation energy – the "kickstart" energy level that must be reached before a reaction can begin.

He acknowledged van 't Hoff in his paper, but the equation nevertheless became indelibly linked to him. Evidently "the Arrhenius-van 't Hoff equation" was just too much of a mouthful.

**Halley's comet**

This is a strange story. Contrary to popular belief, Edmond Halley did not discover the comet but, if anything, thinking that he did is to underestimate the value of his work on it.

The comet itself had been observed as far back as 240 BC, by Chinese astronomers, and it is possible that even earlier sightings were made. Johannes Kepler certainly saw it in 1607, and Halley himself saw it in 1682, making some rough observations.

Some years later, Halley realised that the comet he had seen was extremely similar to comets seen in 1607 and 1531. From this he deduced that the comet was periodic – that it returned to the vicinity of Earth about every 76 years. He published his results in the Royal Society's journal Philosophical Transactions, in 1705.

Other astronomers had suggested that comets might return periodically, but Halley was the first to correctly identify a comet that did so. He also predicted when the comet would return. His calculations had to be refined by a team of French mathematicians, but he wasn't far off. When the comet came back in 1758, 16 years after his death, it became known as Halley's comet.

In other words, the comet bears his name not because he discovered it, but because he was the first to predict its behaviour.

Edmond Halley is, in fact, one of science's forgotten heroes. In his time it was easier to do novel work in a wide range of different disciplines, but even taking that into account he was prodigious.

Among other things, he mapped the stars of the southern sky, built a diving bell, contributed to our understanding of the weather, explained why compasses do not always point to true north, and discovered that stars move relative to each other.

Halley even persuaded the prickly and publicity-shy Isaac Newton to publish the Principia Mathematica, the book in which he set out the laws of gravity and motion, incidentally deploying calculus to do so.

The book was published at Halley's expense, as the Royal Society had blown its budget on the epic History of Fish, which bombed.

## Folklore gets it wrong on love matches

WHEN it comes to relationships, we are often told that opposites attract. Now, a study suggests couples stay together longer if they share some common ground.

Beatrice Rammstedt of the Centre for Survey Research and Methodology in Mannheim, Germany, and Jürgen Schupp of the German Institute for Economic Research in Berlin looked at the "big five" personality traits in over 6000 couples in Germany. They found people choose partners who are similar to themselves in terms of agreeableness, conscientiousness and openness, while extroversion and emotional stability were unrelated to partner choice (Personality and Individual Differences, DOI: 10.1016/j.paid.2008.06.007).

People in long-lasting marriages had particularly similar levels of agreeableness and conscientiousness, suggesting that couples with these traits in common are more likely to stand the test of time. According to Schupp, if you differ in this respect you are more likely to separate.

Fear not if your partner's personality clashes with your own, though. Sanjay Srivastava, a psychologist at the University of Oregon in Eugene, offers an alternative explanation: "Perhaps the longer couples stay together, the more they grow alike."

## Open science promised for Phoenix

The US space agency (Nasa) has quashed any idea that it is hiding information related to discoveries made on Mars. Nasa has acknowledged that its Phoenix probe has seen an unexpected compound - perchlorate - in the Martian soil but says the analysis is incomplete. Scientists said they had not discussed the issue publicly earlier because they were unsure of the data's significance. They said the discovery - if confirmed - was fascinating but made "life on Mars" neither more nor less likely.

Peter Smith, the Phoenix principal investigator from University of Arizona, stressed that his team would be completely open about its investigations.

"Our policy from the beginning has been to show all our pictures as they come in and to try to involve the world, along with us, in exploring Mars for a habitable zone," he told reporters.

"We really feel it's time to let everybody know what we're finding and get that window into our project."

The fuss had kicked off over the weekend when rumours swept the web that major findings from Phoenix were being held back.

The source of this internet storm was an Aviation Week article that claimed the "White House has been alerted by Nasa about plans to make an announcement soon on major new Phoenix lander discoveries concerning the 'potential for life' on Mars".

The respected magazine further claimed that scientists working on one of the Phoenix instrument suites had even been kept out of a press conference last week to avoid the risk they might have to answer questions on the subject.

That subject - Nasa has now confirmed - is the detection in the Martian soil of a strong perchlorate signal.

**Water story**

Perchlorate (a compound containing chlorine and oxygen) is a potentially oxidising substance often seen in arid soils on Earth, such as in the Atacama desert in Chile.

Although the super-dry Atacama was often regarded as being hostile to life, the same assumption should not be made about the presence of perchlorates, the Phoenix team said.

"[On Earth] there are a large number of plants that concentrate perchlorate and grow in perchlorate at certain levels; there are a variety of species of bacteria that utilise perchlorate as a substrate in their metabolism," explained mission scientist Sam Kounaves, from Tufts University.

The apparent perchlorate signal was seen by the probe's Microscopy, Electrochemistry, and Conductivity Analyzer (MECA), but Nasa stresses that complementary analysis is needed to confirm the data and finesse the details.

On Earth, perchlorates are created in the atmosphere by the interaction of aerosols or dust particles in sunlight, and are dry-deposited onto the surface. In a desert setting, they stay at the surface; but in wet regions, they will quickly move through the soil.

"Perchlorates will tell us quite a bit about the history of water, not just at the Phoenix landing site but in other parts of Mars as we continue our exploration," explained Richard Quinn, a Phoenix researcher from Nasa's Ames centre. "Currently, we've seen the perchlorates at the surface and a future line of research will be to look at where else they are on the planet and whether or not water and salt mobility was involved in that transport."

Phoenix scientists have more time to work up their findings. The US space agency recently agreed to add another five weeks to the original 90 days of the prime mission.

**Personal Health**

## Sorting Out Coffee's Contradictions

**By JANE E. BRODY**

When Howard D. Schultz in 1985 founded the company that would become the wildly successful Starbucks chain, no financial adviser had to tell him that coffee was America's leading beverage and caffeine its most widely used drug. The millions of customers who flock to Starbucks to order a double espresso, latte or coffee grande attest daily to his assessment of American passions.

Although the company might have overestimated consumer willingness to spend up to $4 for a cup of coffee — it recently announced that it would close hundreds of underperforming stores — scores of imitators that now sell coffee, tea and other products laced with caffeine reflect a society determined to run hard on as little sleep as possible.

But as with any product used to excess, consumers often wonder about the health consequences. And researchers readily oblige. Hardly a month goes by without a report that hails coffee, tea or caffeine as healthful or damns them as potential killers.

Can all these often contradictory reports be right? Yes. Coffee and tea, after all, are complex mixtures of chemicals, several of which may independently affect health.

| Coffee and Tea | Caffeine |
|---|---|
| Decaffeinated coffee or tea, 8 oz. | 2 mgs |
| Black tea, brewed, 8 oz. | 47 |
| Green tea, brewed, 8 oz. | 30 to 50 |
| Plain coffee, brewed, 8 oz. | 95 |
| Starbucks Coffee Grande, 16 oz. | 330 |
| Soft drinks and energy drinks | |
| Coca-Cola Classic, 12 oz. | 35 |
| Diet Coke, 12 oz. | 47 |
| Mountain Dew, 12 oz. | 54 |
| Red Bull, 8.3 oz. | 76 |
| Monster Energy, 16 oz. | 160 |
| SoBe No Fear, 16 oz. | 174 |
| **Foods and other products** | |
| Hershey's chocolate milk, 8 oz. | 5 |
| Hershey's milk chocolate, 1.5 oz. | 10 |
| Dannon coffee yogurt, 6 oz. | 30 |
| NoDoz Maximum Strength, 1 tablet | 200 |

**Caffeine Myths**

Through the years, the public has been buffeted by much misguided information about caffeine and its most common source, coffee. In March the Center for Science in the Public Interest published a comprehensive appraisal of scientific reports in its Nutrition Action Healthletter. Its findings and those of other research reports follow.

Hydration. It was long thought that caffeinated beverages were diuretics, but studies reviewed last year found that people who consumed drinks with up to 550 milligrams of caffeine produced no more urine than when drinking fluids free of caffeine. Above 575 milligrams, the drug was a diuretic.

So even a Starbucks grande, with 330 milligrams of caffeine, will not send you to a bathroom any sooner than if you drank 16 ounces of pure water. Drinks containing usual doses of caffeine are hydrating and, like water, contribute to the body's daily water needs.

Heart disease. Heart patients, especially those with high blood pressure, are often told to avoid caffeine, a known stimulant. But an analysis of 10 studies of more than 400,000 people found no increase in heart disease among daily coffee drinkers, whether their coffee came with caffeine or not.

"Contrary to common belief," concluded cardiologists at the University of California, San Francisco, there is "little evidence that coffee and/or caffeine in typical dosages increases the risk" of heart attack, sudden death or abnormal heart rhythms.

In fact, among 27,000 women followed for 15 years in the Iowa Women's Health Study, those who drank one to three cups a day reduced their risk of cardiovascular disease by 24 percent, although this benefit diminished as the quantity of coffee rose.

Hypertension. Caffeine induces a small, temporary rise in blood pressure. But in a study of 155,000 nurses, women who drank coffee with or without caffeine for a decade were no more likely to develop hypertension than noncoffee drinkers. However, a higher risk of hypertension was found from drinking colas. A Johns Hopkins study that followed more than 1,000 men for 33 years found that coffee drinking played little overall role in the development of hypertension.

Cancer. Panic swept this coffee-dependent nation in 1981 when a Harvard study tied the drink to a higher risk of pancreatic cancer. Coffee consumption temporarily plummeted, and the researchers later concluded that perhaps smoking, not coffee, was the culprit.

In an international review of 66 studies last year, scientists found coffee drinking had little if any effect on the risk of developing pancreatic or kidney cancer. In fact, another review suggested that compared with people who do not drink coffee, those who do have half the risk of developing liver cancer.

And a study of 59,000 women in Sweden found no connection between coffee, tea or caffeine consumption and breast cancer.

Bone loss. Though some observational studies have linked caffeinated beverages to bone loss and fractures, human physiological studies have found only a slight reduction in calcium absorption and no effect on calcium excretion, suggesting the observations may reflect a diminished intake of milk-based beverages among coffee and tea drinkers.

