

Increased levels of certain cytokines and chemokines predict onset of rheumatoid arthritis

Copenhagen, Denmark, Saturday 13 June 2009: Up-regulation of certain cytokines and chemokines (signaling molecules involved in the functioning of the immune system) can predict the development of rheumatoid arthritis (RA) three years before the onset of symptoms, according to the results of a new study presented today at EULAR 2009, the Annual Congress of the European League Against Rheumatism in Copenhagen, Denmark.

The results of the study showed that up-regulation of certain cytokines (specifically Th1, Th2 and Treg) involved in the growth and proliferation of various cells integral to the immune system, predicted which individuals go on to develop RA. Interestingly, post-disease onset, chemokines, stromal cell and angiogenic-related markers were important in differentiating up-regulation in those who had developed RA compared to findings in the same individual before symptoms of RA.

Cytokines and chemokines are small signalling molecules which are integral to the immune system, as they mediate and regulate immunity, inflammation, and the development of blood cells (haematopoiesis). In this study, several of these molecules, as well as some cytokine receptors, showed significantly increased levels before disease onset compared with controls (median 3.3 years before symptoms), indicating general immune activation ($p < 0.05-0.001$)* and therefore a progression of disease activity.

The levels were seen to be particularly elevated in individuals identified as being ACPA- (anti-citrullinated peptide antibody) and RF- (rheumatoid factor) positive (both known risk factors for RA), and most of the concentrations increased further after disease onset. Notably, the concentration of interleukin 17 (IL-17, a cytokine which acts as a regulator of multiple immune functions) was found to be significantly higher before onset compared with post-diagnosis ($p > 0.01$).

Prof Solbritt Rantapää Dahlqvist, of the University Hospital Umeå, Sweden, who led the study said: "Our findings add another important piece to the complex puzzle of pathophysiological processes responsible for the occurrence of RA. Understanding more about what happens in the body, to precipitate the onset of RA, could potentially contribute to the development of new strategies for the treatment and even prevention of this debilitating disease."

This nested case-control study (whereby new case controls were applied into a cohort that was defined before the study began, at a rate of 1 case:3 controls) was performed in individuals ($n=86$, 65 females, 21 males) who had donated blood to the Medical Biobank of Northern Sweden (median 3.3 years) before onset of disease; and matched controls ($n=256$, 191 females, 61 males) from the same Biobank. At the time of RA diagnosis (using American College of Rheumatology (ACR) criteria), 69 (52 females and 17 males) individuals donated blood samples.

30 cytokines, cytokine receptors and chemokines** were measured in plasma samples using multiplex detection kits from Bio-Rad analysed by a Bio-Plex Array Reader (Luminex200, Labmap™ system).

*The cytokines, cytokine receptors and chemokines that were increased prior to disease onset included: IL-1, IL-2, IL-6, IL-7, IL-1RA, TNF-VEGF, Th1 (IFN-, IL-12), Th2 (IL-4, Eotaxin), Treg (IL-10) and chemokines MCP-1 and MIP-1.

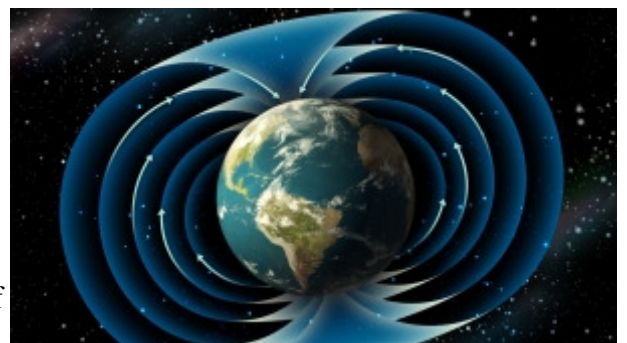
**The 30 cytokines, cytokine receptors and chemokines that were investigated in total for links to onset of RA included: IL-1 β , IL-1RA, IL-2, IL-4, IL-5, IL-6, IL-7, IL-8, IL-9, IL-10, IL-12, IL-13, IL-15, IL-17, Eotaxin, basic FGF, G-CSF, GM-CSF, IFN-, IP-10, MCP-1, MIP-1, MIP-1, PDGF-BB, RANTES, TNF-, VEGF, MIG, MIF and IL-2R.

The Earth's magnetic field remains a charged mystery

Institute of Physics News

400 years of discussion and we're still not sure what creates the Earth's magnetic field, and thus the magnetosphere, despite the importance of the latter as the only buffer between us and deadly solar wind of charged particles (made up of electrons and protons). New research raises question marks about the forces behind the magnetic field and the structure of Earth itself.

The controversial new paper published in New Journal of Physics (co-owned by the Institute of Physics and the German Physical Society), 'Secular variation of the Earth's magnetic field: induced by the ocean flow?', will deflect geophysicists' attention from postulated motion of conducting fluids in the Earth's core, the twentieth century's answer to the mysteries of geomagnetism and magnetosphere.



Magnetic field

Professor Gregory Ryskin from the School of Engineering and Applied Science at Northwestern University in Illinois, US, has defied the long-standing convention by applying equations from magnetohydrodynamics to our oceans' salt water (which conducts electricity) and found that the long-term changes (the secular variation) in the Earth's main magnetic field are possibly induced by our oceans' circulation.

With calculations thus confirming Ryskin's suspicions, there were also time and space correlations - specific indications of the integral relationship between the oceans and our magnetospheric buffer. For example, researchers had recorded changes in the intensity of current circulation in the North Atlantic; Ryskin shows that these appear strongly correlated with sharp changes in the rate of geomagnetic secular variation ("geomagnetic jerks").

Tim Smith, senior publisher of the *New Journal of Physics*, said, "This article is controversial and will no doubt cause vigorous debate, and possibly strong opposition, from some parts of the geomagnetism community. As the author acknowledges, the results by no means constitute a proof but they do suggest the need for further research into the possibility of a direct connection between ocean flow and the secular variation of the geomagnetic field."

In the early 1920s, Einstein highlighted the large challenge that understanding our Magnetosphere poses. It was later suggested that the Earth's magnetic field could be a result of the flow of electrically-conducting fluid deep inside the Earth acting as a dynamo.

In the second half of the twentieth century, the dynamo theory, describing the process through which a rotating, convecting, and electrically conducting fluid acts to maintain a magnetic field, was used to explain how hot iron in the outer core of the Earth creates a magnetosphere.

The journal paper also raises questions about the structure of our Earth's core.

Familiar text book images that illustrate a flow of hot and highly electrically-conducting fluid at the core of the Earth are based on conjecture and could now be rendered invalid. As the flow of fluids at the Earth's core cannot be measured or observed, theories about changes in the magnetosphere have been used, inversely, to infer the existence of such flow at the core of the Earth.

While Ryskin's research looks only at long-term changes in the Earth's magnetic field, he points out that, "If secular variation is caused by the ocean flow, the entire concept of the dynamo operating in the Earth's core is called into question: there exists no other evidence of hydrodynamic flow in the core."

On a practical level, it means the next time you use a compass you might need to thank the seas and oceans for influencing the force necessary to guide the way.

Dr Raymond Shaw, professor of atmospheric physics at Michigan Technological University, said, "It should be kept in mind that the idea Professor Ryskin is proposing in his paper, if valid, has the potential to deem irrelevant the ruling paradigm of geomagnetism, so it will be no surprise to find individuals who are strongly opposed or critical."

Huntington's disease deciphered

Researchers at the University of Illinois at Chicago College of Medicine have discovered how the mutated huntingtin gene acts on the nervous system to create the devastation of Huntington's disease. The researchers were able to show that the mutated huntingtin gene activates a particular enzyme, called JNK3, which is expressed only in neurons and, further, to show what effect activation of that enzyme has on neuron function. The report of their findings is available in *Nature Neuroscience* online.

Huntington's disease is an adult onset neurodegenerative disease marked by progressive mental and physical deterioration. It has been known for more than a decade that everyone who develops the disease has mutations in a particular gene, called huntingtin, according to Scott Brady, professor and head of anatomy and cell biology at the UIC College of Medicine.

"There are several puzzling aspects of this disease," said Brady, who is co-principal investigator on the study. "First, the mutation is there from day one. How is it that people are born with a perfectly functioning nervous system, despite the mutation, but as they grow up into their 30s and 40s they start to develop these debilitating symptoms? We need to understand why the protein is bad at 40 but it wasn't bad at 4."

The second problem, according to Brady, is that the gene is expressed not just in the nervous system but in other parts of the body. However, the only part of the body that is affected is the nervous system. Why are neurons being affected?

Brady, Gerardo Morfini, assistant professor of anatomy and cell biology at UIC and co-principal investigator of the study, and their colleagues began looking for a mechanism that could explain all the pieces of the puzzle. They found that at extremely low concentrations, huntingtin was a potent inhibitor of axonal transport, the system within the neuron that shuttles proteins from the cell body where they are synthesized to the synaptic terminals where they are needed.

A neuron's critical role in making connections may require it to make the cellular trunk, called an axon, between the cell body and the synaptic terminal to be very long. Some cells have axons that reach half the body's length -- for a tall person, a meter or more. But even in the brain, axonal projections are very long compared to other cells. In addition to the challenge of distance, neurons are very complex cells with many specialized areas necessary to carry out synaptic connections, requiring a robust transport system.

"Inhibition of neuronal transport is enough to explain what is happening in Huntington's," said Brady. Loss of delivery of materials to the terminals results in loss of transmission of signals from the neuron. Loss of signal transmission causes the neurons to begin to die back, leading to reduced transmissions, more dying back and eventual neuronal cell death.

This mechanism also explains the late onset of the disease, Brady said. Activation of JNK3 reduces transport but does not eliminate it. Young neurons have a robust transport system, but transport gradually declines with age. "If you take a hit when you're very young, you still are making more and transporting more proteins in each neuron than you need," Brady said. "But as you get older and older, the neuron produces and transports less. Each hit diminishes the system further. Eventually, the neuron falls below the threshold needed to maintain cell health."

Brady's group has also linked this pattern of progressive neurodegeneration -- marked by a loss of signaling between neurons, a slow dying back of neurons, and eventual neuron death -- to damage to the transport system in several other hereditary adult-onset neurodegenerative diseases and to Alzheimer's disease.

"There is a common theme and a common Achilles heel of the neuron that underlies all these diseases," Brady said. "We've invented a word, dysferopathy, (from the Greek 'fero', to carry or transport) for these adult-onset neurodegenerative diseases. All have disruption of the axonal transport system in common."

The study was supported by grants from the Huntington's Disease Society of America, the National Institutes of Health, the Muscular Dystrophy Association, the ALS Association and a Marine Biological Laboratory Summer Fellowship.

Other authors on the study are Yi-Mei You, Sarah Pollema, Agnieszka Kaminska, and Gustavo Pigino of UIC; Katherine Liu of the Marine Biological Laboratory at Woods Hole, Mass.; Katsuji Yoshioka of Kanazawa University, Japan; Benny Björkblom and Eleanor T. Coffey of the Åbo Akademi and Turku University in Finland; Carolina Bagnato and David Han of the University of Connecticut Health Center; and Chun-Fang Huang and Gary Banker of the Oregon Health & Science University.

NYU Langone Medical Center researchers identify key gene in deadly inflammatory breast cancer

Aggressive, deadly and often misdiagnosed, inflammatory breast cancer (IBC) is the most lethal form of primary breast cancer, often striking women in their prime and causing death within 18 to 24 months. Now, scientists from The Cancer Institute at NYU Langone Medical Center have identified a key gene—eIF4G1—that is overexpressed in the majority of cases of IBC, allowing cells to form highly mobile clusters that are responsible for the rapid metastasis that makes IBC such an effective killer.

The new findings, Essential Role for eIF4G1 Overexpression in Inflammatory Breast Cancer Pathogenesis, scheduled for advance online publication on Nature Cell Biology's website (Embargoed for June 14th, 2009 at 1:00PM EST) could lead to the identification of new approaches, therapies and a new class of drugs to target and treat IBC. This would be a critical development in the fight against IBC, which respond poorly to chemotherapy, radiation or any other current treatments for breast cancer, according to the study's lead authors Dr. Robert Schneider, associate director for translational research at The Cancer Institute, co-director of breast cancer research, and the Albert B. Sabin Professor of Molecular Pathogenesis at NYU School of Medicine, and Dr. Deborah Silvera, a postdoctoral research fellow.

"The tragedy of IBC is that it is often misdiagnosed and misclassified. Rather than presenting as a 'typical' lump, IBC looks like an inflammation of the breast and is frequently mistaken for an infection. Physicians often prescribe antibiotics, losing valuable time for treating this fast-moving killer," says Dr. Schneider, noting that IBC accounts for several percent of all breast cancer cases but takes a high toll on mortality, with an incidence that is 50 percent higher in African American women. He adds that there has been little progress in treating IBC over the past two decades, and there are no drugs specifically for this form of cancer. "In fact, IBC has only recently been recognized as a unique, genetically distinct form of breast cancer."

Dr. Schneider and his colleagues found that the overexpression of the gene eIF4G1 reprograms how the IBC tumor cells make proteins. Other researchers have identified genes associated with IBC, but this is the first gene shown to orchestrate how IBC tumor cells form special structures—unique to this disease—known as "tumor emboli." These small clusters of highly mobile tumor cells are responsible for the rapid metastasis of IBC. Because these cell clumps are not stationary or fixed, they can quickly travel to other areas of the body.

"The good news is that we're beginning to understand IBC at both a molecular and genetic level," says Dr. Schneider. "We believe this gene is a target for new drug discovery, and we also believe it is possible to silence

the gene without hurting normal cells. Our next step will be to focus on the genetic basis of this disease and look at the genetic changes underlying IBC to reveal more targets at the genetic level."

The study is co-authored by Dr. Silvia Formenti, chair of the department of radiation oncology at NYU Langone Medical Center and the Sandra and Edward H. Meyer Professor of Radiation Oncology at NYU School of Medicine, and Dr. Paul Levine of George Washington University, who contributed tissues.

Funding for the project was provided by the Department of Defense (DOD) Breast Cancer Research Program and the Breast Cancer Research Foundation (BCRF). The DOD funds a six-year, \$6 million Center of Excellence grant for breast cancer to Dr. Formenti (PI) and Dr. Schneider (co-PI). The BCRF funds a four-year, \$4 million grant to Dr. Formenti and Dr. Schneider as co-PIs.

'Resurrection bug' revived after 120,000 years

*** 00:01 15 June 2009 by Andy Coghlan**

A tiny bacterium has been coaxed back to life after spending 120,000 years buried three kilometres deep in the Greenland ice sheet.

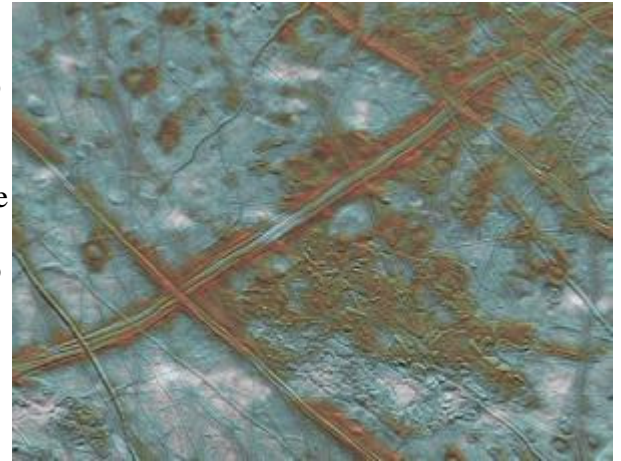
Researchers who found it say it could resemble microbes that may have evolved in ice on other planets.

Officially named *Herminiimonas glaciei*, the bug consists of rods just 0.9 micrometres long and 0.4 micrometres in diameter, about 10 to 50 times smaller than the well-known bacterium, *Escherichia coli*.

"What's unique is that it's so small, and seems to survive on so few nutrients," says Jennifer Loveland-Curtze of Pennsylvania State University, whose team has described the new species.

She speculates that thanks to its tiny dimensions, it can survive in minute veins in the ice, scavenging sparse nutrients that were buried along with the ice. It also has extensive tail-like flagella to help it manoeuvre through the veins to find food.

"Along with the snow, you get dust, bacterial cells, fungal spores, plant spores, minerals and other organic debris," says Loveland-Curtze. "So we postulate that it lives in these microniches in the ice."