Dr. Robert Heaney of Creighton University says that caffeine's negative effect on calcium can be offset by as little as one or two tablespoons of milk. He advised that coffee and tea drinkers who consume the currently recommended amount of calcium need not worry about caffeine's effect on their bones.

Weight loss. Here's a bummer. Although caffeine speeds up metabolism, with 100 milligrams burning an extra 75 to 100 calories a day, no long-term benefit to weight control has been demonstrated. In fact, in a study of more than 58,000 health professionals followed for 12 years, both men and women who increased their caffeine consumption gained more weight than those who didn't.

**Health Benefits**

Probably the most important effects of caffeine are its ability to enhance mood and mental and physical performance. At consumption levels up to 200 milligrams (the amount in about 16 ounces of ordinary brewed coffee), consumers report an improved sense of well-being, happiness, energy, alertness and sociability, Roland Griffiths of the Johns Hopkins School of Medicine reported, although higher amounts sometimes cause anxiety and stomach upset.

Millions of sleep-deprived Americans depend on caffeine to help them make it through their day and drive safely. The drug improves alertness and reaction time. In the sleep-deprived, it improves memory and the ability to perform complex tasks.

For the active, caffeine enhances endurance in aerobic activities and performance in anaerobic ones, perhaps because it blunts the perception of pain and aids the ability to burn fat for fuel instead of its carbohydrates.

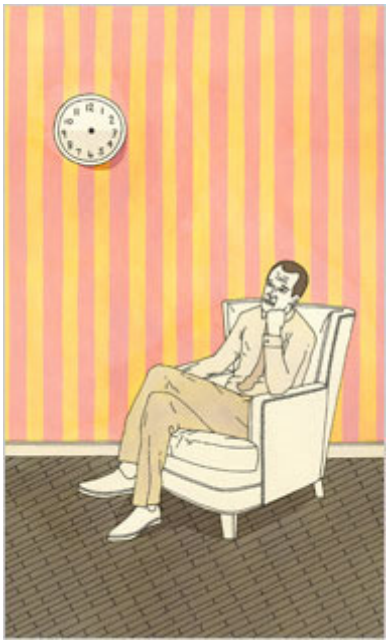
Recent disease-related findings can only add to coffee's popularity. A review of 13 studies found that people who drank caffeinated coffee, but not decaf, had a 30 percent lower risk of Parkinson's disease.

Another review found that compared with noncoffee drinkers, people who drank four to six cups of coffee a day, with or without caffeine, had a 28 percent lower risk of Type 2 diabetes. This benefit probably comes from coffee's antioxidants and chlorogenic acid.

**Mind**

## You're Checked Out, but Your Brain Is Tuned In

**By BENEDICT CAREY**



**Ian Dingman**

Even the most fabulous, high-flying lives hit pockets of dead air, periods when the sails go slack. Movie stars get marooned in D.M.V. lines. Prime ministers sit with frozen smiles through interminable state events. Living-large rappers endure empty August afternoons, pacing the mansion, checking the refrigerator, staring idly out the window, baseball droning on the radio.

Wondering: When does the mail come, exactly?

Scientists know plenty about boredom, too, though more as a result of poring through thickets of meaningless data than from studying the mental state itself. Much of the research on the topic has focused on the bad company it tends to keep, from depression and overeating to smoking and drug use.

Yet boredom is more than a mere flagging of interest or a precursor to mischief. Some experts say that people tune things out for good reasons, and that over time boredom becomes a tool for sorting information — an increasingly sensitive spam filter. In various fields including neuroscience and education, research suggests that falling into a numbed trance allows the brain to recast the outside world in ways that can be productive and creative at least as often as they are disruptive.

In a recent paper in The Cambridge Journal of Education, Teresa Belton and Esther Priyadharshini of East Anglia University in England reviewed decades of research and theory on boredom, and concluded that it's time that boredom "be recognized as a legitimate human emotion that can be central to learning and creativity."

Psychologists have most often studied boredom using a 28-item questionnaire that asks people to rate how closely a list of sentences applies to them: "Time always seems to be passing too slowly," for instance.

High scores in these tests tend to correlate with high scores on measures of depression and impulsivity. But it is not clear which comes first — proneness to boredom, or the mood and behavior problems. "It's the difference between the sort of person who can look at a pool of mud and find something interesting, and someone who has a hard time getting absorbed in anything," said Stephen J. Vodanovich, a psychologist at University of West Florida in Pensacola.

Boredom as a temporary state is another matter, and in part reflects the obvious: that the brain has concluded there is nothing new or useful it can learn from an environment, a person, an event, a paragraph. But it is far from a passive neural shrug. Using brain-imaging technology, neuroscientists have found that the brain is highly active when disengaged, consuming only about 5 percent less energy in its resting "default state" than when involved in routine tasks, according to Dr. Mark Mintun, a professor of radiology at Washington University in St. Louis.

That slight reduction can make a big difference in terms of time perception. The seconds usually seem to pass more slowly when the brain is idling than when it is absorbed. And those stretched seconds are not the live-in-the-moment, meditative variety, either. They are frustrated, restless moments. That combination,

psychologists argue, makes boredom a state that demands relief — if not from a catnap or a conversation, then from some mental game.

"When the external and internal conditions are right, boredom offers a person the opportunity for a constructive response," Dr. Belton, co-author of the review in the Cambridge journal, wrote in an e-mail message.

Some evidence for this can be seen in semiconscious behaviors, like doodling during a dull class, braiding strands of hair, folding notebook paper into odd shapes. Daydreaming too can be a kind of constructive self-entertainment, psychologists say, especially if the mind is turning over a problem. In experiments in the 1970s, psychiatrists showed that participants completing word-association tasks quickly tired of the job once obvious answers were given; granted more time, they began trying much more creative solutions, as if the boredom "had the power to exert pressure on individuals to stretch their inventive capacity," Dr. Belton said.

In the past few years, a team of Canadian doctors had the courage to examine the fog of boredom as it thickened before their (drooping) eyes. While attending lectures on dementia, the doctors, Kenneth Rockwood, David B. Hogan and Christopher J. Patterson, kept track of the number of attendees who nodded off during the talks. They found that in an hourlong lecture attended by about 100 doctors, an average of 16 audience members nodded off. "We chose this method because counting is scientific," the authors wrote in their seminal 2004 article in The Canadian Medical Association Journal.

The investigators analyzed the presentations themselves and found that a monotonous tone was most strongly associated with "nod-off episodes per lecture (NOELs)," followed by the sight of a tweed jacket on the lecturer.

In a telephone interview, Dr. Rockwood, a professor of geriatric medicine at Dalhousie University in Halifax, Nova Scotia, said when the material presented is familiar, as a lot of it was, then performance is everything. "Really, what it comes down to," he said, "is that if you have some guy up there droning on, it drives people crazy."

Dr. Rockwood and his co-authors have followed up with two more related reports and attribute the inspiration for the continuing project to Dr. Patterson.

Early on in one of those first dementia lectures, he went out cold.

**Basics**

## The Nose, an Emotional Time Machine

**By NATALIE ANGIER**

Here is a fun and easy experiment that Rachel Herz of Brown University suggests you try at home, but only if you promise to eat your vegetables first, floss afterward, and are not at risk of a diabetic coma. Buy a bag of assorted jelly beans of sufficiently high quality to qualify, however oxymoronically, as "gourmet." Then, sample all the flavors in the bag systematically until you are sure you appreciate just how distinctive each one is, because expertise is important and you may never get another excuse this good.

**Serge Bloch**

Now for the meat of our matter: pinch your nostrils shut and do the sampling routine again. Notice the differences? That's right — now there are none. Every bean still tastes sweet, but absent a sense of smell you might as well be eating sugared pencil erasers. And if in midchew you unbind your nose, what then? At once the candy's candid charms return, and you can tell your orange sherbet from a buttered popcorn.

We've all heard about the mysterious powers of smell and its importance in love, friendship and food. Yet a simple game like What's My Bean, and our consistent surprise at the impact of shutting down our smell circuits, shows that we don't really grasp just how deep the nose goes. At the International Symposium on Olfaction and Taste held in San Francisco late last month, Dr. Herz and other researchers discussed the many ways our sense of smell stands alone. Olfaction is an ancient sense, the key by which our earliest forebears learned to approach or slink off. Yet the right aroma can evoke such vivid, whole body sensations that we feel life's permanent newness, the grounding of now.

On the one hand, said Jay A. Gottfried of Northwestern University, olfaction is our slow sense, for it depends on messages carried not at the speed of light or of sound, but at the far statelier pace of a bypassing breeze, a pocket of air enriched with the sort of small, volatile molecules that our nasal-based odor receptors can read. Yet olfaction is our quickest sense. Whereas new signals detected by our eyes and our ears must first be assimilated by a structural way station called the thalamus before reaching the brain's interpretive regions, odiferous messages barrel along dedicated pathways straight from the nose and right into the brain's olfactory cortex, for instant processing.

Importantly, the olfactory cortex is embedded within the brain's limbic system and amygdala, where emotions are born and emotional memories stored. That's why smells, feelings and memories become so easily and intimately entangled, and why the simple act of washing dishes recently made Dr. Herz's cousin break down and cry. "The smell of the dish soap reminded her of her grandmother," said Dr. Herz, author of "The Scent of Desire."

Many mammals are clearly nosier than we. Consider that our olfactory epithelium, the yellowish mass of mucous membrane located some three inches up from our nostrils, holds about 20 million smell receptors designed to detect odor molecules delivered either frontally, when we, say, sniff a rose, or via the rear, the volatile aromas that come up through the back of the mouth and give each jelly bean meaning. The nasal membranes of a bloodhound, by contrast, sustain an olfactory army 220 million receptors strong.

Yet for all the meagerness of our hardware, we humans can become better nosehounds with startling ease. In one experiment, Dr. Gottfried said, subjects exposed to a single floral scent for just three and a half minutes markedly improved their ability to discriminate among whole families of flower odors. In another, participants soon learned to distinguish normally undetectable differences between one herbal smell and its mirror-image molecular twin if they were given mild electric shocks every time they guessed wrong.

Moreover, numerous studies have shown that smell memory is long and resilient, and that the earliest odor associations we make often stick. "With a phone number, if you get a new one, a week later you may have forgotten the old one," Dr. Herz said. "With smells, it's the other way around. The first association is better than the second."

In another presentation, Maria Larsson, an associate professor of psychology at Stockholm University, described the power of smell to serve as an almost magical time machine, with potential for treating dementia, depression, the grim fog of age. Johan Willander and others in her lab have sought to give firm empirical foundation to the old Proustian hypothesis, the idea that smells and aromas, like the famed taste of a madeleine dipped in tea, can help disinter the past.

Studying groups of Swedes whose average age was 75, the researchers offered three different sets of the same 20 memory cues — the cue as a word, as a picture and as a smell. The scientists found that while the word and visual cues elicited associations largely from subjects' adolescence and young adulthood, the smell cues evoked thoughts of early childhood, under the age of 10.

And despite the comparative antiquity of such memories, Dr. Larsson said, people described them in exceptionally rich and emotional terms, and they were much likelier to report the sudden sensation of being brought back in time. They smelled cardamom, and there they were in the kitchen, flour dust flying as they helped Mama and Nana roll out the holiday buns. The scent of tar, and they're back at the dock with Dad, tarring the bottom of the family boat in anticipation of long summer sails.

Dr. Larsson attributes the youthfulness of smell memories to the fact that our olfaction is the first of our senses to mature and only later cedes cognitive primacy to vision and words, while the cortical link between olfaction and emotion ensures that those early sensations keep their bloom all life long.

## Pet dogs can 'catch' human yawns

**By Jennifer Carpenter** Science reporter, BBC News

Yawning is known to be contagious in humans but now scientists have shown that pet dogs can catch a yawn, too. The copying activity suggests that canines are capable of empathising with people, say the researchers who recorded dogs' behaviour in lab tests.

Until now, only humans and their close primate relatives were thought to find yawning contagious.

The team - from Birkbeck College, University of London - reports its findings in Biology Letters.

Yawning, although sometimes a response to extreme stress, is more often a sign of tiredness; but the reason for why yawning is catching is not fully understood.

**Human cues**

There is evidence that autistic individuals are less inclined to yawn into response to another human yawning, suggesting that contagious yawning betrays an ability to empathise, explained Birbeck's Dr Atsushi Senju.

Dr Senju and his team wondered whether dogs - that are very skilled at reading human social cues - could read the human yawn signal, and set out to test the yawning capabilities of 29 canines.

The team created two conditions, each five minutes long, in which a person - who was a stranger to the dog - was sat in front of the animal and asked to call its name. Under the first condition, the stranger yawned once the dogs had made eye contact with them.

"We gave dogs everything: visual and auditory stimulus to induce them to yawn," Dr Senju, told BBC News.

Under the second condition, the same procedure was followed, but this time the stranger opened and closed their mouth but did not yawn.

This was a precaution to ensure that dogs were not responding to an open mouth, explained Dr Senju.

**Yawning yet?**

The team found that 21 out of 29 dogs yawned when the stranger in front of them yawned - on average, dogs yawned 1.9 times. By contrast, no dogs yawned during the non-yawning condition.

The researchers believe that these results are the first evidence that dogs have the capacity to empathise with humans; although the team could not rule out stress-induced yawning - they hope to in future studies.

"Dogs have a very special capacity to read human communication. They respond when we point and when we signal," Dr Senju told BBC News.

The researchers explained that along with floppy ears and big soppy-eyes, humans have selected dogs to be obedient and docile. The results from this study suggest the capacity for empathy towards humans is another trait selected in dogs during domestication.

Dr Senju thinks that these traits would have been useful to humans when they began to live side-by-side with canines approximately 15,000 years ago.

*Does your dog yawn when you do? Have you managed to catch this habit on camera? Are you and your pet alike? Send us your pictures of you and your yawning dogs.*

*You can send pictures and video to: yourpics@bbc.co.uk or to send via MMS please dial +44 (0)7725 100 100 .*

## Water is 'designer fluid' that helps proteins change shape, scientists say

CHAMPAIGN, Ill. — According to new research, old ideas about water behavior are all wet.

Ubiquitous on Earth, water also has been found in comets, on Mars and in molecular clouds in interstellar space. Now, scientists say this common fluid is not as well understood as we thought.

"Water, as we know it, does not exist within our bodies," said Martin Gruebele, a William H. and Janet Lycan Professor of Chemistry at the University of Illinois. "Water in our bodies has different physical properties from ordinary bulk water, because of the presence of proteins and other biomolecules. Proteins change the properties of water to perform particular tasks in different parts of our cells."

Consisting of two hydrogen atoms and one oxygen atom, water molecules are by far the body's largest component, constituting about 75 percent of body volume. When bound to proteins, water molecules participate in a carefully choreographed ballet that permits the proteins to fold into their functional, native states. This delicate dance is essential to life.

"While it is well known that water plays an important role in the folding process, we usually only look at the motion of the protein," said Gruebele, who also is the director of the U. of I.'s Center for Biophysics and Computational Biology, and a researcher at the Beckman Institute. "This is the first time we've been able to look at the motion of water molecules during the folding process."

Using a technique called terahertz absorption spectroscopy, Gruebele and his collaborator Martina Havenith at the Ruhr-University Bochum studied the motions of a protein on a picosecond time scale (a picosecond is 1 trillionth of a second). The technique, which uses ultrashort laser pulses, also allowed the researchers to study the motions of nearby water molecules as the protein folded into its native state.

The researchers present their findings in a paper published July 23 in the online version of the chemistry journal Angewandte Chemie.

Terahertz spectroscopy provides a window on protein-water rearrangements during the folding process, such as breaking protein-water-hydrogen bonds and replacing them with protein-protein-hydrogen bonds, Gruebele said. The remaking of hydrogen bonds helps organize the structure of a protein.

In tests on ubiquitin, a common protein in cells, the researchers found that water molecules bound to the protein changed to a native-type arrangement much faster than the protein. The water motion helped establish the correct configuration, making it much easier for the protein to fold.

"Water can be viewed as a 'designer fluid' in living cells," Gruebele said. "Our experiments showed that the volume of active water was about the same size as that of the protein."

The diameter of a single water molecule is about 3 angstroms (an angstrom is about one hundred-millionth of a centimeter), while that of a typical protein is about 30 angstroms. Although the average protein has only 10 times the diameter of a water molecule, it has 1,000 times the volume. Larger proteins can have hundreds of thousands times the volume. A single protein can therefore affect, and be influenced by, thousands of water molecules.

"We previously thought proteins would affect only those water molecules directly stuck to them," Gruebele said. "Now we know proteins will affect a volume of water comparable to their own. That's pretty amazing."

*With Gruebele and Havenith, co-authors of the paper are graduate student Seung Joong Kim at the U. of I., and graduate student Benjamin Born at the Ruhr-University Bochum.*

## Humans' Evolutionary Response to Risk Can Be Unnecessarily Dangerous, Finds TAU Study

Our ancient instincts don't meet the decision-making needs of a modern world

The traffic light ahead of you is turning yellow. Do you gun the engine and speed through the intersection, trusting that others will wait for their green, or do you slow down and wait your turn?

That depends more on experience than personality, according to new research from Tel Aviv University. Arnon Lotem, a behavioral ecologist from the Department of Zoology at Tel Aviv University, reports in the prestigious journal Nature that people adopt risk-taking behaviors similar to those of animals like rats and bees. And this behavior, Prof. Lotem and his colleagues say, might not prepare humankind for the modern dangers we face every day -- like crossing the street, accepting a high-risk mortgage, or driving on the freeway.

Lotem believes that our risk-taking behavior had its advantages when we were living as cave-dwellers, but that it poses new and potentially dangerous challenges in our modern technology-driven world.

**Feeling Risky**

"People want to know how people make decisions, whether it's how you drive your car, or whether to invest in a mortgage. It's important to understand when and how we make those decisions, to understand the type of errors people are prone to make," says Prof. Lotem.

"What we have found is that people make decisions based on what option 'appears' to be better most of the time. Under conditions in the natural world this would be the best strategy, but in modern life it has nothing do with the real inherent risks," he adds, citing our individual responses to that yellow light.

People are aware of the actual risks when driving through a light at an intersection, but unless they've already had a brush-with-death or a brush-with-a-traffic-cop, the perceived risk remains low, says Prof. Lotem. This is because in most cases nothing happens to the risk-taker. "You save one minute, but you can lose everything. People don't do the math," he says.

Lotem's study found that, presented with simple decision-making stimuli, people are not analyzing the complete situation based on logical rationales or statistics. Instead, they appear to be making decisions based on simple strategies for coping in nature, based mainly on personal experience.

**Evolved to Fear Cobras, not Traffic Lights**

During many years of evolution and under natural conditions, he says, people made decisions like other animals. This tactic worked fine for survival, but did not however evolve to survive the modern world. "We've evolved to be afraid of snakes, but not traffic lights," he says.

The results of Lotem's research may also be used by economists, politicians and psychologists, who need to know when people will take risks, says Prof. Lotem. A wider understanding of this phenomenon can affect business decisions, the economy -- and, hopefully, the number of road accidents in America each year.

In the business world, Lotem says, "If you give feedback and rewards to employees in a clear way, they might be more willing to take risks on your behalf." He adds that this approach might help governments to cultivate the entrepreneurial activities of their citizens.

**Don't Gamble On It**

But the more complex the risk, the more difficult to predict how people will react. Lotem cautions that in complicated decision-making scenarios such as gambling, addiction and excitement are new variables that come into play. It is also difficult to assess whether children exhibit similar risk-taking strategies as adults, because children tend to imitate what adults around them are doing.

*The study's participants also included a team of scientists from the Technion Israel Institute of Technology and The Faculty of Agriculture of the Hebrew University of Jerusalem.*

## Jupiter and Saturn full of liquid metal helium

**By Rachel Tompa**, Media Relations | 06 August 2008

BERKELEY – A strange, metal brew lies buried deep within Jupiter and Saturn, according to a new study by researchers at the University of California, Berkeley, and in London.

The study, published in this week's online edition of the journal Proceedings of the National Academy of Sciences, demonstrates that metallic helium is less rare than was previously thought and is produced under the kinds of conditions present at the centers of giant, gaseous planets, mixing with metal hydrogen and forming a liquid metal alloy.