Jupiter's moon Europa has an icy crust made up of blocks, which are thought to have broken apart and 'rafted' into new positions (Image: NASA/JPL/University of Arizona)

Coaxed back to life

Researchers in the team coaxed it back to life by keeping it at 2 °C for 7 months, then at 5 °C for a further four-and-a-half months, after which they saw colonies of very small purplish-brown bacteria.

Loveland-Curtze speculates that similar microbes may have evolved in the ice on other planets and moons, such as the ice at the poles of Mars and the ice-covered ocean on Europa, one of Jupiter's moons.

"All we can say is that because ice is the best medium to preserve nucleic acids, other organic compounds and cells, the potential for finding them in these environments is quite high because of the cold," says Loveland-Curtze. "It gives us hope that if something is there, we can locate it."

The oldest known ice on Earth yielded a bacterium that grew after 8 million years.

Journal reference: International Journal of Systematic and Evolutionary Microbiology (DOI: 10.1099/ij.s.0.001685-0).

Typhoons take the pressure off earthquake zones

Can storms prevent nasty earthquakes? That's the suggestion of study showing that typhoons can trigger benign, "slow" quakes that ease the stress between tectonic plates.

Beneath Taiwan, a tectonic plate is diving under its neighbouring plate at one of the world's fastest rates. "You can almost watch them," says study co-author Alan Linde of the Carnegie Institution in Washington DC. Yet the island has had fewer big rumbles than you'd expect from such movement.

One explanation is that Taiwan undergoes slow earthquakes, in which crustal faults slip over hours or days, rather than seconds, creating no seismic judders.

Now a team led by Chichung Liu of the Academia Sinica in Taipei says these slow earthquakes can be triggered by typhoons. Using strain meters, they identified 20 slow quakes over five years, 11 of which occurred during typhoons (Nature, DOI: 10.1038/nature08042).

The chances of this being a coincidence are vanishingly small, so they suggest that typhoons are triggering slow quakes via low atmospheric pressure, which makes it easier for the land to slip over the descending plate. This is the first "totally unequivocal" evidence that atmospheric changes can trigger fault slip, says Linde.

"These are quite impressive results," says Lars Ottemoller of the British Geological Survey. "I am fairly convinced that the link between the slow earthquakes and the typhoons is real."

What limits the size of birds?

Why aren't birds larger? Fifteen-kilogram swans hold the current upper size record for flying birds, although the extinct *Argentavis* of the Miocene Epoch in Argentina is estimated to have weighed 70 kilograms, the size of an average human. In a forthcoming article in *PLoS Biology*, Sievert Rohwer, and his colleagues at the Burke Museum at the University of Washington, provide evidence that maximum body size in birds is constrained by the amount of time it takes to replace the flight feathers during molt. As bird size increases, feather growth rate fails to keep up with feather length until, eventually; feathers wear out before they can be replaced. This fundamental relationship requires basic changes in the molt strategy as size increases, ultimately limiting the size of flying birds.

Feathers deteriorate with continued exposure to ultra-violet light and bacterial decomposition, and must be replaced periodically to maintain adequate aerodynamic support for flight. Small birds accomplish this in an annual or twice-annual molt, during which the 9 or 10 primary flight feathers are replaced sequentially, taking about three weeks for each feather. Large species of birds need different approaches to feather replacement. These involve several alternative strategies: prolonging the total molt to two or even three years; simultaneously replacing multiple feathers from different molt-origination points in the feather sequence; and, in species that do not require flight to feed or escape enemies (ducks and geese, for example), replacing all feathers simultaneously.

With increasing body size, the length of the primary feathers increases as the one-third power of mass, approximately doubling with each 10-fold increase in mass. However, the rate of feather growth increases only as the one-sixth power of mass, meaning that the time required to replace each feather increases by a factor of about 1.5 for each 10-fold increase in mass, until 56 days are required to replace a single flight feather in a 10-kg bird. The cause of this discrepancy is not known, but the authors speculate that it probably depends on the geometry of producing a two-dimensional feather structure from a one-dimensional growing zone in the feather shaft.

The avian feather is one of the most striking adaptations in the animal world, and yet its growth dynamics are poorly understood. It might be possible to achieve more rapid feather growth with a larger growth zone, but this could also weaken the structure of the growing feather, resulting in frequent breakage in large birds. Understanding the engineering complexities of the growing feather will require further study of the dynamics and structure of the growing zone. And what about *Argentavis*? The authors speculate that this giant bird most likely molted all its feathers simultaneously during a long fast, fueled by accumulated fat deposits much in the same way as emperor penguins do today.

*Citation: Rohwer S, Ricklefs RE, Rohwer VG, Copple MM (2009) Allometry of the Duration of Flight Feather Molt in Birds. PLoS Biol 7(6): e1000132. doi:10.1371/journal.pbio.1000132
<http://biology.plosjournals.org/perlserv/?request=get-document&doi=10.1371/journal.pbio.1000132>*

Can university subjects reveal terrorists in the making?

* 15 June 2009 by **Diego Gambetta and Steffen Hertog**

WHO becomes a terrorist? An MI5 report leaked to London newspaper *The Guardian* in August 2008 concluded that there is no easy way to identify those who become involved in terrorism in the UK because there is "no single pathway to violent extremism" and that "it is not possible to draw up a typical profile of the 'British terrorist' as most are 'demographically unremarkable'".

The extraordinary lengths the German authorities went to after 9/11 to track down potential terrorists are a stark example of how useless profiling can be. They collected and analysed data on over 8 million individuals living in Germany. These people were categorised by demographic characteristics: male, aged 18 to 40; current or former student; Muslim; legally resident in Germany; and originating from one of 26 Islamic countries. Then they were sorted into three further categories: potential to carry out a terrorist attack (such as a pilot's licence); familiarity with locations that could be targets (such as working in airports, nuclear power plants, chemical plants, the rail service, labs and other research institutes); and studying the German language at the Goethe Institute.

With the help of these categories authorities whittled the 8 million down to just 1689 individuals, who were then investigated, one by one. Giovanni Capocchia, an Oxford-based political scientist who analysed this case, reported that not one of them turned out to be a threat. All the real Islamic terrorists arrested in Germany through other investigations were not on the official "shortlist" and did not fit the profile. Does it follow, as some scholars now think, that anyone, given the right conditions and the wrong friendships, can end up joining a terrorist group? Not entirely. We found that engineers are three to four times as likely as other graduates to be present among the members of violent Islamic groups in the Muslim world since the 1970s. Using a sample of 404 Islamic militants worldwide (with a median birth date in 1966), we tracked down

the education of 284. Of these, 26 had less than secondary education, 62 completed secondary education (including madrasas), and 196 had higher education, whether completed or not. Even if none of the cases where we lack data had higher education, the share of those with higher education would be a hefty 48.5 per cent.

The next move was to find out what they had studied - and we tracked down 178 of our 196 cases. The largest single group were engineers, with 78 out of 178, followed by 34 taking Islamic studies, 14 studying medicine, 12 economics and business studies, and 7 natural sciences. The over-representation of engineers applies to all 13 militant groups in the sample and to all 17 nationalities, with the exception of Saudi Arabia.

Our finding holds up quite well in another sample of 259 Islamic extremists who are citizens or residents of 14 western, mostly European, countries, and who have recently come to the attention of the authorities for carrying out or plotting a terrorist attack in the west. Although this sample contains far fewer people with higher education than the older members of the first group, nearly 6 out of 10 of those with higher education are engineers.

We also collected data on non-Muslim extremists. We found that engineers are almost completely absent from violent left-wing groups, while they are present among violent right-wing groups in different countries. Out of seven right-wing leaders in the US whose degrees we were able to establish, four were engineers: for example, Richard Butler, the founder of the neo-Nazi group Aryan Nations, was an aeronautical engineer, and Wilhelm Schmitt, leader of the right-wing, extreme anti-government, pro-localism group known as the Sheriff's Posse Comitatus, was an engineer with Lockheed Martin. Among the total membership of the Islamic groups, however, the over-representation is still much higher.

This could be a coincidence: if the group founders are engineers they would also be more likely to recruit other engineers via their educational or professional networks. This explanation only works up to a point. It does not explain why engineers are over-represented in groups in which the founders were not engineers, or why the founders of groups that were not in contact with each other were often engineers.

Why engineers? Everybody's first reaction is that they are recruited for their technical proficiency in bomb-making and communications technology, but there is no evidence for this. A tiny elite tends to do the technical work in these groups, and jihadist recruitment manuals focus on a personality profile rather than technical skills.

So we are left with two hypotheses: either certain social conditions impinge more on engineers than on other graduates, or engineers are more likely to have certain personality traits that make radical Islamism more attractive to them. Our best guess is that the phenomenon derives from a combination of these two factors.

With engineers in the Middle East we have very intelligent, ambitious students who have found it difficult to find professional satisfaction, both individually and collectively in their desire to help their countries develop. Graduates of very selective degree programmes, they may have endured relatively greater frustration in a stagnant and authoritarian environment.

The fact that engineers are not over-represented in Saudi Arabia offers some support for this, for, alone among the countries of origin of terrorists, Saudi Arabia has had a shortage of engineers and has thus offered better employment opportunities. However, even in western countries and south-east Asia, where labour market opportunities are better for all graduates, engineers appear relatively more attracted to violent Islamist groups than other graduates. Why is this?

We reckon that something else is going on, something at the individual level, that is, relating to cognitive traits. According to polling data, engineering professors in the US are seven times as likely to be right-wing and religious as other academics, and similar biases apply to students. In 16 other countries we investigated, engineers seem to be no more right-wing or religious than the rest of the population, but the number of engineers combining both traits is unusually high. A lot of piecemeal evidence suggests that characteristics such as greater intolerance of ambiguity, a belief that society can be made to work like clockwork, and dislike of democratic politics which involves compromise, are more common among engineers.

US engineering professors are seven times as likely to be right-wing and religious

So the bottom line is that while the probability of a Muslim engineer becoming a violent Islamist is minuscule, it is still be between three and four times that for other graduates.

Profile Diego Gambetta is official fellow at Nuffield College, Oxford. Steffen Hertog is Kuwait Professor at the Chaire Moyen Orient-Méditerranée, Sciences Po, Paris. Their book, *Engineers of Jihad*, will be published next year by Princeton University Press

Editorial

Seeking out the engineers of terror

SPOOKS are kept awake at night by the knowledge that there is no reliable way to spot a potential terrorist. Now, after trawling data since the 1970s, a study has found that engineers are three to four times as likely as

other graduates to belong to a violent Islamic group in the Muslim world (see "There's something about engineers...").

The researchers suggest that this link may be to do with personality, and say there is some evidence that engineers are more likely to be intolerant of ambiguity, believe society can be made to work like clockwork, and to dislike democracy because it involves compromise.

Any new insight into what makes a terrorist is always welcome. But, given that this is a weak correlation and the word "engineer" covers such a dizzying array of disciplines, this one is unlikely to be useful.

Basket Weaving May Have Taught Humans To Count

ScienceDaily (June 8, 2009) — Did animals teach us one of the oldest forms of human technology? Did this technology contribute to our ability to count? These are just two of the themes due to be explored at a conference on basketry at the University of East Anglia.

The event, which takes place today and tomorrow (June 5-6), is part of Beyond the Basket, a major new research project led by the university exploring the development and use of basketry in human culture over 10,000 years.

Basketry has been practised for millennia and ranges from mats for sitting on, containers and traps for hunting, to fencing and barriers for animals or land, partitions and walls - all of which have been central to culture.



Basketry masks in Amazonia. (Credit: Image courtesy of University of East Anglia)

Beyond the Basket is a two-and-a-half year project funded by the Arts and Humanities Research Council as part of its Beyond Text programme. The research will explore the role of basketry in human culture and focus on various parts of the world, both in the past and present, from Europe to Amazonia, central Africa and Papua New Guinea.

The aim is to identify the mechanical traditions of making and the ways in which basketry is implicated in wider patterns of understanding, for example the order of society or the design of the universe. It will also show the impact of woven forms on other media, such as pottery, painting, and stone sculpture and architecture, and look at the future of basketry and the solutions it could offer to current issues, whether technical or social.

Project leader Sandy Heslop, of the School of World Art and Museology at UEA, said: "Basketry is a worldwide technology and is the interaction between human ingenuity and the environment. It tends to make use of, and therefore has to be adapted to, local conditions in terms of resources and environment.

"Without basketry there would be no civilisations. You can't bring thousands of people together unless you can supply them, you can't bring in supplies to feed populations without containers. In the early days of civilisations these containers were basketry.

"We may think of baskets as humble, but other people and cultures don't. They have been used for storage, for important religious and ceremonial processes, even for bodies in the form of coffins."

It is about 10,000 years ago that evidence for basketry starts to appear in North America, Asia, Europe and the Middle East. Today its uses and influences are still seen, from the bamboo scaffolding often used in Asia, to contemporary architecture, for example the 'Boiler Suit' - the name given to the 'woven' steel tiles encasing the boiler room at Guy's Hospital in London.

Mr Heslop said: "Beyond its practical uses, basketry has arguably been even more influential on our lives, since it relies on the relationship of number, pattern and structure. It therefore provides a model for disciplines such as mathematics and engineering and for the organisation of social and political life.

"Given the range of uses of basketry the associations of the technology are very varied. Some are aggressive, others protective, some help create social hierarchies others are recreational."

The conference, Beyond the Basket: Construction, Order and Understanding, will look at various themes including: design and production, environmental issues, commercial and historical perspectives, weaving in architecture, and the mathematics of basketry, as well as more anthropological and archaeological topics. Among the speakers will be experts from North and South America, as well as the UK.

Beyond the Basket will culminate in an exhibition and accompanying book in 2011. The exhibition will include ancient material recovered by excavation as well as more recent examples of basketry from around the world and will enable people to experience basketry directly.

For further information about Beyond the Basket and to view images visit <http://projects.beyondtext.ac.uk/beyondthebasket>

Research Shows How A Stroke Affects Hand Function; Provides Roadmap For Rehabilitation

BETHESDA, Md. (June 15, 2009) A person whose hand function has been affected by a stroke can release an object more quickly when the affected arm is supported on a platform, but the support does not make it easier to grip the object, according to a new study. The study also found that active muscle-stretching exercises improved how quickly the stroke survivor could grip an object, but made release of the object more difficult. These findings show how a stroke affects hand function, and provide a roadmap for rehabilitation.

Stroke is a leading cause of long-term disability among American adults. People who have suffered strokes often experience hand impairment, including significant delays in how long it takes to grip and release objects. This study included 10 people who had hand impairments from a severe stroke that had injured one hemisphere of the brain but not the other.

The study, "Delays in grip initiation and termination in persons with stroke: Effects of arm support and active muscle stretch exercise" appears in the online edition of the Journal of Neurophysiology. The authors are Na Jin Seo, William Z. Rymer and Derek G. Kamper, of the Rehabilitation Institute of Chicago. Dr. Rymer is also affiliated with Northwestern University, and Dr. Kamper with the Illinois Institute of Chicago.

In this study, the authors wanted to quantify the time needed to:

- * grip an object with the hand directly affected by the stroke (the paretic hand) and the non-paretic hand (the unaffected hand controlled by the uninjured hemisphere)
- * release an object with both the paretic and non-paretic hands

They also wanted to determine the effect that:

- * a device that supports the arm has on grip and release times
- * stretching exercises for the hand and finger muscles has on grip and release times

Experimental design

The study included 10 people with severe hand impairment because of a stroke. The study also included five healthy people as controls.

The study participants sat in front of a cylinder that they gripped as quickly and as strongly as they could when they heard an auditory signal. The researchers instructed them to release the cylinder as quickly as they could when the signal stopped. The researchers recorded grip initiation and release by using an electromyogram, which detects muscle activity.

The study found that the speed of grip and release was impaired in both hands for those who suffered a stroke, even though only one hemisphere of the brain had been injured. They found that:

- * Stroke survivors could grip the cylinder much more quickly than they could release it. The paretic hand took 1.9 seconds to grip the cylinder but required 5 seconds to release it. In comparison, the healthy controls took 0.2 seconds to grip and 0.4 seconds to release.

- * The study also found that the non-paretic hands of the stroke survivors had been affected, although not nearly as much as the paretic hand. The non-paretic hand took 0.5 seconds to grip and 1.6 seconds to release.

The researchers also looked at grip initiation and grip termination when the stroke survivors used a device that supported the arm on a platform, leaving the hand free. (See <http://www.ric.org/research/centers/mars2/Projects/development/d3.aspx> for a description of the device.) They found that the device helped stroke survivors release the cylinder more quickly. With the device, they were able to reduce the delay in grip termination by 37%. The device made no significant difference in the time needed to initiate the grip.

The assistive device compensates for gravitational forces, thereby supporting the weight of the arm and permitting relaxation of the muscles of the arm and shoulder. This allows the stroke survivor to more easily control the muscles of the fingers, wrist and hand, Dr. Seo said. She also noted that a special device may not be necessary. Supporting the paretic arm with the non-paretic arm, or using a table to support the arm, may do just as well.

The researchers also tested grip and release following 30 minutes of hand, wrist and finger muscle stretching exercises. They found the muscle stretch exercises helped stroke survivors grip the cylinder more quickly, but it further delayed time to release. The stretches reduced delay in grip initiation by the paretic hand by 32% but increased delay in grip termination by 24%.

The researchers hypothesize that the exercises activate muscles, making it easier to grip but more difficult to relax the muscles, which makes it harder to release. The stroke survivors performed the grip-and-release trials shortly after the muscle-stretching exercises. It is possible that the negative effect on release could be reduced if there was a greater time interval between the stretching and the grip and release task, Dr. Seo said. She recommends further research on this question.

In addition, according to Dr. Seo, these therapies may help improve hand function:

* **Active-passive bilateral therapy.** In the healthy brain, the hemispheres work together to respond to stimuli and coordinate movement. When one hemisphere of the brain suffers injury from a stroke, it upsets the balance between the two hemispheres. Active-passive bilateral therapy is an attempt to restore that balance, so that the two sides can work together. The therapy involves having stroke survivors perform a task using the non-paretic and the paretic hand together to retrain balance between the hemispheres. When added to the conventional therapy that forces the use of the paretic limb repeatedly, this active-passive bilateral therapy may improve hand function.

* **Brain stimulation.** Repeated stimulation of the neurons in the brain's cortex via trans-cranial magnetic stimulation or trans-cranial direct current stimulation can eventually reduce the activities of the neurons that are overactive. Applying this stimulation to the healthy hemisphere will reduce its ability to dominate and inhibit the injured hemisphere, restoring some of the balance.

* **Biofeedback.** Following a stroke, survivors have impaired ability to sense motor function in the paretic limb. Biofeedback may give them greater awareness of muscle contractions and help them relax their hand muscles or coordinate their hand movements.

Editor's Notes: To arrange an interview with Dr. Seo, please contact Christine Guilfooy at cguilfooy@the-aps.org or (301) 634-7253.

You can read the study by clicking [here](#) or by going to:

[http://jn.physiology.org/cgi/search?sortspec=relevance&author1=seo&fulltext=&pubdate_year=&volume=&firstpage=.](http://jn.physiology.org/cgi/search?sortspec=relevance&author1=seo&fulltext=&pubdate_year=&volume=&firstpage=)

They are young and need the job: A second chance for dangerous T cells

The immune system's T-cells react to foreign protein fragments and therefore are crucial to combating viruses and bacteria. Errant cells that attack the body's own material are in most cases driven to cell death. Some of these autoreactive T-cells, however, undergo a kind of reeducation to become "regulatory T-cells" that keep other autoreactive T-cells under control. A group led by immunologist Professor Ludger Klein of LMU Munich has now shown that the developmental stage of an autoreactive T-cell is decisive to its ultimate destiny. Young autoreactive T-cells are very readily reeducated into regulatory T-cells. Under identical conditions, however, older T-cells become fully activated and can cause damage – they are in a way resistant to reeducation. "We now intend to study at the molecular level what makes a T-cell accessible for reeducation," said Klein, "because then it may be possible to convert even normal adult T-cells, which can be obtained easily and in great numbers from blood. Possibly, they could then be used as regulatory T-cells in therapies for autoimmune diseases such as type-1 diabetes or multiple sclerosis: these are diseases that are triggered by uncontrolled autoreactive T-cells." (PNAS, 10 June 2009)

During their development in the thymus gland, a kind of 'T-cell school', every T-cell is fitted out with its own personal receptor. The diversity of these receptors allows the immune system to respond to nearly all pathogens. Since T-cell receptors are all randomly constructed, there is also a constant production of T-cells in the thymus that may recognize and attack the body's own structures. "Most of these dangerous autoreactive T-cells, though, are sorted out in a screening process before they leave the thymus," Klein reported. "This negative selection, that is the elimination of autoreactive T-cells that would otherwise attack their own organism, is an important requirement for immune tolerance."

But not all autoreactive T-cells are driven to cell death. Some of them are 'reeducated' into so-called regulatory T-cells. While these still possess a T-cell receptor that targets the body's own structures, they have been reprogrammed during their development in the thymus so that they can no longer cause any damage. In fact, it is "quite the opposite," as Klein explained. "They even keep other nearby errant T-cells under control. This is why the mechanisms for the creation of regulatory T-cells are of enormous practical interest. Deciphering these processes could lead to new therapeutic approaches for autoimmune diseases such as multiple sclerosis, rheumatic arthritis and type-1 diabetes, which are triggered by autoreactive T-cells."

Klein and his colleagues are working on a study into unexplained aspects of regulatory T-cells: How can negative selection, i.e. induced cell death, and reprogramming into regulatory T-cells both take place in the thymus gland, right alongside each other? Why does apparently the same trigger drive some cells to 'suicide' while bringing on a 'reeducation process' in others? "One largely popular hypothesis among immunologists in answer to these questions is based on the fact that T-cells can only recognize their target structures if they have them presented to them by other immune cells," said Klein. "Since there are various subspecies of these antigen-presenting cells in the thymus, we tested whether some of them are possibly specialized in controlling one or the other T-cell destinies – with a negative result."

Instead, it turned out that the developmental stage – the 'age' as it were – of the T-cells is crucial. This was even observable in vitro: Young T-cells are very readily reeducated into regulatory T-cells, while older T-cells

are largely 'resistant to reeducation' under identical conditions. "It is important for us to understand this 'educability' at a molecular level," Klein said, "because then we might be able to manipulate adult, non-autoreactive T-cells to our needs, since they can be obtained in the millions from the blood of patients. Young T-cells, on the other hand, only exist in the thymus. We will now investigate whether there is a specific time window in the life of a young T-cell that allows negative selection or reprogramming into regulatory T-cells. We are also trying to decode the molecular switch inside T-cells that controls this cell-autonomous switching as a response to external signals."

Publication: "Regulatory T cell differentiation of thymocytes does not require a dedicated antigen-presenting cell but is under T cell-intrinsic developmental control Gerald Wirnsberger, Florian Mair, Ludger Klein PNAS online edition, 10 June 2009

Sea gives up Neanderthal fossil

By Paul Rincon Science reporter, BBC News

Part of a Neanderthal man's skull has been dredged up from the North Sea, in the first confirmed find of its kind.

Scientists in Leiden, in the Netherlands, have unveiled the specimen - a fragment from the front of a skull belonging to a young adult male.

Analysis of chemical "isotopes" in the 60,000-year-old fossil suggest a carnivorous diet, matching results from other Neanderthal specimens.

The North Sea is one of the world's richest areas for mammal fossils.

But the remains of ancient humans are scarce; this is the first known specimen to have been recovered from the sea bed anywhere in the world.

For most of the last half million years, sea levels were substantially lower than they are today.

Significant areas of the North Sea were, at times, dry land. Criss-crossed by river systems, with wide valleys, lakes and floodplains, these were rich habitats for large herds of ice age mammals such as horse, reindeer, woolly rhino and mammoth.

Their fossilised remains are brought ashore in large numbers each year by fishing trawlers and other dredging operations.

According to Professor Chris Stringer, from London's Natural History Museum, some fishermen now concentrate on collecting fossils rather than their traditional catch.

"There were mammoth fossils collected off the Norfolk and Suffolk coasts 150 years ago, so we've known for some time there was material down there that was of this age, or even older," Professor Stringer, a museum research leader, told BBC News. Indeed, some of the fossil material from the North Sea dates to the Cromerian stage, between 866,000 and 478,000 years ago.

It had been "only a matter of time", he said, before a human fossil came to light.

Professor Stringer added: "The key thing for the future is getting this material in a better context.

"It would be great if we could get the technology one day to go down and search (in the sea floor) where we can obtain the dating, associated materials and other information we would get if we were excavating on land."

Private collection

Neanderthals (*Homo neanderthalensis*) were our close evolutionary cousins; they appear in the fossil record some 400,000 years ago. These resourceful, physically powerful hunter-gatherers dominated a wide range spanning Britain and Iberia in the west, Israel in the south and Siberia in the east. Our own species, *Homo sapiens* , evolved in Africa, and replaced the Neanderthals after entering Europe about 40,000 years ago.

The specimen was found among animal remains and stone artefacts dredged up 15km off the coast of the Netherlands in 2001. The fragment was spotted by Luc Anthonis, a private fossil collector from Belgium, in the sieving debris of a shell-dredging operation.

Study of the specimen has been led by Professor Jean-Jacques Hublin, from the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. "Even with this rather limited fragment of skull, it is possible to securely identify this as Neanderthal," Professor Hublin told BBC News. For instance, the thick bony ridge above the eyes - known as a supraorbital torus - is typical of the species, he said.

The fragment's shape best matches the frontal bones of late Pleistocene examples of this human species, particularly the specimens known as La Chapelle-aux-Saints and La Ferrassie 1.

These examples, which were both unearthed in France, date from between 50,000 and 60,000 years ago.

The North Sea fossil also bears a lesion caused by a benign tumour - an epidermoid cyst - of a type very rare in humans today.



The research links up with the Ancient Human Occupation of Britain 2 (AHOB 2) project, which aims to set Britain's prehistory in a European context. Dutch archaeologist Wil Roebroeks, a collaborator on this study, is also a member of the AHOB 2 research team.

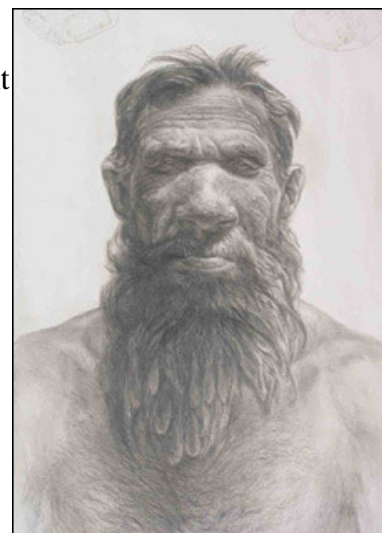
Carnivorous diet

Dr Mike Richards, from the Max Planck Institute in Leipzig, analysed different forms, or isotopes, of the elements nitrogen and carbon in the fossilised bone. This shed light on the types of foods eaten by this young male. The results show survived on a diet dominated by meat.

"High in the food chain, (Neanderthals) must have been quite rare on the ground compared to other mammals," said Wil Roebroeks from the University of Leiden.

The results of the stable isotope analysis fit with what is known about other examples of this species, though other research suggests that in Gibraltar, on the southern coast of Iberia, some Neanderthals were exploiting marine resources, including dolphins, monk seals and mussels.

Researchers decided against carbon dating the specimen; this requires the preservation of a protein called collagen.



Neanderthals were our close evolutionary cousins

Professor Hublin explained that while there was some collagen left in the bone, scientists would have needed to destroy approximately half of the fossil in order to obtain enough for direct dating.

Professor Roebroeks told BBC News: "Dutch scientists - geologists and archaeologists alike - are hoping this find will convince governmental agencies that the Netherlands needs to invest much more in that... archive of Pleistocene sediments off our coast - and off the coast of Britain."

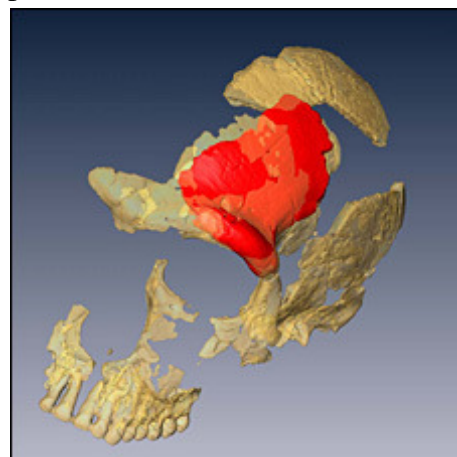
He said this submerged repository contained "high resolution information on past climate change and its environmental consequences, points of reference for how rivers 'worked' before any human interference and now, as this find shows, remains of people who once roamed these landscapes."

Extreme ways

Chris Stringer said that studying the landscape beneath the North Sea was crucial for a better understanding of prehistoric movements of humans into the British Isles.

"We have Neanderthals at Lynford (in Norfolk) 60,000 years ago, though we only have stone tools. This specimen might indeed be the kind of Neanderthal that was crossing into Norfolk around that time. It will help us understand our British sequence when we can much more precisely map what's under the North Sea," he said.

Professor Hublin said the individual was living at the extreme edge of the Neanderthals' northern range, where the relatively cold environment would have challenged their capabilities to the limit. Neanderthal remains have been found at only two sites this far north.



A CT scan shows the find super-imposed on another Neanderthal skull

"What we have here is a marginal population, probably with low numbers of people," Professor Hublin explained. "It's quite fascinating to see that these people were able to cope with the environment and be so successful in an ecological niche which was not the initial niche for humans."

While these hunting grounds would at times have provided plentiful sources of meat for a top carnivore, Neanderthals living in these areas would also have been at the mercy of fluctuations in the numbers of big game animals. Periodic dips in populations of mammals such as reindeer could have caused local extinctions of Neanderthal groups which hunted them, Dr Hublin explained.

Paul.Rincon-INTERNET@bbc.co.uk Story from BBC NEWS: <http://news.bbc.co.uk/1/hi/science/nature/8099377.stm>

Is the sky the limit for wind power?

Palo Alto, CA—In the future, will wind power tapped by high-flying kites light up New York? A new study by scientists at the Carnegie Institution and California State University identifies New York as a prime location for exploiting high-altitude winds, which globally contain enough energy to meet world demand 100 times over. The researchers found that the regions best suited for harvesting this energy match with population centers in the eastern U.S. and East Asia, but fluctuating wind strength still presents a challenge for exploiting this energy source on a large scale.

Using 28 years of data from the National Center for Environmental Prediction and the Department of Energy, Ken Caldeira of the Carnegie Institution's Department of Global Ecology and Cristina Archer of California State University, Chico, compiled the first-ever global survey of wind energy available at high altitudes in the atmosphere. The researchers assessed potential for wind power in terms of "wind power density," which takes into account both wind speed and air density at different altitudes.

"There is a huge amount of energy available in high altitude winds," said coauthor Ken Caldeira. "These winds blow much more strongly and steadily than near-surface winds, but you need to go get up miles to get a big advantage. Ideally, you would like to be up near the jet streams, around 30,000 feet."

Jet streams are meandering belts of fast winds at altitudes between 20 and 50,000 feet that shift seasonally, but otherwise are persistent features in the atmosphere. Jet stream winds are generally steadier and 10 times faster than winds near the ground, making them a potentially vast and dependable source of energy. Several technological schemes have been proposed to harvest this energy, including tethered, kite-like wind turbines that would be lofted to the altitude of the jet streams. Up to 40 megawatts of electricity could be generated by current designs and transmitted to the ground via the tether.

"We found the highest wind power densities over Japan and eastern China, the eastern coast of the United States, southern Australia, and north-eastern Africa," said lead author Archer. "The median values in these areas are greater than 10 kilowatts per square meter. This is unthinkable near the ground, where even the best locations have usually less than one kilowatt per square meter."

Included in the analysis were assessments of high altitude wind energy for the world's five largest cities: Tokyo, New York, Sao Paulo, Seoul, and Mexico City. "For cities that are affected by polar jet streams such as Tokyo, Seoul, and New York, the high-altitude resource is phenomenal," said Archer. "New York, which has the highest average high-altitude wind power density of any U.S. city, has an average wind power density of up to 16 kilowatts per square meter."