"This is a breakthrough in terms of our understanding of materials, and that's important because in order to understand the long-term evolution of planets, we need to know more about their properties deep down," said Raymond Jeanloz, professor of astronomy and of earth and planetary science at UC Berkeley and one of the authors of the study. "The finding is also interesting from the point of view of understanding why materials are the way they are, and what determines their stability and their physical and chemical properties."

Jeanloz studies pressures tens of millions of times greater than Earth's atmospheric pressure - the kinds of forces felt inside Jupiter and Saturn, so called "gas giants" that lack a solid surface. The core of the Earth, which is small and dense compared to the cores of these gas giants, contains pressures of about 3.5 million times atmospheric pressure. Pressures at Jupiter's core for example, reach 70 million times Earth's atmospheric pressure, the planet's massive size more than offsetting its low density. The cores of Jupiter and Saturn are a balmy 10,000 to 20,000 degrees Celsius, two to four times hotter than the surface of the sun.

In this study, Jeanloz and Lars Stixrude, earth sciences professor at University College London, took a closer look at what happens to helium under such extreme conditions.

Most studies of materials in gaseous planets have focused on hydrogen, Jeanloz said, because it is the predominant element of both these planets and the universe. But even though hydrogen is the lightest element, its behavior is fairly complicated due to its tendency to form molecules of two bonded hydrogen atoms, Jeanloz said. Jeanloz and Stixrude wanted to study a simpler element, to more easily understand the effects of extreme temperatures and pressure.

***Results from UC Berkeley and London researchers suggest that giant, gaseous planets such as Jupiter, shown here in a mosaic constructed from images from the Cassini spacecraft, are filled with a liquid metal alloy of helium and hydrogen.*** **(NASA/JPL/Space Science Institute photo)**

So, they picked helium, the second most abundant element, which comprises five to 10 percent of the universe. They used theories based on quantum mechanics to calculate the behavior of helium under different pressures and temperatures. Although these equations are only approximations, Stixrude said, the researchers' predictions closely matched experimental results for lower pressures.

Under Earthly conditions, helium is a colorless, see-through, electrically insulating gas. But under the kinds of pressure and temperature found at the centers of Jupiter and Saturn, the researchers found that helium turns into a liquid metal, like mercury.

"You can imagine this liquid looking like mercury, only less reflective," Jeanloz said.

The finding was a surprise, as scientists had assumed that high pressures and high temperatures would make metallization of elements such as helium more difficult, not easier, Jeanloz said. He and his colleagues had previously found that helium starts to have some metal-like qualities in experiments at extremely high pressure, but they have not yet been able to experiment with helium under the conditions found inside giant planets.

A metal's key characteristic is its ability to conduct electricity, meaning electrons can flow through it like water flowing unimpeded down a riverbed.

"High temperatures make the atoms jiggle around, and so people thought that raising the heat would deflect the electrons, like putting enough rocks in a stream to block the flow of water," Jeanloz said. "The scattering caused by atoms was thought to make it harder for the electrons to flow down the stream."

But it turns out that the atoms' jostling also creates new ways for the electrons to move, almost as if new crevices had opened in the ground for the river's flow, Jeanloz said.

Scientists recently discovered that hydrogen metalizes under lower temperatures and pressures than was previously appreciated. The dogma in the field was that the characteristics of hydrogen and helium were different enough that the two wouldn't mix inside giant gaseous planets, Jeanloz said. The researchers' findings, however, indicate that the two elements probably do mix, forming a metal alloy like brass, but liquid.

This finding also speaks to one of the many mysteries of these large planets, Stixrude said. More energy is emitted from Jupiter and Saturn than they absorb from the sun, and scientists don't understand where it comes from. One of the prevailing theories is that droplets of helium condense out of the planets' outer atmospheres and fall to their centers as "helium rain," releasing gravitational energy. But Jeanloz and Stixrude's findings show that helium and hydrogen are probably a more homogenous mix than was previously suspected, meaning that helium rain is unlikely.

"Now, we have to look elsewhere for this energy source," Stixrude said.

## First 'virophage' could take the fight to viruses

* 18:00 06 August 2008
* NewScientist.com news service
*** Nic Fleming**

A newly discovered type of virus that spreads at the expense of other viruses, could be used to combat viral infections, say researchers.

Didier Raoult and colleagues from the University of the Mediterranean, France, say that the virus, called Sputnik, spreads by hijacking the replication machinery of the mamavirus – itself a new strain of the giant mimivirus.

The team says Sputnik is the first member of a new class they call "virophages" because of similarities with bacteriophages or phages – viruses that infect bacteria – and is the first time a virus has been seen to propagate at the expense of a viral host.

Research into phage therapy during the early 20th century was largely abandoned following the discovery of antibiotics.

**Virus weapon?**

Not only does Sputnik cut the spread of mamavirus in amoeba, Raoult's analysis also shows it has looted genes from other viruses. This could help researchers understand the genetic evolution of harmful viruses, and potentially, use virophages to destroy them. However, the team is cautious.

"It's too early to say we could use Sputnik as a weapon against big viruses or to modify them," says co-author Bernard La Scola, also at the University of the Mediterranean. "But phages are used to modify bacteria, so why not?"

Sputnik resembles satellite viruses – such as the one that causes hepatitis D. These can only replicate in and infect their host if another virus is present. A key difference, though, is that Sputnik significantly reduces the viral load of the other virus.

"What is interesting here is that Sputnik is doing this at the expense of the bigger virus," says Robin Weiss, of University College London.

However Geoffrey Smith, a virologist at Imperial College London, says this may not be surprising since both viruses are dependent upon the host cell for metabolites and will compete for them. He adds: "Bacteriophages replicate only in bacteria and that's all they need, so the use of the phrase 'virophage' is inappropriate." *Journal reference: Nature (DOI: 10.1038/nature07218)*

## Scientists use CT technology to virtually reconstruct Hadropithecus skull

Science Centric | 29 July 2008 12:46 GMT —

Fossils recovered in a remote cave in the Southeast corner of Madagascar by William L. Jungers, Ph.D., a paleoanthropologist at Stony Brook University Medical Centre, and his colleagues in Hawaii, Oregon, Massachusetts and Madagascar have been reuinted and reconstructed via computed tomography (CT) technology by collaborators at Pennsylvania State University. The team used CT scanning and computerisation to virtually glue newly discovered skull fragments of a rare extinct lemur found in 2003 back into its partial skull, originally discovered in 1899 and housed in Vienna, Austria. An article describing the work will be published in the early edition of the Proceedings of the National Academy of Sciences during the week of 28 July 2008.

***Final reconstruction of the Hadropithecus skull.*** **(c) Stony Brook News**

The result of the digital manipulation is a nearly complete skull of Hadropithecus stenognathus, which is one of only two known skulls for this extinct lemur. To date scientists have known little about this giant lemur, the size of a large baboon, because few of its fossil remains have been found until recently by Dr Jungers and colleagues. The first specimens, partial skull pieces, found by fossil collector Franz Sikora in Madagascar in 1899 and the early 1900s are in Vienna. The modern finds of frontal skull bone pieces remain in the United States.

'Hadropithecus stenognathus is a poorly known and enigmatic 'monkey lemur' that went extinct in the recent past, but this new virtual restoration offers a fascinating glimpse into the brain and skull of what appears to be one of the most advanced giant lemurs,' said Dr Jungers.

'From the moment we combined the two datasets, it was obvious that the fossils belonged to the same individual,' said Timothy Ryan, Ph.D., anthropologist and lead author of the PNAS paper, titled 'A reconstruction of the Vienna skull of Hadropithecus stenognathus.'

'Because the newly discovered fragments fit into the skull so cleanly, we decided to attempt a more thorough virtual reconstruction,' said Dr Ryan. 'All the work was with the help of computers and neither all the scientists nor all of the specimens were ever in the same room.'

The end result was a beautiful image and three-dimensional print of the skull of the extinct lemur species that opened doors to new findings. For the first time, its cranial capacity (115 ml.) has been measured accurately. The team could also estimate its body size reliably from limb bones, as well as figure out accurate brain measurements. Hadropithecus not only had one of the largest brains relative to its body size of any known prosimian (a group of lemurs, lorises, and other similar animals), it also had a brain as large as that of some large monkeys.

*Other members of the research team included D.A. Burney, National Tropical Botanical Garden, Kaleheo, Hawaii; L.R. Godfrey, University of Massachusetts; U.B. Gohlich, National History Museum of Vienna; N.Vasey, Portland State University, Portland, Oregon; Ramilisonia, Musee d'Art Archeologie, in Madagascar; A. Walker, Pennsylvania State University, and G.W. Weber, University of Vienna.*

*The research was supported by the National Science Foundation, the European Union, and Penn State and Portland State Universities.*

## Cairo paternity test for King Tut

DNA tests are to be conducted on the mummified remains of two stillborn children found in the tomb of Tutankhamun, Egyptian officials say.

Egypt's chief archaeologist hopes the tests will confirm whether they were the offspring of the boy pharaoh.

It is also hoped the tests will clarify whether the children's grandmother was the famously-beautiful queen Nefertiti.

They were found in the Luxor tomb of the boy king, who died over 3,000 years ago, by explorer Howard Carter in 1922.

Since then they have been kept in storage at the Cairo School of Medicine, and have not been publicly displayed.

Some scholars think the female foetuses' mother was Ankhesenamun, Tutankhamun's only known wife and daughter of Nefertiti.

Zahi Hawass, the head of Egypt's Supreme Council for Antiquities, said the tests could help determine Tutankhamun's family lineage, which has long piqued the curiosity of Egyptologists.

***One of the two mummified foetuses during preparations for a DNA test in Cairo, Egypt, 6 August 2008***

"For the first time we will be able to identify the family of King Tut," Mr Hawass told Reuters news agency.

He added that this should help "to discover the mummy of Nefertiti", which scholars say has never been identified.

DNA samples from the two foetuses - thought to have been stillborn between five and seven months into pregnancy - will be compared to each other and to Tutankhamun at Cairo University, and the results should be known by December, Mr Hawass said.