Tokyo and Seoul also have high wind power density because they are both affected by the East Asian jet stream. Mexico City and Sao Paulo are located at tropical latitudes, so they are rarely affected by the polar jet streams and just occasionally by the weaker sub-tropical jets. As a result they have lower wind power densities than the other three cities.

"While there is enough power in these high altitude winds to power all of modern civilization, at any specific location there are still times when the winds do not blow," said Caldeira. Even over the best areas, the wind can be expected to fail about five percent of the time. "This means that you either need back-up power, massive amounts of energy storage, or a continental or even global scale electricity grid to assure power availability. So, while high-altitude wind may ultimately prove to be a major energy source, it requires substantial infrastructure."

Reference: Archer, C. L.; Caldeira, K. Global Assessment of High-Altitude Wind Power. Energies 2009, 2, 307-319.

June 15, 2009 - New Exotic Material Could Revolutionize Electronics

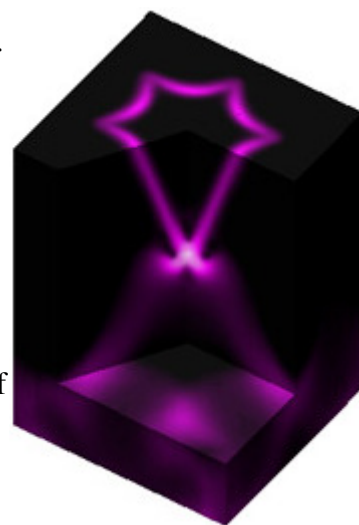
Menlo Park, Calif.—Move over, silicon—it may be time to give the Valley a new name. Physicists at the Department of Energy's (DOE) SLAC National Accelerator Laboratory and Stanford University have confirmed the existence of a type of material that could one day provide dramatically faster, more efficient computer chips.

Recently-predicted and much-sought, the material allows electrons on its surface to travel with no loss of energy at room temperatures and can be fabricated using existing semiconductor technologies. Such material could provide a leap in microchip speeds, and even become the bedrock of an entirely new kind of computing industry based on spintronics, the next evolution of electronics.

Physicists Yulin Chen, Zhi-Xun Shen and their colleagues tested the behavior of electrons in the compound bismuth telluride. The results, published online June 11 in Science Express, show a clear signature of what is called a topological insulator, a material that enables the free flow of electrons across its surface with no loss of energy.

Surface electron band structure of bismuth telluride. (Image courtesy of Yulin Chen and Z. X. Shen.)

The discovery was the result of teamwork between theoretical and experimental physicists at the Stanford Institute for Materials & Energy Science, a joint SLAC-Stanford institute. In recent months, SIMES theorist Shoucheng Zhang and colleagues predicted that several bismuth and antimony compounds would act as topological insulators at room-temperature. The new paper confirms that prediction in bismuth telluride. "The



working style of SIMES is perfect," Chen said. "Theorists, experimentalists, and sample growers can collaborate in a broad sense."

The experimenters examined bismuth telluride samples using X-rays from the Stanford Synchrotron Radiation Lightsource at SLAC and the Advanced Light Source at Lawrence Berkeley National Laboratory. When Chen and his colleagues investigated the electrons' behavior, they saw the clear signature of a topological insulator. Not only that, the group discovered that the reality of bismuth telluride was even better than theory.

"The theorists were very close," Chen said, "but there was a quantitative difference." The experiments showed that bismuth telluride could tolerate even higher temperatures than theorists had predicted. "This means that the material is closer to application than we thought," Chen said.

This magic is possible thanks to surprisingly well-behaved electrons. The quantum spin of each electron is aligned with the electron's motion—a phenomenon called the quantum spin Hall effect. This alignment is a key component in creating spintronics devices, new kinds of devices that go beyond standard electronics. "When you hit something, there's usually scattering, some possibility of bouncing back," explained theorist Xiaoliang Qi. "But the quantum spin Hall effect means that you can't reflect to exactly the reverse path." As a dramatic consequence, electrons flow without resistance. Put a voltage on a topological insulator, and this special spin current will flow without heating the material or dissipating.

Topological insulators aren't conventional superconductors nor fodder for super-efficient power lines, as they can only carry small currents, but they could pave the way for a paradigm shift in microchip development. "This could lead to new applications of spintronics, or using the electron spin to carry information," Qi said. "Whether or not it can build better wires, I'm optimistic it can lead to new devices, transistors, and spintronics devices."

Fortunately for real-world applications, bismuth telluride is fairly simple to grow and work with. Chen said, "It's a three-dimensional material, so it's easy to fabricate with the current mature semiconductor technology. It's also easy to dope—you can tune the properties relatively easily."

"This is already a very exciting thing," he said, adding that the material "could let us make a device with new operating principles."

The high quality bismuth telluride samples were grown at SIMES by James Analytis, Ian Fisher and colleagues. SIMES, the Stanford Synchrotron Radiation Lightsource at SLAC, and the Advanced Light Source at Lawrence Berkeley National Laboratory are supported by the Office of Basic Energy Sciences within the DOE Office of Science. SLAC National Accelerator Laboratory is a multi-program laboratory exploring frontier questions in photon science, astrophysics, particle physics and accelerator research. Located in Menlo Park, California, SLAC is operated by Stanford University for the U.S. Department of Energy Office of Science.

Popular Alzheimer's theory may be false trail

April Frawley Birdwell

The idea that anti-inflammatory drugs might protect people struggling with dementia from Alzheimer's disease has received a blow with the online release of a study of human brain tissue in *Acta Neuropathologica*.

Researchers with the McKnight Brain Institute of the University of Florida, in collaboration with scientists at the University of Frankfurt, Germany, discovered that inflammation of microglia -- an abundant cell type that plays an important supporting role in the brain -- does not appear to be associated with dementia in Alzheimer's disease.

The finding supports recent clinical trial results that indicate anti-inflammatory drugs are not effective at fighting dementia in patients with Alzheimer's disease, which affects about 5.3 million Americans.

"For almost 20 years now, it's been claimed that brain inflammation contributes to the development of Alzheimer's disease dementia, and based on that claim, numerous clinical trials with anti-inflammatory drugs have been conducted. They have been unsuccessful," said Wolfgang Streit, a professor of neuroscience at the College of Medicine. "In the current paper we have shown that the brain's immune system, made up of microglia, is not activated in the brains of Alzheimer's patients, as would be the case if there were inflammation. Instead, microglia are degenerating. We claim that a loss of microglial cells contributes to the loss of neurons, and thus to the development of dementia."

Microglial cells are a subset of a very large population of brain cells known as glial cells. Neurons are the workhorse cells of the brain, enabling thought and movement, but glia are their faithful sidekicks, providing physical and nutritional support.

Glial cells, which outnumber neurons 10-to-1, are at the heart of a popular explanation for Alzheimer's disease that suggests protein fragments called beta amyloid -- Abeta for short -- clump together in the spaces between brain cells, causing memory loss and dementia. Inflammation theories suggest that microglia become

"activated" and mount an immune response to these protein clumps, and instead of being helpful, a toxic release of chemicals occurs, worsening the disease effects.

However, Streit's high-resolution observations did not find evidence that Abeta activates, or inflames, human microglia cells. Nor did researchers find evidence that inflammation is to blame for brain cell death.

"This paper potentially represents a paradigm shift in the way we look at Alzheimer's disease," said Mark A. Smith, a professor of pathology at Case Western Reserve University and editor-in-chief of the Journal of Alzheimer's Disease. "The study goes against the very popular idea of neuro-inflammation; instead, the idea that microglia are senescent is consistent with a number of features of the disease.

"The research makes a very good case that these cells are subject to aging," said Smith, who did not participate in the study. "These cells were thought to be activated (against Alzheimer's), but this paper makes a strong case that they are not. The study has taken a novel approach that has led to a novel insight."

Using a commercially available antibody, Streit for the first time created a marker for microglial cells in human brain specimens that had been in chemical storage. The specimens were from 19 people with varying degrees of Alzheimer's, ranging from severe to none at all. Two of the samples were from Down syndrome patients, who are known to develop Alzheimer's pathology in middle age.

When researchers examined these cells alongside neurons under a high-resolution microscope, they found that -- unless an infection had occurred elsewhere in the body -- microglial cells from Alzheimer's patients were not distinctly larger or unusually shaped, which would have been the case had they been inflamed.

"What I expected to see is activated microglia right next to dying neurons," Streit said. "That is what I did not find. What I propose is glia are dying, and the neurons lose support. We now need to find out what caused glia to degenerate. Rather than trying to find ways to inhibit microglia with anti-inflammatory drugs, we need to find ways to keep them alive and strong. It's a whole new field."

The microglial cells had a tangled, fragmented appearance, similar to neurons in the throes of Alzheimer's disease or -- old age.

"These cells are breaking into pieces," said Streit, who collaborated with Alzheimer's researcher Dr. Heiko Braak, of the Institute for Clinical Neuroanatomy in Frankfurt. "They are on their way out. For the first time, we are proving that microglial cells are subject to aging and may undergo degeneration, and that the loss of these cells precedes the loss of neurons. Research has been so focused on finding activated microglia, no one considered that these cells were degenerating and neurons lost support."

The work was supported by the National Institutes of Health, the German Research Council and the Evelyn F. and William L. McKnight Brain Institute.

Alzheimer's disease is the sixth leading cause of death in the United States and the fifth leading cause of death for Americans 65 and older, according to the Alzheimer's Association. The association estimates Alzheimer's and other dementias cost Medicare, Medicaid and businesses a total of \$148 billion annually.

'Shortcuts' of the mind lead to miscalculations of weight and caloric intake, says Penn study

PHILADELPHIA - Psychologists at the University of Pennsylvania have identified a cognitive shortcut, or heuristic, they call "Unit Bias," which causes people to ignore vital, obvious information in their decision-making process, points to a fundamental flaw in the modern, evolved mind and may also play a role in the American population's 30 years of weight gain.

Researchers who focus on the cognitive aspects that contribute to obesity conducted several studies with college-age participants in which the subjects were asked to estimate the weight of adult women from either photographs or a live presentation by models. Other student participants were asked to estimate the calories in one of two actual meals. Both meals contained the same foods, but one had larger portion sizes than the other.

The results demonstrated that when estimating the body weight of women, participants apparently disregard or ignore the provided height information and focus solely on the width of the model. In certain instances, researchers would inflate the provided height information of the models as much as 10 inches, though that did not alter participants' estimates of the models' weights.

When estimating calories, study participants assumed portion sizes were culturally typical and guessed no caloric differences between small and large portions.

The findings are akin to asking a room full of people to calculate the volume of a box when given only the height and width and no one asks for the length. Or, more accurately, the length is provided and no one pays attention to that one, crucial dimension, thereby making it impossible to arrive at the correct answer.

The study suggests that there are situations where critical dimensions to understanding are devalued or ignored. The paper examines different circumstances discovered by researchers where single dimensions dominate multidimensional judgments. In these studies specifically, participants estimated body weight based

on the model's shape even though height information was provided in the photographs or directly available with live models. Meanwhile, participants devalued or completely ignored other parameters critical to an accurate judgment.

Penn psychologists point to the study as a novel example of the negative artifacts packaged within the evolved way the human brain processes information. The mind has evolved to develop a capacity to free up our conscious thinking for dangerous and reproductive situations. For example, a driver at a green light doesn't need to cycle through a series of decisions. Green simply means go. The brain has evolved to remove common or repetitive situations or tasks from our awareness because the capacity of our consciousness is quite limited.

What ties these studies together is that missing information was literally thrust in the face of participants, and yet they didn't use it. "We have heuristics in our brain - simple mechanistic shortcuts that have evolved over hundreds of thousands of years, which free up precious space in our consciousness," said Andrew Geier, lead author in the Department of Psychology in Penn's School of Arts and Sciences. "In these atypical instances, however, it's the shortcut that hurts us."

The researchers believe that the negative artifacts of the evolved mind may be directly connected with America's obesity epidemic.

"We have evolved in a very different environment," Geier said. "It used to be that food was scarce, and you ate what was available because you didn't know where your next meal would come from. That is not the case anymore. Although we have yet to prove this, we believe that the ecology of eating in the current food environment has become an example of the atypical situations demonstrated in this new article, which may be an explanation for why almost 70 percent of American adults are either overweight or obese. This represents a cognitive explanation for why America is gaining so much weight. The eating environment has morphed into an atypical scenario where our usually helpful mental mechanisms betray us."

The study, published in the June issue of the Journal of Experimental Psychology--Applied, was written by Geier and Paul Rozin of the Penn Department of Psychology, which supported the study.

New study closes in on geologic history of Earth's deep interior

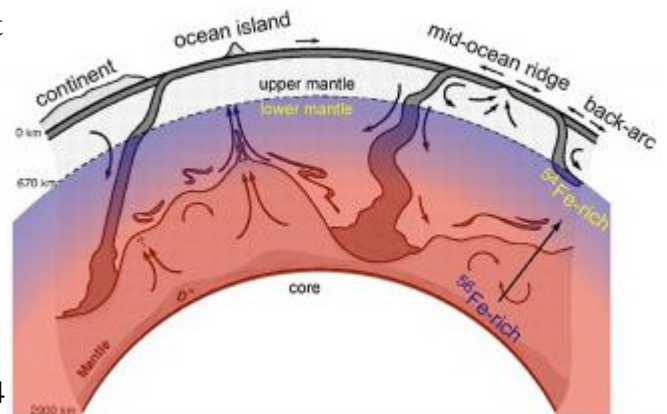
UC Davis team calculates distribution of iron isotopes in Earth's mantle 4.5 billion years ago, opening door to new studies of planet's geologic history

By using a super-computer to virtually squeeze and heat iron-bearing minerals under conditions that would have existed when the Earth crystallized from an ocean of magma to its solid form 4.5 billion years ago, two UC Davis geochemists have produced the first picture of how different isotopes of iron were initially distributed in the solid Earth.

The discovery could usher in a wave of investigations into the evolution of Earth's mantle, a layer of material about 1,800 miles deep that extends from just beneath the planet's thin crust to its metallic core.

"Now that we have some idea of how these isotopes of iron were originally distributed on Earth," said study senior author James Rustad, a Chancellor's fellow and professor of geology, "we should be able to use the isotopes to trace the inner workings of Earth's engine."

A paper describing the study by Rustad and co-author Qing-zhu Yin, an associate professor of geology, was posted online by the journal Nature Geoscience on Sunday, June 14 in advance of print publication in July.



This schematic of Earth's crust and mantle shows the results of a new study that found that extreme pressures would have concentrated iron's heavier isotopes near the bottom of the mantle as it crystallized from an ocean of magma to its solid form 4.5 billion years ago. Louise Kellogg, modified by James Rustad & Qing-zhu Yin/UC Davis

Sandwiched between Earth's crust and core, the vast mantle accounts for about 85 percent of the planet's volume. On a human time scale, this immense portion of our orb appears to be solid. But over millions of years, heat from the molten core and the mantle's own radioactive decay cause it to slowly churn, like thick soup over a low flame. This circulation is the driving force behind the surface motion of tectonic plates, which builds mountains and causes earthquakes.

One source of information providing insight into the physics of this viscous mass are the four stable forms, or isotopes, of iron that can be found in rocks that have risen to Earth's surface at mid-ocean ridges where seafloor spreading is occurring, and at hotspots like Hawaii's volcanoes that poke up through the Earth's crust. Geologists suspect that some of this material originates at the boundary between the mantle and the core some

1,800 miles beneath the surface. "Geologists use isotopes to track physico-chemical processes in nature the way biologists use DNA to track the evolution of life," Yin said.

Because the composition of iron isotopes in rocks will vary depending on the pressure and temperature conditions under which a rock was created, Yin said, in principle, geologists could use iron isotopes in rocks collected at hot spots around the world to track the mantle's geologic history. But in order to do so, they would first need to know how the isotopes were originally distributed in Earth's primordial magma ocean when it cooled down and hardened.

As a team, Yin and Rustad were the ideal partners to solve this riddle. Yin and his laboratory are leaders in the field of using advanced mass spectrometric analytical techniques to produce accurate measurements of the subtle variations in isotopic composition of minerals. Rustad is renowned for his expertise in using large computer clusters to run high-level quantum mechanical calculations to determine the properties of minerals.