Tutankhamun's remains were examined by DNA and computerised tomography (CT) scans in 2005.

His was one of the first royal mummies to undergo the procedure as Egypt attempted to confirm the identities of all its ancient rulers.

**'Wonderful things'**

Tutankhamun ruled Egypt from 1333-1324 BC and is believed to have ascended to the throne aged about nine.

***Death mask of Tutankhamun Scholars believe Tutankhamun had no surviving children***

Scholars believe he married Ankhesenamun at the age of 12, but the couple had no surviving children.

Although in life he was of only moderate historical significance, in death Tutankhamun achieved worldwide fame thanks to the virtually intact state of his tomb when it was opened by British explorer Carter in 1922.

It was packed with such a fabulous trove of gold and ebony treasures that when Carter first peered inside and was asked if he could see anything, his famous reply was: "Yes, wonderful things."

The treasures that were unearthed have captivated the world and drawn millions to the Valley of the Kings.

Questions over why Tutankhamun died at about the age of 19, and rumours of a curse prematurely killing those involved with the excavation of his tomb, have only increased the pharaoh's fame.

## Researchers find cancer-inhibiting compound under the sea

GAINESVILLE, Fla. — University of Florida College of Pharmacy researchers have discovered a marine compound off the coast of Key Largo that inhibits cancer cell growth in laboratory tests, a finding they hope will fuel the development of new drugs to better battle the disease.

The UF-patented compound, largazole, is derived from cyanobacteria that grow on coral reefs. Researchers, who described results from early studies today (Aug. 7) at an international natural products scientific meeting in Athens, Greece, say it is one of the most promising they've found since the college's marine natural products laboratory was established three years ago.

An initial set of papers in the Journal of the American Chemical Society also has garnered the attention of other scientists, and the lab is racing to complete additional research. The molecule's natural chemical structure and ability to inhibit cancer cell growth were first described in the journal in February and the laboratory synthesis and description of the molecular basis for its anticancer activity appeared July 2.

"It's exciting because we've found a compound in nature that may one day surpass a currently marketed drug or could become the structural template for rationally designed drugs with improved selectivity," said Hendrik Luesch, Ph.D., an assistant professor in UF's department of medicinal chemistry and the study's principal investigator.

Largazole, discovered and named by Luesch for its Florida location and structural features, seeks out a family of enzymes called histone deacetylase, or HDAC. Overactivity of certain HDACs has been associated with several cancers such as prostate and colon tumors, and inhibiting HDACs can activate tumor-suppressor genes that have been silenced in these cancers.

Although scientists have been probing the depths of the ocean for marine products since the early 1960s, many pharmaceutical companies lost interest before researchers could deliver useful compounds because natural products were considered too costly and time-consuming to research and develop.

Many common medications, from pain relievers to cholesterol-reducing statins, stem from natural products that grow on the earth, but there is literally an ocean of compounds yet to be discovered in our seas. Only 14 marine natural products developed are in clinical trials today, Luesch said, and one drug recently approved in Europe is the first-ever marine-derived anticancer agent.

"Marine study is in its infancy," said William Fenical, Ph.D., a distinguished professor of oceanography and pharmaceutical sciences at the University of California, San Diego. "The ocean is a genetically distinct environment and the single, most diverse source of new molecules to be discovered."

The history of pharmacy traces its roots back thousands of years to plants growing on Earth's continents, used by ancient civilizations for medicinal purposes, Fenical added. Yet only in the past 30 years have scientists begun to explore the organisms in Earth's oceans, he said. Fewer than 30 labs exist worldwide and research dollars have only become available in the past 15 years.

HDACs are already targeted by a drug approved for cutaneous T-cell lymphoma manufactured by the global pharmaceutical company Merck & Co. Inc. However, UF's compound does not inhibit all HDACs equally, meaning a largazole-based drug might result in improved therapies and fewer side effects, Luesch said.

Since 2006, Luesch and his team of researchers have screened cyanobacteria provided by collaborator Valerie Paul, Ph.D., head scientist at the Smithsonian Marine Station in Fort Pierce. They check the samples for toxic activity against cancer cells and last year encountered one exceptionally potent extract — the one that ultimately yielded largazole.

To conduct further biological testing on the compound, Luesch and his team have been collaborating with Jiyong Hong, an assistant professor in the department of chemistry at Duke University, to replicate its natural structure and its actions in the laboratory.

Luesch said that within the next few months he plans to study whether largazole reduces or prevents tumor growth in mice.

Luesch has several other antitumor natural products from Atlantic and Pacific cyanobacteria in the pipeline.

"We have only scratched the surface of the chemical diversity in the ocean," Luesch said. "The opportunities for marine drug discovery are spectacular."

## Testosterone key to disease transmission

High levels of testosterone may be a key factor in spreading disease among mice, according to biologists. The findings could help explain why males in a population are often more likely to get infected, and transmit disease.

Previous research has linked testosterone, the male sex hormone, to immune system suppression. Studies have shown that males, compared to females, experience more bouts of disease, and account for a larger share of disease transmission. However, it is not fully clear what makes males such super-spreaders of disease.

"We know that testosterone makes males more susceptible to disease," said Daniel Grear, Penn State doctoral student in ecology. "We wanted to find out if it impacts their behavior as well and how that increases their ability to transmit disease."

Grear and his Penn State colleagues Sarah E. Perkins, postdoctoral fellow, and Peter J. Hudson, the Verne M. Willaman chair in biology and director of the Huck Institutes of Life Sciences at Penn State, investigated the effects of increased testosterone on mice behavior.

"Our plan was to raise the testosterone levels in wild mice and measure the disease risk they posed to the population," said Grear, who presented the team's findings today (Aug. 8) at the annual meeting of the Ecological Society of America in Milwaukee, Wis.

The researchers randomly treated 24 male mice trapped at five sites in Huntingdon County, Pa., with testosterone implants. Twenty-five other male mice received sham implants, while mice at three separate sites received neither treatment. All sites were trapped twice a week for six weeks before and after treatment.
The trapping sites were innovatively positioned to represent a large grid and mice were electronically tagged so researchers could keep precise track of where the animals were being recaptured. Such a social network, Grear explained, could help provide a clear picture of how the treated and untreated mice mix on the grids over time. Tests on recaptured mice indicated that the average number of contacts made between both males and females by mice that received the treatment -- sham and testosterone -- increased significantly increased after treatment.

In other words, all mice were mixing more when testosterone treated mice were present.

Researchers also found that all mice at the separate untreated sites made significantly less contacts with other mice during the same time that the testosterone treatment significantly increased contacts.

"These findings suggest that even if some individuals in a population have high levels of testosterone, they can impact the behavior of those around, and drive the transmission of diseases transmitted by close contact such as the respiratory pathogen bordetella," explained Grear, whose work is funded by the National Science Foundation.

## PSA screening may be biased against obese men, leading to more aggressive cancers

DURHAM, N.C. -- Testing men for elevated levels of prostate-specific antigen (PSA) in the blood -- the gold standard screening test for prostate cancer -- may be biased against obese men, whose PSA levels tend to be deceptively low. And this bias may be creating more aggressive cancers in this population by delaying diagnosis, according to a new study led by investigators in the Duke Prostate Center and the Durham Veterans Affairs (VA) Medical Center.

"We know that obese men tend to have lower PSA values than their normal-weight counterparts, possibly caused by larger blood volumes which dilute the readings," said Stephen Freedland, M.D., a urologist at Duke and the Durham VA, and lead investigator on this study. "Now we know some of the real implications of this -- that these men are at a disadvantage in terms of prognosis compared to normal-weight men."

The researchers published their findings online in the journal BJU International. The study was funded by the United States Department of Veterans Affairs, the National Institutes of Health, the Georgia Cancer Coalition, the United States Department of Defense, the Prostate Cancer Research Program and the American Urological Association Foundation's Astellas Rising Star in Urology Award, given to Freedland.

"We used patient data to examine the association between body mass index, or BMI -- a measure of obesity -- and the amount of disease discovered after surgery to remove the prostate, " Freedland said. "We compared men who had their cancers detected by PSA screening to those who had an abnormal digital rectal exam, which may not confer the same bias against obese men."

The researchers looked at a total of nearly 3,400 men in the years since 2000, when PSA screening became the gold standard test for prostate cancer.

Obese patients whose cancer was diagnosed by PSA testing had more than twice the risk of cancer recurrence after surgery than their normal-weight counterparts, Freedland said. "In contrast, obese men with abnormal digital rectal exams had similar outcomes as normal-weight men," Freedland said.

Another Duke study published in the same issue of the journal provides further substantiation of the concern that obese men have poorer prognoses than normal-weight men. This study showed that obese men have a higher rate of positive surgical margins after surgery to remove the prostate, meaning that there was a higher chance cancer was left behind.

This suggests that prostate cancer surgery is technically more challenging in obese men, making complete tumor removal harder, according to Jayakrishnan Jayachandran, M.D., a urological oncology fellow at Duke and lead investigator on the second study.

"The aggressiveness of obese men's tumors, coupled with the fact that they may be more difficult to remove, is like a double whammy for being obese," Jayachandran said.

"The least we can do is find a way to level the playing field when it comes to diagnostic tools," Freedland said.

PSA screening has been the most common tool used to detect prostate cancer over the past eight to ten years; men are less commonly diagnosed based on digital rectal exam alone.

The researchers are hopeful that this data, coupled with the earlier data on which it builds, may be a catalyst to encourage alternative screening methods for obese men, or a lower threshold for worrisome PSA levels in obese men.

"Obesity is very common in the United States, so this potentially affects a lot of people," Freedland said. "We can't forget that when we use the term obese we are not just talking about very, very large men. A man who is 5 foot 9 and weighs 203 pounds would be considered obese."

*Other researchers involved with the PSA study include Leon Sun and Judd Moul of Duke; Christopher Kane of the University of California – San Diego; Joseph Presti of Stanford; Martha Terris of the Medical College of Georgia; and William Aronson of the University of California – Los Angeles.*

## First Neanderthal genome completed

* 17:00 07 August 2008
* NewScientist.com news service
*** Ewen Callaway**

A 38,000-year old bone has yielded the world's first complete Neanderthal mitochondrial genome sequence, offering a tantalising glimpse at the genetic changes that separate humans from Neanderthals, which split some 600 millennia ago. The mitochondrion – a structure often dubbed the cell's powerhouse – contains a mere 16,565 DNA letters that code for 13 proteins, whereas the nucleus holds more than 3 billion letters that produce more than 20,000 proteins. If DNA were to the size of a standard soccer pitch, then mitochondrial DNA (mtDNA) would be equivalent to a small flowerbed.

For the time being therefore, the largely symbolic and technical breakthrough offers only limited insight into the evolution of humankind. "It's kind of opening the window a crack," says Tom Gilbert, an expert on ancient DNA at the University of Copenhagen, who was not involved in the sequencing project.

Yet the research, led by Richard Green and Svante Pääbo of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, will pave the way for the construction and analysis of the complete Neanderthal genome. A rough draft should be finished by the end of the year, Green told New Scientist.

**No sex, please**

This is not to say that such mtDNA sequences are of no use to scientists. Previous work on shorter stretches of Neanderthal mtDNA has dated their last common ancestor with humans to about 660,000 years ago, give or take 140,000 years. We know also that humans and Neanderthals didn't interbreed enough to leave a mark in either genome. The new, complete sequence firms up these conclusions.

The code also offers tantalising clues to Neanderthal life and human evolution.

When Green's team compared the protein-making portion of Neanderthal mtDNA to that of other primates, they found a pattern of genetic differences suggesting that either Neanderthals were evolving rapidly or that they lived in small groups, which would reduce genetic mixing. Green and Gilbert both favour the latter interpretation because Neanderthals lived as hunter-gatherers, a lifestyle unsuited for large groups.

**Evolutionary clues**

One particular gene hints at a potentially important change in human evolution.

The DNA code for COX2, a gene involved in making cellular energy, varies enough between Neanderthals and humans to change its encoded protein at four places. The differences might affect how active the protein is, though it's equally likely that the mutations are a fluke of human evolution, Green says.

Moreover, other such substantive differences between human and Neanderthal genes and proteins should point the way to what makes humans unique from other primates. "The Neanderthal can let us know where to look for things that might be important in recent human evolution," Green says.

Less glamorously, the newly minted mitochondrial genome offers important technical insights into constructing and verifying far larger ancient genomes.

DNA crumbles somewhat predictably over time, and efforts to rebuild samples that are thousands of years old can introduce errors. Based on the Neanderthal mtDNA sequence in which each letter was read 35 times on average, Green's team can now predict and correct potential errors in other ancient DNA sequences.

Gilbert notes that Green's team went to extraordinary feats to prove that the Neanderthal sequence was unsullied by the DNA of its human handlers. Such bona fides should carry over to the complete genome, he says.

“When they do get the genome we can rely on it – really, that what we're getting is Neanderthal, not human.”

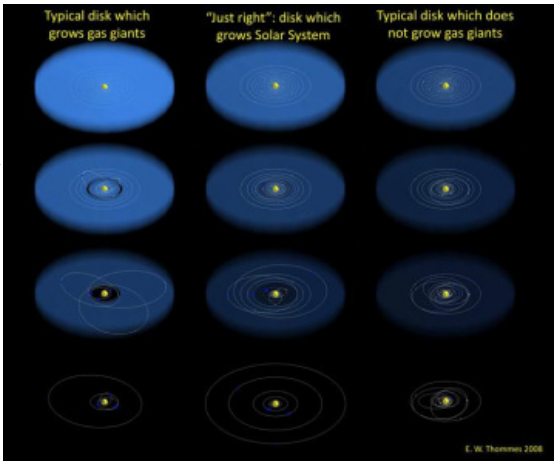
*Journal reference: Cell (DOI: 10.1016/j.cell.2008.06.021)*

## Solar systems like ours may be rare

* 19:13 07 August 2008
* NewScientist.com news service
*** Jeff Hecht**

Our solar system is a Goldilocks among planetary systems. Conditions have to be just right for a disc of dust and gas to coalesce into such a set of neatly ordered planets, a new computer model suggests.

Similar planetary systems are likely to be a minority in the galaxy, says model developer Edward Thommes of the University of Guelph in Ontario, Canada. Even so, if only 1% of the Milky Way's hundreds of billions of stars have a terrestrial planet with a stable orbit in the habitable zone, the Earth could have plenty of company.




Astronomers long thought planets orbited where they formed, with small terrestrial planets close to the star, gas giants near the middle, and smaller ice giants such as Neptune towards the edge of a 'protoplanetary' disc of gas and dust before it dissipated.
But the discovery of "hot Jupiters" – gas giants orbiting close to their stars – since 1995 gave powerful evidence that planets could migrate.

To understand why planetary systems differ, Thommes and colleagues decided to study how various types of protoplanetary discs evolved over time.

**Left***: Planet-forming discs with higher mass and viscosity tend to produce two or more gas giants which migrate inwards toward the star).* **Right***: Discs with lower mass and viscosity tend to dissipate earlier, producing larger numbers of much smaller planets that jostle each other about after the disc dissipates* **(Illustration: E Thommes et al.)**

### Complex interactions

Standard simulations need large amounts of computer time to model the complex interactions among multiple growing planets and their disc material. So Thommes reduced computing time by dividing the disc into a series of rings, rather than into smaller chunks, and by treating interactions between planets separately.

This allowed runs to last 10 million simulated years – long enough for all the disc material that hadn't collected into planets to fall into the star.

The team used 100 different sets of disc properties – varying the disc's mass from between 1% and 10% that of the Sun, as well as its viscosity.

They found that discs with higher mass and viscosity tend to produce two or more gas giants which migrate inwards towards the star. Discs with lower mass and viscosity tend to dissipate earlier, producing larger numbers of much smaller planets, which jostle each other after the disc dissipates.

### Less migration

Only in a few intermediate cases – six out of the 100 runs – did the model produce gas giants about as far from the Sun-sized model star as Jupiter is from our Sun. And in only one case did the gas giants resemble Jupiter and Saturn.

This middle range "is more peaceful because there isn't as much planetary migration and not quite as many planets forming", Thommes told New Scientist.

But he says the model can't predict the exact fraction of solar-like planetary systems in the galaxy. That's because planetary formation is a chaotic process, and initial disc conditions are poorly known.

Other astronomers think the new study is an important advance. "The idea is probably qualitatively right," says Hal Levison of the Southwest Research Institute in Boulder, Colorado, who calls Thommes's technique "a breakthrough". But he warns that the model needs a lot of refinement before it can produce solid estimates of the types of planetary systems. *Journal reference: Science (vol 321, p 814)*

## Mystery killer disease may be spread by vampire bats

* 11:38 08 August 2008
* NewScientist.com news service
*** Ewen Callaway**

A mysterious illness has killed at least 38 people in a remote patch of South American rain forest in recent months. Most, if not all, of the dead are Warao, an indigenous tribe native to north-eastern Venezuela. The nation's health authorities are just beginning to tackle the disease, while early indications may point to bat-transmitted rabies, according to The New York Times.

***Vampire bat (Desmodus rotundus)*** **(Image: Wikimedia commons)**

However, without epidemiological studies and confirmatory lab work, that conclusion remains speculative, says Charles Rupprecht, a tropical disease expert at the US Centers for Disease Control and Prevention in Atlanta. "One would hope that at least there is a proper field investigation going on," he tells New Scientist.

Rabies outbreaks, often spread by infected vampire bats, are not unheard of in South America, says Hervé Bourhy, a virologist at the Pasteur Institute in Paris, France. Yet they account for a fraction of the 50,000 to 60,000 rabies deaths worldwide each year, most of them in Asia and Africa and spread by dogs, he says.

**Bat preferences**

Vampire bats prefer to lunch on cattle and other livestock, but protective nets often keep the bats away from these animals. In search of a blood meal, many turn to humans sleeping out of doors or in open-air houses.

"It's probably a problem of poverty in the sense that, in fact, most of the people that are dying are those that are living outside and bitten during their sleep," Hervé says.

For those unfortunate enough to contract rabies in a remote area, "it is a death sentence", says virologist Charles Calisher of Colorado State University in Fort Collins. Vaccines offer some hope after exposure, but are often unavailable. "People out in the middle of nowhere are not going to be vaccinated with an expensive vaccine. It's 150 bucks a shot and there's not much around," he says.

**Emerging disease?**

Rupprecht, who has previously trapped vampire bats in South American jungles, still isn't sure that the disease affecting the Warao is indeed rabies. Many of the victims have lived longer than is typical for rabies, and previous vampire bat infections have often involved ecological changes brought on by logging, mining and damming. Another emerging disease could underlie the outbreak, he says. "There's a whole suite of things that can be found in the American tropics."

Moreover, the current outbreak may represent a baseline level of infection and nothing extraordinary, he says. "The vast majority or people who die of rabies in these situations are never counted."

Two American researchers living among the Warao, anthropologist Charles Briggs of the University of California, Berkeley, and his wife medical researcher Clara Mantini-Briggs, have called on Venezuela's government to tackle the disease. "The authorities must investigate this outbreak with extreme urgency," Mantini-Briggs told The New York Times.

**History**

## Love of Milk Dated Back to 6000 B.C.

**By Andrea Thompson**, Senior Writer

The answer to "Got milk?" just got a little older: A new study indicates that people have been milking cattle and other domesticated animals as well as processing and storing milk products for 2,000 years longer than originally thought.

A group of scientists studied thousands of pottery shards from sites all over the Near East and the Balkans and tested them for residues of milk fats. They found that milk was already being used and processed by societies there by the seventh millennium B.C. Previously, the earliest evidence of milk use came from the fifth millennium, though cattle, sheep and goats had already been domesticated by the eighth millennium.

The traces of milk fats can survive on the pottery, even after being buried for thousands of years, because the fats are hydrophobic, so they don't dissolve in water, and they are produced in large amounts, said study leader Richard Evershed of the University of Bristol in England.

Ceramic vessels are very porous, so if you store or cook animal products in them, "the pottery vessels pick up that organic matter like crazy," Evershed told LiveScience.

The residues don't indicate the presence of milk itself, as those would decay away very quickly, but instead suggest more processed dairy substances, such as butter, yogurt, ghee (or clarified butter), and possibly cheese, though cheese is largely altered by microbes and so may not leave a recognizable dairy signature, Evershed said.