The challenge the pair faced was to determine how the competing effects of extreme pressure and temperature deep in Earth's interior would have affected the minerals in the lower mantle, the zone that stretches from about 400 miles beneath the planet's crust to the core-mantle boundary. Temperatures up to 4,500 degrees Kelvin in the region reduce the isotopic differences between minerals to a miniscule level, while crushing pressures tend to alter the basic form of the iron atom itself, a phenomenon known as electronic spin transition.

Using Rustad's powerful 144-processor computer, the two calculated the iron isotope composition of two minerals under a range of temperatures, pressures and different electronic spin states that are now known to occur in the lower mantle. The two minerals, ferropervovskite and ferroperricline, contain virtually all of the iron that occurs in this deep portion of the Earth.

These calculations were so complex that each series Rustad and Yin ran through the computer required a month to complete. In the end, the calculations showed that extreme pressures would have concentrated iron's heavier isotopes near the bottom of the crystallizing mantle.

It will be a eureka moment when these theoretical predictions are verified one day in geological samples that have been generated from the lower mantle, Yin said. But the logical next step for him and Rustad to take, he said, is to document the variation of iron isotopes in pure chemicals subjected to temperatures and pressures in the laboratory that are equivalent to those found at the core-mantle boundary. This can be achieved using lasers and a tool called a diamond anvil. "Much more fun work lies ahead," he said. "And that's exciting."

The work was supported by the U.S. Department of Energy's Office of Basic Energy Sciences, and by a NASA Cosmochemistry grant and a NASA Origins of Solar Systems grant. An abstract of the paper "Iron isotope fractionation in the Earth's lower mantle" can be found at <http://www.nature.com/ngeo/journal/vaop/ncurrent/abs/ngeo546.html>.

Why do we choose our mates? Ask Charles Darwin, prof says

Adam Jones, an evolutionary biologist who has studied Darwin's work for years, says that Darwin's beliefs about the choice of mates and sexual selection being beyond mere chance have been proven correct

Charles Darwin wrote about it 150 years ago: animals don't pick their mates by pure chance – it's a process that is deliberate and involves numerous factors. After decades of examining his work, experts agree that he pretty much scored a scientific bullseye, but a very big question is, "What have we learned since then?" asks a Texas A&M University biologist who has studied Darwin's theories.

Adam Jones, an evolutionary biologist who has studied Darwin's work for years, says that Darwin's beliefs about the choice of mates and sexual selection being beyond mere chance have been proven correct, as stated in Darwin's landmark book *The Descent of Man, and Selection in Relation to Sex*. His work has withstood decades of analysis and scrutiny, as Jones states in his paper, "Mate Choice and Sexual Selection: What Have We Learned Since Darwin?" in the current Proceedings of the National Academy of Sciences.

Bottom line: It's no accident that certain peahens submit to gloriously-colored male peacocks, that lions get the females of their choice or that humans spend hours primping to catch the perfect spouses – it's a condition that is ingrained into all creatures and a conscious "choice" is made between the two so the romantic fireworks can begin.

Jones says Darwin set the standard for original thinking about animal reproduction and was first scientist to propose plausible mechanisms of evolution, and from there he took it one step further – he confirmed that animals' mating choices can drive evolutionary change.

"He noticed that birds, especially, seemed to be a bit picky about who they mated with," Jones explains. "He discovered that birds – especially females – had preferences and that they did not just choose a mate randomly. He believed this is due to beauty of the plumage, that females usually selected the most colorful males.

"That was an important first step, and it's given us models to work from to try to answer other big questions."

Those include determining methods to find out the actual criteria used in choosing a mate, what methods work and which do not, and the passing of genes on to the next generation, a field of study Jones says gained popularity in the 1970s and 1980s.

"Another big recent advance was the development of molecular markers, which allow us to perform paternity testing," Jones adds.

"These markers can be applied to animal populations, and they give us a definitive record of who is mating with whom and what offspring resulted from the mating events. And also, what is the driving force behind sexual selection? We have an unprecedented ability to document mating patterns but we still don't completely understand why some populations experience strong sexual selection and others don't."

Jones notes that other key questions Darwin's work uncovered but has not yet answered include the role of population characteristics and the environment and how they work together to produce strong sexual selection, and also what determines whether or not female choice will evolve in a particular species.

And perhaps the biggest question of all: How does all of this pertain to humans?

"Darwin concluded that sexual selection existed in the animal world and that humans definitely followed a similar process," Jones confirms.

"But he realized he had to explain it first as it related to animals. Darwin thought that sexual selection was an important process in humans, both for males and females. But how much has sexual selection acted on males versus females in humans? Today, while we are celebrating the 200th year of the birth of Charles Darwin, we know sexual selection occurs and is very important but there are still many unanswered questions about precisely why and how it works, especially in humans."

Study gives clues to increasing X-rays' power 3-D, real-time X-ray images may be closer to reality

Three-dimensional, real-time X-ray images of patients could be closer to reality because of research recently completed by scientists at the University of Nebraska-Lincoln and a pair of Russian institutes.

In a paper to be published in an upcoming edition of *Physical Review Letters*, UNL Physics and Astronomy Professor Anthony Starace and his colleagues give scientists important clues into how to unleash coherent, high-powered X-rays.

"This could be a contributor to a number of innovations," Starace said.

Starace's work focuses on a process called high-harmonic generation, or HHG. X-ray radiation can be created by focusing an optical laser into atoms of gaseous elements – usually low-electron types such as hydrogen, helium, or neon. HHG is the process that creates the energetic X-rays when the laser light interacts with those atoms' electrons, causing the electrons to vibrate rapidly and emit X-rays.

But the problem with HHG has been around almost as long as the onset of the method in 1988: The X-ray light produced by the atoms is very weak. In an effort to make the X-rays more powerful, scientists have attempted using higher-powered lasers on the electrons, but success has been limited.

"Using longer wavelength lasers is another way to increase the energy output of the atoms," Starace said. "The problem is, the intensity of the radiation (the atoms) produce drops very quickly."

Instead of focusing on low-electron atoms like hydrogen and helium, Starace's group applied HHG theory to heavier (and more rare) gaseous atoms having many electrons – elements such as xenon, argon and krypton. They discovered that the process would unleash high-energy X-rays with relatively high intensity by using longer wavelength lasers (with wavelengths within certain atom-specific ranges) that happen to drive collective electron oscillations of the many-electron atoms.

"If you use these rare gases and shine a laser in on them, they'll emit X-Rays with an intensity that is much, much stronger (than with the simple atoms)," Starace said. "The atomic structure matters."

Starace said that unlocking the high-powered X-rays could lead one day, for example, to more powerful and precise X-ray machines. For instance, he said, heart doctors might conduct an exam by scanning a patient and creating a 3D hologram of his or her heart, beating in real time.

Nanoscientists, who study the control of matter on an atomic or molecular scale, also may benefit from this finding, Starace said. Someday, the high-intensity X-rays may be used to make 3D images of the microscopic structures with which nanoscientists work.

"With nanotechnology, miniaturization is the order of the day," he said. "But nanoscientists obviously could make use of a method to make the structures they're building and working with more easily visible."

The work is sponsored through funding by the National Science Foundation. Starace said NSF's sponsorship made the collaboration with his Russian colleagues – Mikhail V. Frolov, N.L. Manakov and T.S. Sarantseva of Voronezh State University, and M.Y. Emelin and M.Y. Ryabikin of the Russian Academy of Sciences – possible.

Cases

A Time in a Life for Pie and Beer

By **JUDITH WOODBURN**

You've heard the one about the old man who was dying? He smelled cherry pie baking, so he roused himself from bed and staggered into the kitchen. He was reaching for the pie when his wife swatted his wrist away. "No!" she barked. "That's for the funeral."

There are lots of jokes involving pies; they're funnier than other foods, somehow. But for caregivers like me who've helped feed a loved one through a long illness, the very idea of pie may carry regret. Like the wife in the joke, I spent years nudging my ailing father away from pastry and anything like it. Recently, though, I've found myself wishing I'd cooked with a little less yogurt and a lot less worry.



Christopher Silas Neal

My father died last year at age 85. Over two decades, as his health declined, I cooked for him when I could. It was hard to find foods that weren't literally deadly for him. What made it harder was that only one of us cared.

It's not that Dad had given up hope. Paradoxically, he loved life more as he grew sicker. And the happier he became, the more he indulged in things that were bad for his health. Alcohol was dangerous, given its interactions with his many medications, but he became devoted to a daily cocktail or beer. Though his blood sugar soared, he stopped saying no to sweets.

Because his heart was failing, salty food made fluids pool in his body. But the soups he adored were oceans of sodium, prompting hospital visits and the need for powerful diuretics. Even while threaded with intravenous lines, he'd poke at his food and ask for salt from the cafeteria.

After a lifetime of hard work and moderation, my father simply wanted to enjoy himself. He had come to live — and eat — entirely in the moment. I wanted to join him there. I wanted to bake pies with buttery crusts and bask in his delight. Yet I was stuck not in this moment, but in the next: the one where we were about to lose him.

So I kept trying. I made banana bread with yogurt and wheat germ, salmon with the barest suggestion of sauce. Dad received the food graciously, though I often returned to find it cached in the depths of the refrigerator, shriveled and rubbery.

Just after I had stacked a batch of low-sodium meatloaves in my parents' freezer, my father's illness entered its final phase. It was time for hospice. In a blur of phone calls and furniture moving, it was done: Dad had a hospital bed, an oxygen tank and a flock of children and grandchildren to do what we could.

My father last sat for a family dinner two nights before he died. I'd been the only one in the kitchen, but it was as if two daughters had been cooking. One of us still believed she could rescue her father; she had fixed pork tenderloin in a no-salt marinade and a salad with oven-roasted tomatoes. The other daughter acknowledged something her father had come to understand years earlier. She'd put together a pudding that held nothing back. It had cream, five eggs, sugar and a transgressive dose of salt.

Hospice literature suggests that the dying often lose interest in food. My father did. He looked, mystified, at all I'd set out. "Now, who is going to eat this?" he marveled, and while everyone else ate, he and I just held hands.

Then, at the sound of a beer being opened, a mischievous light entered his face. "Hey," he said. "I'll have some of that!"

My sister caught my eye. We shrugged. There is a love that concerns itself with the tides inside the body, with organs and arteries (and the fact that alcohol and sublingual morphine don't exactly mix). There at the table, I finally understood. We were past this kind of love.

My brother filled a juice glass with beer. Dad downed it in a near-gulp, the way we'd tossed back grape juice at the Methodist communion rail as kids. He sighed. Then he smiled and said, "This is so good." He was looking around at us as he said it, there was joy in his eyes, and we were pretty sure he didn't mean the beer.

Judith Woodburn is a writer based in Madison, Wis.

First Mention

X-Rays, 1896

By **NICHOLAS BAKALAR**

On Jan. 19, 1896, toward the end of a long front-page article summarizing recent events in Europe, The New-York Times (the hyphen would disappear in December of that year) reported some news from Prussia with a combination of contempt and disbelief.

“Emperor William,” Our Own Correspondent wrote, “had Prof. Roentgen to rush from Würzburg to Potsdam to give an illustrated lecture to the royal family on his alleged discovery of how to photograph the invisible.” The reporter then went on to dismiss the discoverer, Wilhelm Konrad Roentgen, as a purveyor of old news about a photographic technique that had been discovered a decade earlier.

Yet one week later, The Times printed another Page 1 wrap-up of European news in which Our Own Correspondent (the same one?) wrote: “Roentgen’s photographic discovery increasingly monopolizes scientific attention. Already numerous successful applications of it to surgical difficulties are reported from various countries, but perhaps even more striking are the proofs that it will revolutionize methods in many departments of metallurgical industry.”

Then on Feb. 4, on Page 9, a full-column article devoted to the subject and illustrated with a “Roentgen Ray” photograph of a human hand gave the discovery its due. The article, “taken in part from the French journal *l’Illustration*,” described the properties of the “new rays,” and conceded that “the photographs obtained in this way have nothing in common with ordinary photographs.”



American Institute of Physics/Associated Press

In a Page 9 headline the next day, The Times first used the name that Roentgen had given to his discovery: X-rays. Roentgen was awarded the first Nobel Prize in Physics in 1901, but The Times made no further mention of it until the publication of his obituary in 1923. What The Times had 27 years earlier called “his alleged discovery” it now described as “one of the greatest discoveries in the history of science.”

Dad's overworked and tired while mom's potentially fired

New research indicates overtime pressures are adversely affecting families

If dad looks exhausted this Father's Day it could be due to his job, suggests new research that found many male employees are now pressured to work up to 40 hours of overtime—often unpaid— per week to stay competitive.

Women face the same pressures, but family obligations may force them to work fewer hours on the job, putting them at risk for demotions or even firings.

The new findings, published in the journal *Gender & Society*, add to the growing body of evidence that heightened competition in the workplace, combined with modern business practices, are resulting in near-unprecedented levels of overtime that may not even be productive in the long run.

"This clearly does not ease the situation for women and men who want to combine career and family-life," concluded lead author Patricia van Echtelt and colleagues. "Moreover, a growing body of literature shows that working long hours does not automatically lead to greater productivity and effectiveness, and thus not necessarily contributes to employers' needs but potentially harms the well-being of employees."

The extensive study looked at the working habits of 1,114 male and female Dutch employees. While the researchers indicate their findings could apply to other countries, they chose to focus on the Netherlands, where outside family support, such as childcare, has been unable to meet the growing demands.

Van Echtelt, a Netherlands Institute for Social Research scientist, and her team found that, among the survey respondents, 69 percent of all men worked overtime versus 42 percent of women. Women who work overtime do so at a rate that is about one-third lower than that of their male colleagues.

It's "usually explained by the continuing trend for women to be more involved in unpaid family work," the researchers noted. And even when partners share family chores, "men often characterize their contribution as 'helping' their wives, without feeling to have the main responsibility."

The researchers therefore predict families with more kids and at-home responsibilities will become "more constrained in their opportunities to indulge the 'choice' to work overtime."

Choice is turning into expectation at most companies built upon the "team work" model, with pressures coming from project teams, responsibility for meeting profit or production targets, imposed deadlines and employees left to manage their own careers. A separate study at a software engineering firm, for example, determined that interdependent work patterns, "a crisis mentality," and a reward system based on individual heroics led to "inefficient work processes and long working hours."

Cornell University's Youngjoo Cha, who led another U.S. data-based study accepted for publication in the *American Sociological Review*, found that if a husband works more than 60 hours a week, his wife is 42 percent more likely to leave her position.

Cha, who agrees with the Dutch findings, said, "The norm of overwork systematically disadvantages women, who are less likely to work long hours because of the expectation that they will have primary caregiving responsibilities and do more housework than men."

In future, van Echtelt and her team hope that businesses will value their "employees more for their efficiency and relational skills and less for their crisis mentality and working long hours."

University of Leicester geologists demonstrate extent of ancient ice age ***Team investigates the climate of planet Earth 440 million years ago***

Geologists at the University of Leicester have shown that an ancient Ice Age, once regarded as a brief 'blip', in fact lasted for 30 million years.

They have published their findings and are due to discuss them at a public lecture at the University on Wednesday June 17.

Their research suggests that during this ancient Ice Age, global warming was curbed through the burial of organic carbon that eventually lead to the formation of oil – including the 'hot shales' of north Africa and Arabia which constitute the world's most productive oil source rock.

This ice age has been named 'the Early Palaeozoic Icehouse' by Dr Alex Page and his colleagues in a paper published as part of a collaborative Deep Time Climate project between the University of Leicester and British Geological Survey.

The Ice Age occurred in the Ordovician and Silurian Periods of geological time (part of the Early Palaeozoic Era), an interval that witnessed a major diversification of early marine animals including trilobites and primitive fish as well as the emergence of the first land plants.

The Early Palaeozoic climate had long been considered characterised by essentially greenhouse conditions with elevated atmospheric CO₂ and warm temperatures extending to high latitudes, and only brief snaps of frigid climate. However, during his doctoral studies in the internationally renowned Palaeobiology Research Group of the University of Leicester, Department of Geology, Alex Page and his colleagues Jan Zalasiewicz and Mark Williams demonstrated how the ice age was probably of much longer duration.

The team demonstrated that the Late Ordovician and Early Silurian Epochs were characterised by widespread ice formation, with changes in the extent of continental glaciation resulting in rapid sea-level changes around the globe.