Evershed and his colleagues were surprised that they found the most residues in sites in Anatolia (most of modern Turkey), which lies outside the traditional Fertile Crescent region where agriculture was first developed.

To see why milk production seemed to be more important in Anatolia than in the other sites, the team looked at animal bones and found a strong correlation between the number of cattle bones present at a site and the prevalence of milk residues.

"So it looks like there's a linkage between the importance of dairy, of cattle and the production of dairy products," Evershed said, pointing out that this is much the situation in the world today, where cattle are the main source of dairy products. Evershed said that the region in Anatolia around the Sea of Marmara was supposedly very lush, and so "it might have been that the conditions were just right for grazing cattle."

Because Anatolia is outside of the Fertile Crescent, it also suggests that the various pieces of domestication didn't evolve in a linear order and that some aspects, such as milk production, may have only boomed in the right places when the conditions were ripe. *The results of the study are detailed in the Aug. 7 issue of the journal Nature.*

**Cases**

## The Germs Are Potent. But So Is a Kiss.

**By MANOJ JAIN, M.D**

"I have been waiting to see you, and I want answers now," my patient said angrily as I entered her hospital room. Like a silent guard, her husband stood three feet from her, costumed in olive-green gloves and a bright yellow paper gown.

My patient was a 75-year-old retired middle manager with a schoolteacher's voice and air of confidence. She had been hospitalized for more than a month with a failing heart and recurrent hospital-acquired infections that had required multiple rounds of antibiotics.

The night before, a culture from her urine had yielded a drug-resistant germ called VRE, and she had been placed in "contact isolation" — meaning that everyone entering the room had to wear gloves and a gown, even her husband of 57 years. In the tone of an upset customer at a department store, she said, as I recall: "Every morning I get a kiss from my husband, but this morning I didn't. I want an explanation."

Like the better-known MRSA, VRE is a so-called multidrug-resistant organism, able to survive an assault from powerful antibiotics. Half a century ago these bugs did not exist; a decade ago they were rare; today, nearly 30 percent of the Enterococcus bacteria collected from cultures in hospitals are VRE, and 60 percent of the Staphylococcus aureus are MRSA.

Their emergence is an unintended consequence of our use (and overuse) of antibiotics. Hardy organisms like MRSA evolve to withstand the drugs; then, through vectors like the unwashed hands of health care workers, they hitch a ride from patient to patient, hiding like terrorists among the natural bacteria that all humans harbor.

And when a severely ill patient is further compromised by tubes in a vein, the bladder or the lung, the bacteria flourish in defiance of the usual treatments, leading to infections of the urinary tract, bloodstream and lungs. The Centers for Disease Control and Prevention estimates that there are 1.7 million hospital infections a year, resulting in nearly 90,000 deaths, costing the health system more than $11 billion.

Contact isolation is part of the battle plan to control the spread of drug-resistant organisms. And it is effective, as long as everyone complies. Remember SARS? In that case, respiratory and contact precautions were credited with stopping the epidemic.

Sadly, studies show that nearly 30 percent of health care workers don't comply. I can understand why such measures are hard to enforce, because isolation precautions create a barrier between patients and their caregivers. At times, patients in isolation reach out to shake or hold my hand before I've put my gloves on. Sometimes I allow myself to touch patients without gloves, partly because the separation makes me feel I am shunning them, as if the hospital were an ancient leper colony.

And isolation barriers can be dangerous for patients. Two studies showed that doctors and nurses were half as likely to enter the rooms of or to examine patients on contact precautions. One study has even shown that patients in isolation have significantly more preventable adverse events, get less care and are more dissatisfied with their treatment than other patients.

Unlike other treatment, contact isolation does not benefit the patient in isolation; rather, it benefits other hospitalized patients and the community. Our goal is to contain the spread of the resistant organism from one patient to another, through health care workers. But family members, who are also subject to the same glove-and-gown requirements, are not nearly as likely to spread the organisms to other patients. In fact, there are no formal, enforceable recommendations for family members.

In the end, I believe, it is contact precaution and prudent use of antibiotics — and not new antibiotics or advanced technologies — that will save us from multidrug-resistant organisms. So the best I can do is to provide a long explanation to the patient and family, and hope they will comply, within reason. This is exactly what I did.

"Last night," I told my patient, "the lab had called and said that your urine culture was showing a resistant organism. To make sure the organism does not spread to other patients through health care workers, we need to have people wear gloves and gown."

But in this case, I also took some liberty with hospital policy; after all, the isolation recommendations are murky when it comes to family members. I said, "It is O.K. for him to kiss you."

"Now you can kiss me," my patient told her husband. With me standing just a few feet away, he hesitated for a second. And as his yellow gown draped over her and his green gloves held her shoulders, he gave her a long wedding kiss. I felt like a yellow-gowned chaplain who had just remarried a couple.

*Manoj Jain is an infectious disease physician in Memphis.*

## Fingerprint Test Tells What a Person Has Touched

**By KENNETH CHANG**

With a new analytical technique, a fingerprint can now reveal much more than the identity of a person. It can now also identify what the person has been touching: drugs, explosives or poisons, for example.

Writing in Friday's issue of the journal Science, R. Graham Cooks, a professor of chemistry at Purdue University, and his colleagues describe how a laboratory technique, mass spectrometry, could find a wider application in crime investigations.

The equipment to perform such tests is already commercially available, although prohibitively expensive for all but the largest crime laboratories. Smaller, cheaper, portable versions of such analyzers are probably only a couple of years away.

In Dr. Cooks's method, a tiny spray of liquid that has been electrically charged, either water or water and alcohol, is sprayed on a tiny bit of the fingerprint. The droplets dissolve compounds in the fingerprints and splash them off the surface into the analyzer. The liquid is heated and evaporates, and the electrical charge is transferred to the fingerprint molecules, which are then identified by a device called a mass spectrometer. The process is repeated over the entire fingerprint, producing a two-dimensional image.

The researchers call the technique desorption electrospray ionization, or Desi, for short.

In the experiments described in the Science paper, solutions containing tiny amounts of various chemicals including cocaine and the explosive RDX were applied to the fingertips of volunteers. The volunteers touched surfaces like glass, paper and plastic. The researchers then analyzed the fingerprints.

Because the spatial resolution is on the order of the width of a human hair, the Desi technique did not just detect the presence of, for instance, cocaine, but literally showed a pattern of cocaine in the shape of the fingerprint, leaving no doubt who had left the cocaine behind.

"That's an advantage that this technique would have," said Bruce Goldberger, professor and director of toxicology at the University of Florida who runs a forensics laboratory that helps medical examiners and law enforcement. Dr. Goldberger was not involved in the research.

The chemical signature could also help crime investigators tease out one fingerprint out of the smudges of many overlapping prints if the person had been exposed to a specific chemical, said Demian R. Ifa, a postdoctoral researcher and the lead author of the Science paper.

Prosolia Inc., a small company in Indianapolis, has licensed the Desi technology from Purdue and is already selling such analyzers as add-ons to large laboratory mass spectrometers, which cost several hundred thousand dollars each.

Prosolia has so far sold about 70 analyzers, said Peter T. Kissinger, the company's chairman and chief executive. The most sophisticated $60,000 version that would be needed for fingerprint analysis went on sale this year.

However, fingerprints are not the main focus for Prosolia or Dr. Cooks. "This is really just an offshoot of a project that is really aimed at trying to develop a methodology ultimately to be used in surgery," Dr. Cooks said.

If a Desi analyzer can be miniaturized and automated into a surgical tool, a surgeon could, for example, quickly test body tissues for the presence of molecules associated with cancer. "That's the long-term aim of this work," Dr. Cooks said.

In unpublished research, the researchers have successfully tested the method on bladder tumors in dogs.

Prosolia is collaborating with Griffin Analytical Technologies, a subsidiary of ICx Technologies, on a Desi analyzer that works with a portable mass spectrometer. That product is probably a year or two away from the market, Dr. Kissinger said.

As it becomes cheaper and more widely available, the Desi technology has potential ethical implications, Dr. Cooks said. Instead of drug tests, a company could surreptitiously check for illegal drug use by its employees by analyzing computer keyboards after the workers have gone home, for instance.

## Unlocking mystery of why dopamine freezes Parkinson's patients

***Dopamine reshapes key brain circuits that control behavior***

CHICAGO -- Parkinson's disease and drug addiction are polar opposite diseases, but both depend upon dopamine in the brain. Parkinson's patients don't have enough of it; drug addicts get too much of it. Although the importance of dopamine in these disorders has been well known, the way it works has been a mystery.

New research from Northwestern University's Feinberg School of Medicine has revealed that dopamine strengthens and weakens the two primary circuits in the brain that control our behavior. This provides new insight into why a flood of dopamine can lead to compulsive, addictive behavior and too little dopamaine can leave Parkinson's patients frozen and unable to move.

"The study shows how dopamine shapes the two main circuits of the brain that control how we choose to act and what happens in these disease states, " said D. James Surmeier, lead author and the Nathan Smith Davis Professor and chair of physiology at the Feinberg School. The paper is published in the August 8 issue of the journal Science.

These two main brain circuits help us decide whether to act out a desire or not. For example, do you get off the couch and drive to the store for an icy six-pack of beer on a hot summer night, or just lay on the couch?

One circuit is a "stop" circuit that prevents you from acting on a desire; the other is a "go" circuit that provokes you to action. These circuits are located in the striatum, the region of the brain that translates thoughts into actions.

In the study, researchers examined the strength of synapses connecting the cerebral cortex, the region of the brain involved in perceptions, feelings and thought, to the striatum, home of the stop and go circuits that select or prevent action.

Scientists electrically activated the cortical fibers to simulate movement commands and boosted the natural level of dopamine. What happened next surprised them. The cortical synapses connecting to the "go" circuit became stronger and more powerful. At the same time, dopamine weakened the cortical connections in the "stop" circuit.

"This could be what underlies addiction," Surmeier said. "Dopamine released by drugs leads to abnormal strengthening of the cortical synapses driving the striatal 'go' circuits, while weakening synapses at opposing 'stop' circuits. As a result, when events associated with drug taking – where you took the drug, what you were feeling – occur, there is an uncontrollable drive to go and seek drugs."

"All of our actions in a healthy brain are balanced by the urge to do something and the urge to stop," Surmeier said. "Our work suggests that it is not just the strengthening of the brain circuits helping select actions that is critical to dopamine's effects, it is the weakening of the connections that enable us to stop as well. "

In the second part of the experiment, scientists created an animal model of Parkinson's disease by killing dopamine neurons. Then they looked at what happened when they simulated cortical commands to move. The result: the connections in the "stop" circuit were strengthened, and the connections in the "go" circuit were weakened.

"The study illuminates why Parkinson's patients have trouble performing everyday tasks like reaching across a table to pick up a glass of water when they are thirsty," Surmeier said.

Surmeier explained the phenomenon using the analogy of a car. "Our study suggests that the inability to move in Parkinson's disease is not a passive process like a car running out of gas," he said. "Rather, the car doesn't' move because your foot is jammed down on the brake. Dopamine normally helps you adjust the pressure on the brake and gas pedals. It helps you learn that when you see a red light at an intersection, you brake and when the green light comes on, you take your foot off the brake and depress the gas pedal to go. Parkinson's disease patients, who have lost the neurons that release dopamine, have their foot perpetually stuck on the brake."

Understanding the basis for these changes in brain circuitry moves scientists closer to new therapeutic strategies for controlling these brain disorders and other involving dopamine like schizophrenia, Tourette's syndrome and dystonia.

## Eat kangaroo to 'save the planet'

***Switching from beef to kangaroo burgers could significantly help to reduce greenhouse gas emissions, says an Australian scientist.***

The methane gas produced by sheep and cows through belching and flatulence is more potent than carbon dioxide in the damage it can cause to the environment. But kangaroos produce virtually no methane because their digestive systems are different. Dr George Wilson, of the Australian Wildlife Services, urges farming them. He says they have a different set of micro-organisms in their guts to cows and sheep.

Sheep and cattle account for 11% of Australia's carbon footprint and over the years, there have been various proposals to deal with the problem. Now Dr Wilson believes kangaroos might hold the answer. He said: "It tastes excellent, not unlike venison - only a different flavour."

The country already produces 30 million kangaroos farmed by landholders in the outback. But Dr Wilson is keen to see that population dramatically increased to produce the same amount of kangaroo meat as that currently produced by conventional livestock.

# To Heal the Wounded

**By DONALD G. McNEIL Jr.**

*Science Times Podcast (mp3)*

The pictures show shredded limbs, burned faces, profusely bleeding wounds. The subjects are mostly American G.I.'s, but they include Iraqis and Afghans, some of them young children.

They appear in a new book, "War Surgery in Afghanistan and Iraq: A Series of Cases, 2003-2007," quietly issued by the United States Army — the first guidebook of new techniques for American battlefield surgeons to be published while the wars it analyzes are still being fought.

Its 83 case descriptions from 53 battlefield doctors are clinical and bone dry, but the gruesome photographs illustrate the grim nature of today's wars, in which more are hurt by explosions than by bullets, and body armor leaves many alive but maimed.

And the cases detail important advances in treating blast amputations, massive bleeding, bomb concussions and other front-line trauma.

Though it is expensively produced and includes a foreword by the ABC correspondent Bob Woodruff, who was severely injured by a roadside bomb in 2006, "War Surgery" is not easy to find. There were strenuous efforts within the Army over the last year to censor the book and keep it out of civilian hands.

Paradoxically, the book is being issued as news photographers complain that they are being ejected from combat areas for depicting dead and wounded Americans.

But efforts to censor the book were overruled by successive Army surgeons general. It can be ordered from the Government Printing Office for $71; Amazon.com lists it as out of stock, but the Borden Institute, the Army medical office that published it, said thousands more copies would be printed.

"I'm ashamed to say that there were folks even in the medical department who said, Over my dead body will American civilians see this," said Dr. David E. Lounsbury, one of the book's three authors. Dr. Lounsbury, 58, an internist and retired colonel, took part in the 1991 and 2003 invasions of Iraq and was the editor of military medicine textbooks at Walter Reed Army Medical Center.

"The average Joe Surgeon, civilian or military, has never seen this stuff," Dr. Lounsbury said. "Yeah, they've seen guys shot in the chest. But the kind of ferocious blast, burn and penetrating trauma that's part of the modern I.E.D. wound is like nothing they've seen, even in a Manhattan emergency room. It's a shocking, heart-stopping, eye-opening kind of thing. And they need to see this on the plane before they get there, because there's a learning curve to this."

The pictures of wounded children include some of a 5-year-old shot in a vehicle trying to run through a checkpoint. Other pictures show wounds riddled with dirt, genitals severed by a roadside bomb, a rib — presumably that of a suicide bomber — driven deep into a soldier's body, and the tail of an unexploded rocket protruding from a soldier's hip.

There are moments that reflect the desperation in the invaded country: an Afghan in the jaw-locked rictus of tetanus after home-treating a foot blown off by a landmine. And moments that reflect the modern American army: a soldier with unexplained pelvic pain that turns out to be a life-threatening ectopic pregnancy.

The book was created to teach techniques that surgeons adopted, abandoning old habits.

For example, they no longer pump saline into a patient with massive trauma to try to get the blood pressure back up to 120. "You do that, you end up with a highly diluted, cold patient with no clotting factors, and the high pressure restarts bleeding," Dr. Lounsbury said. Instead, they try to bring it up to just 80 or 90 with red cells and extra platelets, which encourage clotting.

Also, initial surgery even on a severely wounded patient may be brief — just enough to control hemorrhaging and prevent contamination by a torn bowel. Then the patient is returned to intensive care to warm up, raise the blood pressure and restore the electrolyte balance. The next operation is usually just enough to stabilize the patient for transport to a more sophisticated hospital, perhaps in Baghdad or Kabul, in Germany or the United States.

The book describes a surgeon who erred fatally by trying to do too much — a four-hour operation on a soldier who had lost a leg to a roadside bomb. The effort drained the forward hospital's blood bank, and the patient died on the helicopter to the next hospital.

Also, neurosurgeons treating a blast victim now quickly remove a large section of the skull to relieve pressure, even if no shrapnel has penetrated. Such patients are sometimes able to walk and talk after a blast but then collapse and die as their brain swells.

The procedure is described by the surgeon who saved Mr. Woodruff's life that way.

Amputations have also changed. Dr. Lounsbury's brother lost both legs and an arm in Vietnam, and in those days clean "guillotine" amputations were done as high as possible. Now surgeons try to preserve as much bone and flesh as they can, even if the stump is unsightly. Modern prosthetics are molded to it.

Doctors have also become quicker to diagnose "compartment syndrome" even in patients too sedated to feel pain; swelling in an injured muscle can cut off the blood supply, leading to gangrene and amputation. Surgeons now "fillet" the muscles to relieve the pressure, often even before it builds, since restitching healthy tissue is better than losing a limb.

And when morphine is not enough, nerve blocks — internal drips of local anesthetic, often given by a small pump held by the patient — have become common in pain control.

Dr. Ramanathan Raju, chief medical officer for the New York City Health and Hospitals Corporation and a former trauma surgeon, viewed the book and said it would be "extremely useful" to civilian surgeons because of what it teaches about blast injuries and when a surgeon should stop to let a patient recover.

"The Army should be very happy about this," Dr. Raju said. "In the past, people said, Oh, Army surgeons are like butchers, they're not research oriented. This shows how skillful they are."

One of the book's most powerful aspects is its juxtaposition of operating room photographs with those of the war outside the tent. It is filled with random shots — burning vehicles, explosions, a medic carrying a child, another in a Santa Claus hat. It also has portraits of soldiers, often dazed and exhausted; one even has tears on his cheek.

Many are by David Leeson of The Dallas Morning News, who was embedded with the Third Infantry Division during the Iraq invasion and won a Pulitzer Prize for his coverage.

Even more humanizing are photos of recovered patients: an Iraqi whose jaw was destroyed shown with it rebuilt, a soldier who lost half of his skull smiling at a ceremonial dinner with his wife, a soldier whose face was pulverized by a blast looking scarred but handsome a year later.

Military censors suggested numerous changes, including removing photos showing burning vehicles and the faces of any American wounded. They also wanted to excise references to branches of service and how injuries occurred.

For example, according to unclassified e-mail provided by the authors, one suggested removing this description: "A helmeted soldier suffered a forehead injury during the explosion of an improvised explosive device. He was a front seat passenger" in a Humvee. The censor suggested: "A 22-year-old male was hurt in a blast."

Two in the chain of command who raised such objections — one civilian and one officer — said they did so only out of concern for patients' privacy and for security reasons. For example, they said, mentions of wound patterns might tell the enemy that helmets and Humvees were vulnerable.

But the authors argued that it was crucial for surgeons to expect wounds behind armor and absurd to conceal that they occurred.

"The enemy knows that," said Dr. Stephen P. Hetz, a retired colonel and co-author.

They also argued that the book was dedicated to soldiers and marines and that the wounded were proud to be identified as such. All whose faces were fully shown, whether American, Iraqi or Afghan, had given written permission, they said. If it was not obtained, patients' eyes were covered with black bars. The random war photos, they argued, were as much as five years old and some had been in newspapers, so they would give enemies no useful information.

Censors also tried to prevent the book from getting a copyright and the international standard book number letting it be sold commercially, Dr. Lounsbury said.

Ultimately, they were overruled.

Kevin C. Kiley, a retired lieutenant general who was the Army's surgeon general when the book was being prepared, said some higher-ups in the military had been worried that the pictures "could be spun politically to show the horrors of war."

"The counter-argument to that, which I concurred with," Dr. Kiley said, "was that this is a medical textbook that could save lives."

He said it "absolutely" ought to be available to civilians, particularly to surgeons.

Dr. Hetz said that as a West Point graduate and onetime infantry officer — and as a former aide to two surgeons general, to whom he could appeal directly — he always had more faith than Dr. Lounsbury that the book would ultimately not be suppressed.

"There was never any doubt in my mind that the Army would publish this," he said. "It was just a matter of getting around the nitwits."