They compared evidence of sea-level change from the rock record of ancient coastlines with evidence of sediments being deposited by glacial meltwaters or ice-rafting at high latitudes, and with chemical indicators of temperature in the strata.

The team showed that although the Early Palaeozoic Icehouse was of similar extent and duration to the modern ice age, the workings of the carbon cycle appeared markedly different to that of the present day. Unlike the modern oceans, the oceans of the Early Palaeozoic were often oxygen-starved 'dead zones' leading to the burial of plankton-derived carbon in the sea floor sediments. The strata produced in this way include the 'hot shales' of north Africa and Arabia which constitute the world's most productive oil source rock. In fact, the burial of organic carbon derived from fossil plankton may have served to draw down CO₂ from the atmosphere to promote cooling during the Early Palaeozoic Icehouse.

Page commented: "These fossil fuel-rich deposits formed during relatively warmer episodes during the Early Palaeozoic Icehouse when the partial melting of ice sheets brought about rapid sea-level rise. This melt-water may have brought a massive influx of nutrients into the surface waters, allowing animals and algae to thrive and bloom in the plankton, but also altered ocean circulation, creating oxygen-poor deep waters which facilitated the preservation of fragile, carbonaceous planktonic fossils. The deglacial outwash formed a less dense, low-salinity 'lid' on the oceans preventing atmospheric oxygen penetrating to the seafloor. The absence of oxygen under such conditions served to shut down decay accounting for the preservation of these fossils."

Page added that the burial of oil shales in deglacial anoxia "may have been a negative feedback mechanism that prevented runaway warming, meaning that in the Early Palaeozoic Icehouse at least, processes eventually leading to oil formation may have been the solution to the greenhouse effect."

Alex Page's research will be presented at the Doctoral Inaugural Lectures being held in the Ken Edwards Lecture Theatre 3, University of Leicester. Lecture time: 5.30pm-6.30pm on Wednesday June 17.

Government of Canada supports research to help address medical isotope shortage

OTTAWA (June 16, 2009) – The Honourable Leona Aglukkaq, Minister of Health, announced today that the Government of Canada is supporting research to find alternatives to nuclear-produced Technetium-99m, the principal medical isotope affected by the current shutdown at the Chalk River nuclear reactor. Health

professionals use medical isotopes in combination with imaging technologies to diagnose and treat conditions such as cancer and heart disease.

The initiative announced today is a partnership between the Canadian Institutes of Health Research (CIHR) and the Natural Sciences and Engineering Research Council of Canada (NSERC).

“Our government is taking several measures to address the medical needs of Canadians during this medical isotope shortage,” said Minister Aglukkaq. “One course of action we are actively pursuing is funding research that would provide alternatives to the principal medical isotope produced at Chalk River.”

The Government of Canada is providing \$6 million towards this research initiative which will advance research into alternative, non-nuclear, medical isotopes that could replace Technetium-99m in certain medical imaging procedures and support the production and clinical testing of these alternatives.

“Canadian health researchers and clinicians are world leaders in the development and use of imaging technologies,” said Dr. Alain Beaudet, President of CIHR. “We are pleased to support this effort to find solutions that will address the needs of Canadians.”

“We are proud to be a partner in this initiative,” says Dr. Suzanne Fortier, President of NSERC. “This is a complex, multidisciplinary issue. Involving experts from chemistry, physics, engineering and related fields will help advance discovery and innovation in this critical area.”

Alcohol’s Good for You? Some Scientists Doubt It

By RONI CARYN RABIN

By now, it is a familiar litany. Study after study suggests that alcohol in moderation may promote heart health and even ward off diabetes and dementia. The evidence is so plentiful that some experts consider moderate drinking - about one drink a day for women, about two for men - a central component of a healthy lifestyle.

But what if it’s all a big mistake?



Pier Paolo Cito/Associated Press

For some scientists, the question will not go away. No study, these critics say, has ever proved a causal relationship between moderate drinking and lower risk of death - only that the two often go together. It may be that moderate drinking is just something healthy people tend to do, not something that makes people healthy.

“The moderate drinkers tend to do everything right - they exercise, they don’t smoke, they eat right and they drink moderately,” said Kaye Middleton Fillmore, a retired sociologist from the University of California, San Francisco, who has criticized the research. “It’s very hard to disentangle all of that, and that’s a real problem.”

Some researchers say they are haunted by the mistakes made in studies about hormone replacement therapy, which was widely prescribed for years on the basis of observational studies similar to the kind done on alcohol. Questions have also been raised about the financial relationships that have sprung up between the alcoholic beverage industry and many academic centers, which have accepted industry money to pay for research, train students and promote their findings.

“The bottom line is there has not been a single study done on moderate alcohol consumption and mortality outcomes that is a ‘gold standard’ kind of study - the kind of randomized controlled clinical trial that we would be required to have in order to approve a new pharmaceutical agent in this country,” said Dr. Tim Naimi, an epidemiologist with the Centers for Disease Control and Prevention.

Even avid supporters of moderate drinking temper their recommendations with warnings about the dangers of alcohol, which has been tied to breast cancer and can lead to accidents even when consumed in small amounts, and is linked with liver disease, cancers, heart damage and strokes when consumed in larger amounts.

“It’s very difficult to form a single-bullet message because one size doesn’t fit all here, and the public health message has to be very conservative,” said Dr. Arthur L. Klatsky, a cardiologist in Oakland, Calif., who wrote a landmark study in the early 1970s finding that members of the Kaiser Permanente health care plan who drank in moderation were less likely to be hospitalized for heart attacks than abstainers. (He has since received research grants financed by an alcohol industry foundation, though he notes that at least one of his studies found that alcohol increased the risk of hypertension.)

“People who would not be able to stop at one to two drinks a day shouldn’t drink, and people with liver disease shouldn’t drink,” Dr. Klatsky said. On the other hand, “the man in his 50s or 60s who has a heart attack and decides to go clean and gives up his glass of wine at night - that person is better off being a moderate drinker.”

Health organizations have phrased their recommendations gingerly. The American Heart Association says people should not start drinking to protect themselves from heart disease. The 2005 United States dietary guidelines say that “alcohol may have beneficial effects when consumed in moderation.”

The association was first made in the early 20th century. In 1924, a Johns Hopkins biologist, Raymond Pearl, published a graph with a U-shaped curve, its tall strands on either side representing the higher death rates of heavy drinkers and nondrinkers; in the middle were moderate drinkers, with the lowest rates. Dozens of other observational studies have replicated the findings, particularly with respect to heart disease.

“With the exception of smoking and lung cancer, this is probably the most established association in the field of nutrition,” said Eric Rimm, an associate professor of epidemiology and nutrition at the Harvard School of Public Health. “There are probably at least 100 studies by now, and the number grows on a monthly basis. That’s what makes it so unique.”

Alcohol is believed to reduce coronary disease because it has been found to increase the “good” HDL cholesterol and have anticlotting effects. Other benefits have been suggested, too. A small study in China found that cognitively impaired elderly patients who drank in moderation did not deteriorate as quickly as abstainers. A report from the Framingham Offspring Study found that moderate drinkers had greater mineral density in their hipbones than nondrinkers. Researchers have reported that light drinkers are less likely than abstainers to develop diabetes, and that those with Type 2 diabetes who drink lightly are less likely to develop coronary heart disease.

But the studies comparing moderate drinkers with abstainers have come under fire in recent years. Critics ask: Who are these abstainers? Why do they avoid alcohol? Is there something that makes them more susceptible to heart disease?

Some researchers suspect the abstainer group may include “sick quitters,” people who stopped drinking because they already had heart disease. People also tend to cut down on drinking as they age, which would make the average abstainer older - and presumably more susceptible to disease — than the average light drinker.

In 2006, shortly after Dr. Fillmore and her colleagues published a critical analysis saying a vast majority of the alcohol studies they reviewed were flawed, Dr. R. Curtis Ellison, a Boston University physician who has championed the benefits of alcohol, hosted a conference on the subject. A summary of the conference, published a year later, said scientists had reached a “consensus” that moderate drinking “has been shown to have predominantly beneficial effects on health.”

The meeting, like much of Dr. Ellison’s work, was partly financed by industry grants. And the summary was written by him and Marjana Martinic, a senior vice president for the International Center for Alcohol Policies, a nonprofit group supported by the industry. The center paid for tens of thousands of copies of the summary, which were included as free inserts in two medical journals, *The American Journal of Medicine* and *The American Journal of Cardiology*.

In an interview, Dr. Ellison said his relationship with the industry did not influence his work, adding, “No one would look at our critiques if we didn’t present a balanced view.”

Dr. Fillmore and the co-authors of her analysis posted an online commentary saying the summary had glossed over some of the deep divisions that polarized the debate at the conference. “We also dispute Ellison and Martinic’s conclusions that more frequent drinking is the strongest predictor of health benefits,” they wrote.

(Dr. Fillmore has received support from the Alcohol Education and Rehabilitation Foundation of Australia, a nonprofit group that works to prevent alcohol and substance abuse.)

Dr. Ellison said Dr. Fillmore’s analysis ignored newer studies that corrected the methodological errors of earlier work. “She threw out the baby with the bathwater,” he said.

Meanwhile, two central questions remain unresolved: whether abstainers and moderate drinkers are fundamentally different and, if so, whether it is those differences that make them live longer, rather than their alcohol consumption.

Dr. Naimi of the C.D.C., who did a study looking at the characteristics of moderate drinkers and abstainers, says the two groups are so different that they simply cannot be compared. Moderate drinkers are healthier, wealthier and more educated, and they get better health care, even though they are more likely to smoke. They are even more likely to have all of their teeth, a marker of well-being.

“Moderate drinkers tend to be socially advantaged in ways that have nothing to do with their drinking,” Dr. Naimi said. “These two groups are apples and oranges.” And simply advising the nondrinkers to drink won’t change that, he said.

Some scientists say the time has come to do a large, long-term randomized controlled clinical trial, like the ones for new drugs. One approach might be to recruit a large group of abstainers who would be randomly

assigned either to get a daily dose of alcohol or not, and then closely followed for several years; another might be to recruit people who are at risk for coronary disease.

But even the experts who believe in the health benefits of alcohol say this is an implausible idea. Large randomized trials are expensive, and they might lack credibility unless they were financed by the government, which is unlikely to take on the controversy. And there are practical and ethical problems in giving alcohol to abstainers without making them aware of it and without contributing to accidents.

Still, some small clinical trials are already under way to see whether diabetics can reduce their risk of heart disease by consuming alcohol. In Boston, researchers at Beth Israel Deaconess Medical Center are recruiting volunteers 55 and over who are at risk for heart disease and randomly assigning them to either drink plain lemonade or lemonade spiked with tasteless grain alcohol, while scientists track their cholesterol levels and scan their arteries.

In Israel, researchers gave people with Type 2 diabetes either wine or nonalcoholic beer, finding that the wine drinkers had significant drops in blood sugar, though only after fasting; the Israeli scientists are now working with an international team to begin a larger two-year trial.

"The last thing we want to do as researchers and physicians is expose people to something that might harm them, and it's that fear that has prevented us from doing a trial," said Dr. Sei Lee of the University of California, San Francisco, who recently proposed a large trial on alcohol and health.

"But this is a really important question," he continued. "Because here we have a readily available and widely used substance that may actually have a significant health benefit - but we just don't know enough to make recommendations."

Providing health insurance for US children would be cheaper than expected, study says ***Research from Rice University's Baker Institute finds that economic benefits would outweigh costs***

Extending health insurance coverage to all children in the U.S. would be relatively inexpensive and would yield economic benefits that are greater than the costs, according to new research conducted at Rice University's Baker Institute for Public Policy.

"Providing health insurance to all children in America will yield substantial economic benefits," wrote Vivian Ho, chair in health economics at the Baker Institute and associate professor of medicine at Baylor College of Medicine. She co-authored the report with Marah Short, senior staff researcher in health economics at the Baker Institute. They based their research on recent studies published in peer-reviewed journals to examine the evidence regarding the economic impact of failing to insure all children in the United States.

The children will receive better health care and enjoy better health, thereby improving their productivity as adults, the researchers said. The cost incurred by providing universal coverage to children "will be offset by the increased value of additional life years and improved health-related quality of life gained from improved health care. From a societal perspective, universal coverage for children appears to be cost-saving."

Ho and Short compared the children's health care in the United States to the care provided in other industrialized countries and found that despite higher per capita spending, "the United States ranks third-highest among 30 Organisation for Economic Co-operation and Development countries in the percentage of the population lacking health insurance, with one in seven people uninsured." They estimate the number of uninsured children in the U.S. to be more than 8 million.

The literature clearly indicates this lack of coverage leads to "lower access to medical care and lower use of health care services," the authors wrote. It may even be reflected in relatively high child morbidity rates in the United States, they argued. Moreover, lack of health care for children has long-term effects as those children become adults.

"The collective body of research that we have reviewed," Ho and Short said, "provides compelling evidence that covering all children in the United States with health insurance will yield immediate improvements in the health of children, as well as long-term returns of greater health and productivity in adulthood. The upfront incremental costs of universal health insurance coverage for children are relatively modest, and they will be offset by the value of increased health capital gained in the long term."

To view the report titled ["The Economic Impact of Uninsured Children on America," click here.](#)

When palm trees gave way to spruce trees

For climatologists, part of the challenge in predicting the future is figuring out exactly what happened during previous periods of global climate change.

One long-standing climate puzzle relates to a sequence of events 33.5 million years ago in the Late Eocene and Early Oligocene. Profound changes were underway. Globally, carbon dioxide levels were falling and the

hothouse warmth of the dinosaur age and Eocene Period was waning. In Antarctica, ice sheets had formed and covered much of the southern polar continent.

But what exactly was happening on land, in northern latitudes? When and how did Northern glaciation begin, and what does this knowledge add to the understanding of the relationship between carbon dioxide levels and today's climate?

An international team that included Dr. David Greenwood, an NSERC-funded researcher at Brandon University, now provides some of the very first detailed answers, and they come from an unusual source.

"Fossils of land plants are excellent indicators of past climates," said Dr. Greenwood. "But the fossil plant localities from the Canadian Arctic and Greenland don't appear to record this major climate change, and pose problems for precisely dating their age, so we needed to look elsewhere."

The "where" was in marine sediments entombed when the North Atlantic Ocean was beginning to open, and lying now at the bottom of today's Norwegian-Greenland Sea. Sediment cores taken from there contained a record of ancient spores and pollen blown from the continent to the west.

"These marine sediment cores give us a very precise chronology of the changes in the dominant land plants," said Dr. Greenwood "and since many of these species have modern relatives, we can assume that the temperatures and environments they lived in were very similar."

To arrive at a holistic picture of the climate of the transition, the researchers merged the plant data with physical information about the state of the atmosphere and ocean taken from chemical and isotopic information in the same sediments, and compared this to computer modelling of climate in the period.

"We can see that summer temperatures on land remained relatively warm throughout the Eocene/Oligocene transition, but that the period was marked by increasing seasonality," said Dr. Greenwood. "Mean temperatures during the coldest month dropped by five degrees Celsius, to just above freezing," he said.

"This was probably not enough to create much in the way of continental ice on East Greenland," he said, "but it did wipe out palms and other subtropical trees such as swamp cypress. They were replaced by temperate climate trees such as spruces and hemlock."

The researcher said that, nonetheless, the middle period of the transition remained fairly warm. "Hickory and walnut were still present, but these became rare in the final stages," he said. Although the march to a cooler world was gradual in northern latitudes, it was inevitable according to Dr. Greenwood.

"Changes in the earth's position in its orbit were leading a much greater seasonal range in radiation for polar regions and, overall, heat was becoming more concentrated in the tropics, largely due to a global drop in carbon dioxide levels in the atmosphere" he said.

The group's detailed record of the Eocene/Oligocene transition will appear in the June 18 issue of Nature. Further information can be found in a release from the University of Southampton, England.

New Glimpses of Life's Puzzling Origins

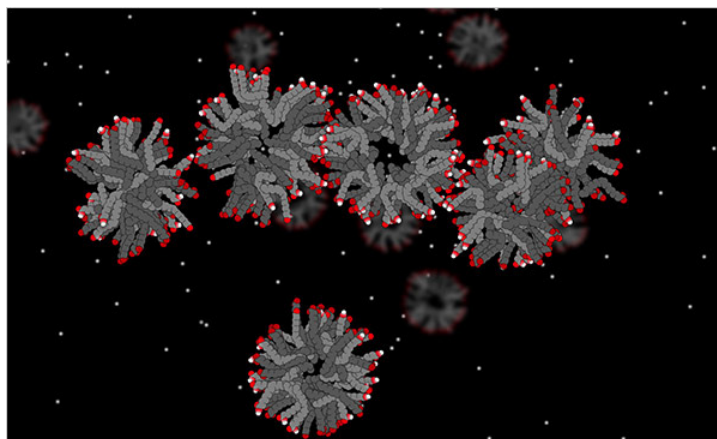
By NICHOLAS WADE

Some 3.9 billion years ago, a shift in the orbit of the Sun's outer planets sent a surge of large comets and asteroids careening into the inner solar system. Their violent impacts gouged out the large craters still visible on the Moon's face, heated Earth's surface into molten rock and boiled off its oceans into an incandescent mist.

Yet rocks that formed on Earth 3.8 billion years ago, almost as soon as the bombardment had stopped, contain possible evidence of biological processes. If life can arise from inorganic matter so quickly and easily, why is it not abundant in the solar system and beyond? If biology is an inherent property of matter, why have chemists so far been unable to reconstruct life, or anything close to it, in the laboratory?

A START In one view of the beginnings of life, depicted in an animation, carbon monoxide molecules condense on hot mineral surfaces underground to form fatty acids, above, which are then expelled from geysers. Janet Iwasa

The origins of life on Earth bristle with puzzle and paradox. Which came first, the proteins of living cells or the genetic information that makes them? How could the metabolism of living things get started without an enclosing membrane to keep all the necessary chemicals together? But if life started inside a cell membrane, how did the necessary nutrients get in?



The questions may seem moot, since life did start somehow. But for the small group of researchers who insist on learning exactly how it started, frustration has abounded. Many once-promising leads have led only to years of wasted effort. Scientists as eminent as Francis Crick, the chief theorist of molecular biology, have quietly suggested that life may have formed elsewhere before seeding the planet, so hard does it seem to find a plausible explanation for its emergence on Earth.

In the last few years, however, four surprising advances have renewed confidence that a terrestrial explanation for life's origins will eventually emerge.

One is a series of discoveries about the cell-like structures that could have formed naturally from fatty chemicals likely to have been present on the primitive Earth. This lead emerged from a long argument between three colleagues as to whether a genetic system or a cell membrane came first in the development of life. They eventually agreed that genetics and membranes had to have evolved together.

The three researchers, Jack W. Szostak, David P. Bartel and P. Luigi Luisi, published a somewhat adventurous manifesto in *Nature* in 2001, declaring that the way to make a synthetic cell was to get a protocell and a genetic molecule to grow and divide in parallel, with the molecules being encapsulated in the cell. If the molecules gave the cell a survival advantage over other cells, the outcome would be "a sustainable, autonomously replicating system, capable of Darwinian evolution," they wrote.

"It would be truly alive," they added.

One of the authors, Dr. Szostak, of the Massachusetts General Hospital, has since managed to achieve a surprising amount of this program.

Simple fatty acids, of the sort likely to have been around on the primitive Earth, will spontaneously form double-layered spheres, much like the double-layered membrane of today's living cells. These protocells will incorporate new fatty acids fed into the water, and eventually divide.

Living cells are generally impermeable and have elaborate mechanisms for admitting only the nutrients they need. But Dr. Szostak and his colleagues have shown that small molecules can easily enter the protocells. If they combine into larger molecules, however, they cannot get out, just the arrangement a primitive cell would need. If a protocell is made to encapsulate a short piece of DNA and is then fed with nucleotides, the building blocks of DNA, the nucleotides will spontaneously enter the cell and link into another DNA molecule.

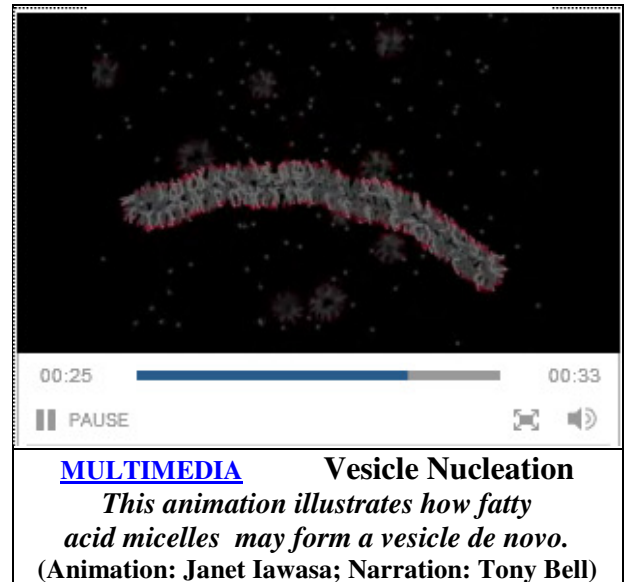
At a symposium on evolution at the Cold Spring Harbor Laboratory on Long Island last month, Dr. Szostak said he was "optimistic about getting a chemical replication system going" inside a protocell. He then hopes to integrate a replicating nucleic acid system with dividing protocells.

Dr. Szostak's experiments have come close to creating a spontaneously dividing cell from chemicals assumed to have existed on the primitive Earth. But some of his ingredients, like the nucleotide building blocks of nucleic acids, are quite complex. Prebiotic chemists, who study the prelife chemistry of the primitive Earth, have long been close to despair over how nucleotides could ever have arisen spontaneously.

Nucleotides consist of a sugar molecule, like ribose or deoxyribose, joined to a base at one end and a phosphate group at the other. Prebiotic chemists discovered with delight that bases like adenine will easily form from simple chemicals like hydrogen cyanide. But years of disappointment followed when the adenine proved incapable of linking naturally to the ribose.

Last month, John Sutherland, a chemist at the University of Manchester in England, reported in *Nature* his discovery of a quite unexpected route for synthesizing nucleotides from prebiotic chemicals. Instead of making the base and sugar separately from chemicals likely to have existed on the primitive Earth, Dr. Sutherland showed how under the right conditions the base and sugar could be built up as a single unit, and so did not need to be linked.

"I think the Sutherland paper has been the biggest advance in the last five years in terms of prebiotic chemistry," said Gerald F. Joyce, an expert on the origins of life at the Scripps Research Institute in La Jolla, Calif.



Once a self-replicating system develops from chemicals, this is the beginning of genetic history, since each molecule carries the imprint of its ancestor. Dr. Crick, who was interested in the chemistry that preceded replication, once observed, “After this point, the rest is just history.”

Dr. Joyce has been studying the possible beginning of history by developing RNA molecules with the capacity for replication. RNA, a close cousin of DNA, almost certainly preceded it as the genetic molecule of living cells. Besides carrying information, RNA can also act as an enzyme to promote chemical reactions. Dr. Joyce reported in *Science* earlier this year that he had developed two RNA molecules that can promote each other’s synthesis from the four kinds of RNA nucleotides.

“We finally have a molecule that’s immortal,” he said, meaning one whose information can be passed on indefinitely. The system is not alive, he says, but performs central functions of life like replication and adapting to new conditions. “Gerry Joyce is getting ever closer to showing you can have self-replication of RNA species,” Dr. Sutherland said. “So only a pessimist wouldn’t allow him success in a few years.”

Another striking advance has come from new studies of the handedness of molecules. Some chemicals, like the amino acids of which proteins are made, exist in two mirror-image forms, much like the left and right hand. In most naturally occurring conditions they are found in roughly equal mixtures of the two forms. But in a living cell all amino acids are left-handed, and all sugars and nucleotides are right-handed.

Prebiotic chemists have long been at a loss to explain how the first living systems could have extracted just one kind of the handed chemicals from the mixtures on the early Earth. Left-handed nucleotides are a poison because they prevent right-handed nucleotides linking up in a chain to form nucleic acids like RNA or DNA. Dr. Joyce refers to the problem as “original syn,” referring to the chemist’s terms syn and anti for the structures in the handed forms.

The chemists have now been granted an unexpected absolution from their original syn problem. Researchers like Donna Blackmond of Imperial College London have discovered that a mixture of left-handed and right-handed molecules can be converted to just one form by cycles of freezing and melting.

With these four recent advances — Dr. Szostak’s protocells, self-replicating RNA, the natural synthesis of nucleotides, and an explanation for handedness — those who study the origin of life have much to be pleased about, despite the distance yet to go. “At some point some of these threads will start joining together,” Dr. Sutherland said. “I think all of us are far more optimistic now than we were five or 10 years ago.”

One measure of the difficulties ahead, however, is that so far there is little agreement on the kind of environment in which life originated. Some chemists, like Günther Wächtershäuser, argue that life began in volcanic conditions, like those of the deep sea vents. These have the gases and metallic catalysts in which, he argues, the first metabolic processes were likely to have arisen.

But many biologists believe that in the oceans, the necessary constituents of life would always be too diluted. They favor a warm freshwater pond for the origin of life, as did Darwin, where cycles of wetting and evaporation around the edges could produce useful concentrations and chemical processes.

No one knows for sure when life began. The oldest generally accepted evidence for living cells are fossil bacteria 1.9 billion years old from the Gunflint Formation of Ontario. But rocks from two sites in Greenland, containing an unusual mix of carbon isotopes that could be evidence of biological processes, are 3.830 billion years old.

How could life have gotten off to such a quick start, given that the surface of the Earth was probably sterilized by the Late Heavy Bombardment, the rain of gigantic comets and asteroids that pelted the Earth and Moon around 3.9 billion years ago? Stephen Mojzsis, a geologist at the University of Colorado who analyzed one of the Greenland sites, argued in *Nature* last month that the Late Heavy Bombardment would not have killed everything, as is generally believed. In his view, life could have started much earlier and survived the bombardment in deep sea environments.

Recent evidence from very ancient rocks known as zircons suggests that stable oceans and continental crust had emerged as long as 4.404 billion years ago, a mere 150 million years after the Earth’s formation. So life might have had half a billion years to get started before the cataclysmic bombardment.

But geologists dispute whether the Greenland rocks really offer signs of biological processes, and geochemists have often revised their estimates of the composition of the primitive atmosphere. Leslie Orgel, a pioneer of prebiotic chemistry, used to say, “Just wait a few years, and conditions on the primitive Earth will change again,” said Dr. Joyce, a former student of his.

Chemists and biologists are thus pretty much on their own in figuring out how life started. For lack of fossil evidence, they have no guide as to when, where or how the first forms of life emerged. So they will figure life out only by reinventing it in the laboratory.

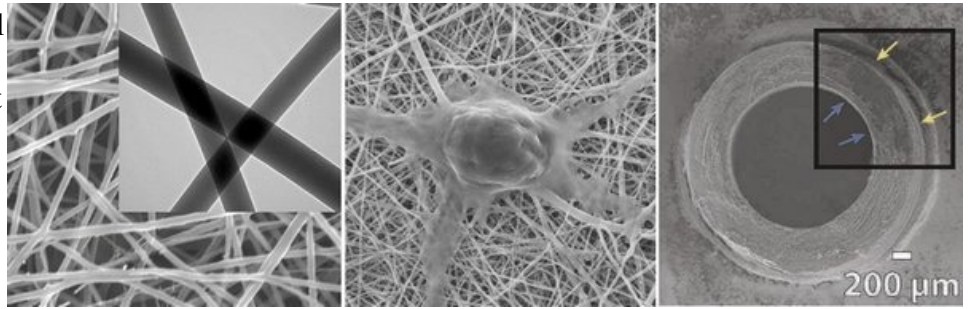
Crustacean shell with polyester creates mixed-fiber material for nerve repair

Hannah Hickey

In the clothing industry it's common to mix natural and synthetic fibers. Take cotton and add polyester to make clothing that's soft, breathable and wrinkle free.

Now researchers at the University of Washington are using the same principle for biomedical applications.

Mixing chitosan, found in the shells of crabs and shrimp, with an industrial polyester creates a promising new material for the tiny tubes that support repair of a severed nerve, and could serve other medical uses. The hybrid fiber combines the biologically favorable qualities of the natural material with the mechanical strength of the synthetic polymer.



The left panel shows a closeup of chitosan and polyester fibers woven at the nanometer scale. The middle panel shows a nerve cell growing on the resulting mesh, which has a texture similar to the body's fibrous connective tissue. The right panel shows a cross-section of the synthetic nerve guide. Arrows point to nerve cells that have attached to the inner and outer surfaces of the tube. University of Washington

"A nerve guide requires very strict conditions. It needs to be biocompatible, stable in solution, resistant to collapse and also pliable, so that surgeons can suture it to the nerve," said Miqin Zhang, a UW professor of material science and engineering and lead author of a paper now available online in the journal *Advanced Materials*. "This turns out to be very difficult."

After an injury that severs a peripheral nerve, such as one in a finger, nerve endings continue to grow. But to regain control of the nerve surgeons must join the two fragments. For large gaps surgeons used to attempt a more difficult nerve graft. Current surgical practice is to attach tiny tubes, called nerve guides, that channel the two fragments toward each other.

Today's commercial nerve guides are made from collagen, a structural protein derived from animal cells. But collagen is expensive, the protein tends to trigger an immune response and the material is weak in wet environments, such as those inside the body.

The strength of the nerve guide is important for budding nerve cells.

"This conduit serves as a guide to protect the neuron from injury," Zhang said. "If the tube is made of collagen, it's difficult to keep the conduit open because any stress and it's going to collapse."

Zhang and colleagues developed an alternative. The first component of their material, polycaprolactone, is a strong, flexible, biodegradable polyester commonly used in sutures. It is not suitable on its own for use as a nerve guide because water-based cells don't like to grow on the polyester's water-repelling surface.

The second component, chitosan, is found in the shells of crustaceans. It's cheap, readily available, biodegradable and biocompatible, meaning that it won't trigger an immune response. Chitosan has a rough surface similar to the surfaces found inside the body that cells can attach to. The problem is chitosan swells in water, making it weak in wet environments.

Researchers combined the fibers at the nanometer scale by first using a technique called electrospinning to draw the materials into nanometer-scale fibers, and then weaving the fibers together. The resulting material has a texture similar to that of the nanosized fibers of the connective tissue that surrounds human cells.

The two materials are different and are difficult to blend, but proper mixing is crucial because imperfectly blended fibers have weak points.

Zhang and colleagues built prototype nerve guides measuring 1.5 millimeters (0.06 inches) in diameter, and between five and 15 centimeters (two to six inches) long. They tested a guide made from the chitosan-polyester blend against another biomaterial under study, polylactidoglycolic acid, and a commercially available collagen guide.

Of the three materials, the chitosan-polyester weave showed the most consistent performance for strength, flexibility and resistance to compression under both dry and wet conditions. Under wet conditions, which the researchers say best mimics those in the body, the chitosan-polyester blend required twice as much force to push the tube halfway shut as the other biomaterial, and eight times as much force as the collagen tube.

The new material showed promise for nerve guides but would also work well for wound dressings, heart grafts, tendons, ligament, cartilage, muscle repair and other biomedical applications, Zhang said.

The research was funded by the National Science Foundation through a grant to the UW's Engineered Biomaterials Research Center. Co-authors on the paper are Richard Ellenbogen, Narayan Bhattarai, Zhensheng Li, Jonathan Gunn, Matthew Leung, Ashleigh Cooper, Dennis Edmonson and Omid Veisheh of the UW; Ming-Hong Chen of the National Yang-Ming University in Taiwan; and Yong Zhang of the National University of Singapore.

For more information, contact Zhang at 206-616-9356 or mzhang@u.washington.edu.

New discovery suggests mammoths survived in Britain until 14,000 years ago

Research which finally proves that bones found in Shropshire, England provide the most geologically recent evidence of woolly mammoths in North Western Europe publishes today in the *Geological Journal*. Analysis of both the bones and the surrounding environment suggests that some mammoths remained part of British wildlife long after they are conventionally believed to have become extinct.

The mammoth bones, consisting of one largely complete adult male and at least four juveniles, were first excavated in 1986, but the carbon dating which took place at the time has since been considered inaccurate. Technological advances during the past two decades now allow a more exact reading, which complements the geological data needed to place the bones into their environmental context. This included a study of the bones' decay, analysis of fossilised insects which were also found on the site, and a geological analysis of the surrounding sediment.

The research was carried out by Professor Adrian Lister, based at the Natural History Museum in London, who has conducted numerous studies into 'extinction lag' where small pockets of a species have survived for thousands of years longer than conventionally thought.

"Mammoths are conventionally believed to have become extinct in North Western Europe about 21,000 years ago during the main ice advance, known as the 'Last Glacial Maximum'" said Lister. "Our new radiocarbon dating of the Conover mammoths changes that, by showing that mammoths returned to Britain and survived until around 14,000 years ago."

As the Shropshire bones are the latest record of mammoths in North Western Europe they not only prove that the species survived for much longer than traditionally believed it also provides strong evidence to settle the debate as to whether mammoth extinction was caused by climate change or human hunting.

"The new dates of the mammoths' last appearance correlate very closely in time to climate changes when the open grassy habitat of the Ice Age was taken over by advancing forests, which provides a likely explanation for their disappearance," said Lister. "There were humans around during the time of the Conover mammoths, but no evidence of significant mammoth hunting."

*Dr Lister's findings feature in one of three papers on the Conover Mammoths which are all published in the *Geological Journal*. The other papers focus on the Palaeoenvironmental context of the mammoths (Allen et al) and a geological study of the site in which the mammoths were discovered (Scourse et al).*

Monkey 'IQ test' hints at intelligent human ancestor

* 01:00 17 June 2009 by Ewen Callaway

Human intelligence may not be so human after all. New research on monkeys finds that individual animals perform consistently on numerous different tests of intelligence – a hallmark of human IQ and, perhaps, an indication that human intellect has a very ancient history.

No doubt, the human brain has bulged in the six million or so years since our species last shared a common ancestor with chimpanzees, offering more cognitive prowess compared to our closest relatives.

But traces of human intelligence, such as a sense of numbers, or the ability to use tools, lurk in a wide range of animals, particularly in other primates.

Less clear, though, is whether animals possess the same kind of general intelligence as humans: where performance on one facet, say verbal, strongly predicts performance on other tests of intelligence like working memory.

Cotton-top tamarins perform remarkably well on different tests of intelligence (Image: Peter Oxford / Nature Picture Library / Rex Features)



Monkey IQ test

"We were essentially looking for evidence of a general intelligence factor – something that would be an evolutionary homologue of what we see in humans," says Konika Banerjee, a psychologist at Harvard University who led the new study along with colleague Marc Hauser.

Working with 22 cotton-top tamarins (*Saguinus Oedipus*), the researchers tested all the monkeys on a wide range of cognitive tasks, 11 in total. "What we did here was, very crudely, create a monkey IQ test," Banerjee says.

In most tasks, the monkeys ended up in clear-cut groupings – above average, average, and below average.

For instance, in one test, animals had to reach around a plastic barrier to obtain a raisin placed right in front of them, but behind the barrier. The smartest monkeys quickly figured out the trick, another group went straight for the raisin before realizing a reach-around was needed, while the dunces never seem to figure it out, Banerjee says.

Consistent performance

There was less of a spread in a test of numerical discrimination, when monkeys had to pick between two dishes, one with three treats another with four. Most monkeys consistently picked the dish with four treats.

Banerjee's team ranked the 22 monkeys across all 11 tasks and found that the same animals tended to perform similarly well across all the tests. When her team calculated an IQ score for each monkey, the smarter monkey bested the less intelligent monkey two-thirds of the time for any given test.

"This is a difficult study to undertake, and this team should be commended for doing it so well," says Robert Deaner, a psychologist at Grand Valley State University in Allendale, Michigan. He says the new work "really strengthens the argument" that general intelligence has a long evolutionary history.

Journal reference: PLoS ONE (in press)

Brain detects happiness more quickly than sadness

People make value judgements about others based on their facial expressions. A new study, carried out by Spanish and Brazilian researchers, shows that – after looking at a face for only 100 milliseconds – we can detect expressions of happiness and surprise faster than those of sadness or fear.

Our brains get a first impression of people's overriding social signals after seeing their faces for only 100 milliseconds (0.1 seconds). Whether this impression is correct, however, is another question. Now an international group of experts has carried out an in-depth study into how we process emotional expressions, looking at the pattern of cerebral asymmetry in the perception of positive and negative facial signals.

The researchers worked with 80 psychology students (65 women and 15 men) to analyze the differences between their cerebral hemispheres using the "divided visual field" technique, which is based on the anatomical properties of the visual system.

"What is new about this study is that working in this way ensures that the information is focused on one cerebral hemisphere or the other", J. Antonio Aznar-Casanova, one of the authors of the study and a researcher at the University of Barcelona (UB), tells SINC.

The results, published in the latest issue of the journal *Laterality*, show that the right hemisphere performs better in processing emotions. "However, this advantage appears to be more evident when it comes to processing happy and surprised faces than sad or frightened ones", the researcher points out.

"Positive expressions, or expressions of approach, are perceived more quickly and more precisely than negative, or withdrawal, ones. So happiness and surprise are processed faster than sadness and fear", explains Aznar-Casanova.

The two faces of the brain

This research study adds to previous ones, which had revealed asymmetries in the way the brain processes emotions, and enriches the international debate in cognitive-emotional neuroscience in terms of how to define the exact way in which human beings process these facial expressions.

People make deductions from the expressions on people's faces. "These inferences can strongly influence election results or the sentences given in trials, and have been studied before in fields such as criminology and the pseudoscience of physiognomy", the neuroscientist tells SINC.

Two theories are currently "competing" to explain the pattern of cerebral asymmetry in processing emotions. The older one postulates the dominance of the right hemisphere in the processing of emotions, while the second is based on the approach-withdrawal hypothesis, which holds that the pattern of cerebral asymmetry depends upon the emotion in question, in other words that each hemisphere is better at processing particular emotions (the right, withdrawal, and the left, approach).

"Today there is scientific evidence in favour of both these theories, but there is a certain consensus in favour of the lateralisation of emotional processing predicted by the approach-withdrawal hypothesis", concludes Aznar-Casanova.

References: Torro-Alves, N.; Aznar-Casanova, J. A. y Fukusima, S.S. "Patterns of brain asymmetry in the perception of positive and negative facial expressions". Laterality: Asymmetries of Body, Brain and Cognition, 14: 256 – 272, mayo de 2009.

Lung-on-a-chip could replace countless lab rats

* 17 June 2009 by **Duncan Graham-Rowe**

"MICROLUNGS" grown from human tissue might one day help to replace the vast numbers of rats used to check the safety of drugs, cosmetics and other chemicals. The work is part of a growing drive to develop toxicology tests based on human cells as a replacement for animal testing.

Such efforts are made partly for ethical concerns, and partly because animal testing is so time-consuming and expensive. For example, the European Union's REACH regulations require about 30,000 chemicals to be tested for toxicity over the next decade. Yet testing the effects of inhaling a single dose of a particular chemical typically requires more than 200 rats, while testing the chronic effects of breathing it in over time can take more than 3000. Meanwhile the EU Cosmetics Directive - which covers items from deodorants and perfume to air-fresheners - seeks to ban all tests of cosmetics on animals by 2013.

The obvious alternative is to test chemicals on human cells grown in the lab. The difficulty, however, lies in enticing those cells to form complex tissue that responds as our organs do.

Cell biologist Kelly BÉruBÉ at the University of Cardiff, UK, has managed to grow human lung cells into flat differentiated layers that resemble the inner lining of the lungs. Her method is already being used for drug testing by companies such as Unilever and AstraZeneca. But when allowed to grow in three dimensions, as in the body, cells arrange themselves very differently, and this can change how they respond to chemical stimuli. "We need to move from something flat to 3D structures," says BÉruBÉ.

A popular approach is to seed plastic scaffolds with stem cells to grow artificial "organs", but BÉruBÉ and her colleagues have found an alternative which could allow thousands of drugs to be screened at once.

Instead of large scaffolds, BÉruBÉ has grown lung cells on the surface of plastic spheres half a millimetre in diameter (see image), essentially producing a tiny inside-out lung around each bead (see image). The ultimate aim is to develop a chip on which thousands of microlungs can be grown then tested simultaneously, she told the Cheltenham Festival of Science in the UK last week (see image).

Cells grow on little plastic spheres, essentially producing a tiny inside-out lung around each bead

The big challenges will be getting the technique accepted by regulatory authorities and convincing academia that tiny globs of lab-grown tissue can tell us as much in tests as whole animals. But BÉruBÉ points out that rat models are less relevant to humans than most people realise. Chocolate, for example, is lethal to rats and their anatomy is such that they can only breathe through their noses.

Wrong type of help from parents could worsen child's OCD

April Frawley Birdwell

For most parents, soothing a child's anxiety is just part of the job. But for a parent whose child has obsessive-compulsive disorder, soothing anxiety and helping with behaviors linked to the disease could lead to more severe symptoms, University of Florida researchers say.

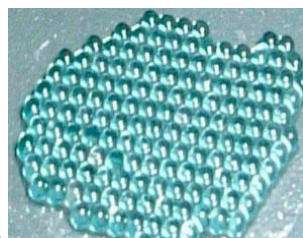
Often, parents of children with OCD will help their children complete rituals related to their obsessions and compulsions, such as excessive bathing or checking things like door locks, according to findings recently published in the *Journal of Consulting and Clinical Psychology*. These accommodations can be anything that makes the symptoms of OCD less impairing, from reassuring a child that his hands are clean and his baby brother is OK to even doing his homework for him or buying objects that make the child feel safe.

"Parents do that because that is what a parent whose child doesn't have OCD would do," said Lisa Merlo, Ph.D., a UF assistant professor of psychiatry and the lead author of the study. "If your child is upset, you try to comfort them. But what we know is, for patients with OCD, if they get an accommodation, that reinforces the OCD to them.

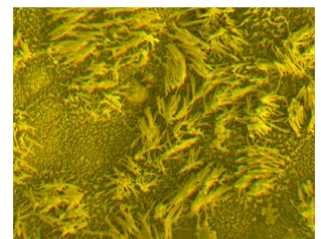
"It's validating the OCD in the kid's mind, and that's what you don't want to do."

About one in 200 children and teenagers in the United States have OCD, according to the American Academy of Child & Adolescent Psychiatry.

The study included 49 children between 6 and 18 with OCD and their families who came to UF for a type of treatment called cognitive-behavioral therapy. This form of therapy involves exposing children to their fears and teaching them better ways to respond and cope. During the sessions, therapists teach parents how they should deal with their child's OCD, too.



These polymer beads make up the microlungs (Image: courtesy of Dr Kelly BÉruBÉ / School of Biosciences, Cardiff University)



Close-up of the surface of a health microlung (Image: courtesy of Dr Kelly BÉruBÉ / School of Biosciences, Cardiff University)

Prior to the start of the 14-session therapy, the researchers gauged how severe each child's condition was and compared it to how many accommodating behaviors parents reported. They found that the more severe the child's OCD, the more the child's family seemed to accommodate OCD behaviors.

"You would think if parents are helping, the kids would be less impaired," Merlo said. "But what we are seeing is that it snowballs and makes it worse and worse."

After the treatment, researchers noticed a significant decrease in how often families were assisting children with OCD behaviors and rituals. Children whose families had the biggest decrease in these accommodations also had the biggest improvement in their OCD symptoms, Merlo said.

What researchers don't yet know is if a family's "help" causes a child's OCD to worsen or if the severity of the disease causes parents to try to do more to help their children.

Some children, including many who come to UF's clinic, have symptoms so severe it prevents them from playing with friends or even going to school, Merlo said. In these instances, parents often feel they have to do whatever they can to help their children function, from doing their homework for them to buying specific items they feel like they need.

"If a kid is struggling a lot, parents feel like they have to do a lot to get through the day," Merlo said. "But if the child is not experiencing the natural consequences of the OCD symptoms, then they don't have any motivation to stop."

This phenomenon isn't exclusive to children and parents, said Jonathan S. Abramowitz, Ph.D., an associate professor and associate chairman of psychology at the University of North Carolina at Chapel Hill.

"We see it with adults' spouses and partners, too. In trying to be helpful to the person with OCD, they end up making the problem worse."

Although therapists have noticed this phenomenon anecdotally, there has so far been little research evidence to prove it. UF's study will help therapists and scientists address the problem, he said.

"It is very nice to have research data to back up these clinical observations," he said.

University of Colorado team finds definitive evidence for ancient lake on Mars

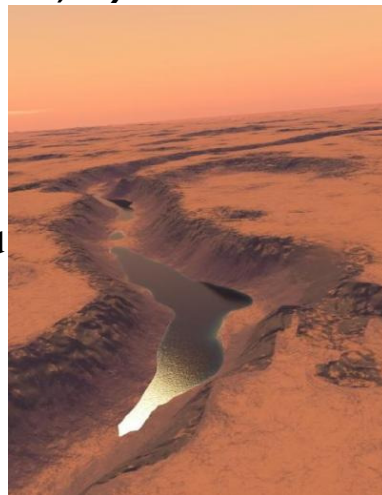
First unambiguous evidence for shorelines on the surface of Mars, say researchers

A University of Colorado at Boulder research team has discovered the first definitive evidence of shorelines on Mars, an indication of a deep, ancient lake there and a finding with implications for the discovery of past life on the Red Planet.

Estimated to be more than 3 billion years old, the lake appears to have covered as much as 80 square miles and was up to 1,500 feet deep -- roughly the equivalent of Lake Champlain bordering the United States and Canada, said CU-Boulder Research Associate Gaetano Di Achille, who led the study. The shoreline evidence, found along a broad delta, included a series of alternating ridges and troughs thought to be surviving remnants of beach deposits.

"This is the first unambiguous evidence of shorelines on the surface of Mars," said Di Achille. "The identification of the shorelines and accompanying geological evidence allows us to calculate the size and volume of the lake, which appears to have formed about 3.4 billion years ago."

This is reconstructed landscape showing the Shalbatana lake on Mars as it may have looked roughly 3.4 billion years ago. Data used in reconstruction are from NASA and the European Space Agency. Image credit: G. Di Achille, University of Colorado



A paper on the subject by Di Achille, CU-Boulder Assistant Professor Brian Hynek and CU-Boulder Research Associate Mindi Searls, all of the Laboratory for Atmospheric and Space Physics, has been published online in *Geophysical Research Letters*, a publication of the American Geophysical Union.

Images used for the study were taken by a high-powered camera known as the High Resolution Imaging Science Experiment, or HiRISE. Riding on NASA's Mars Reconnaissance Orbiter, HiRISE can resolve features on the surface down to one meter in size from its orbit 200 miles above Mars.

An analysis of the HiRISE images indicate that water carved a 30-mile-long canyon that opened up into a valley, depositing sediment that formed a large delta. This delta and others surrounding the basin imply the existence of a large, long-lived lake, said Hynek, also an assistant professor in CU-Boulder's geological sciences department. The lake bed is located within a much larger valley known as the Shalbatana Vallis.

"Finding shorelines is a Holy Grail of sorts to us," said Hynek.

In addition, the evidence shows the lake existed during a time when Mars is generally believed to have been cold and dry, which is at odds with current theories proposed by many planetary scientists, he said. "Not only

does this research prove there was a long-lived lake system on Mars, but we can see that the lake formed after the warm, wet period is thought to have dissipated."

Planetary scientists think the oldest surfaces on Mars formed during the wet and warm Noachian epoch from about 4.1 billion to 3.7 billion years ago that featured a bombardment of large meteors and extensive flooding. The newly discovered lake is believed to have formed during the Hesperian epoch and postdates the end of the warm and wet period on Mars by 300 million years, according to the study.

The deltas adjacent to the lake are of high interest to planetary scientists because deltas on Earth rapidly bury organic carbon and other biomarkers of life, according to Hynek. Most astrobiologists believe any present indications of life on Mars will be discovered in the form of subterranean microorganisms.

But in the past, lakes on Mars would have provided cozy surface habitats rich in nutrients for such microbes, Hynek said.

The retreat of the lake apparently was rapid enough to prevent the formation of additional, lower shorelines, said Di Achille. The lake probably either evaporated or froze over with the ice slowly turning to water vapor and disappearing during a period of abrupt climate change, according to the study.

Di Achille said the newly discovered pristine lake bed and delta deposits would be a prime target for a future landing mission to Mars in search of evidence of past life.

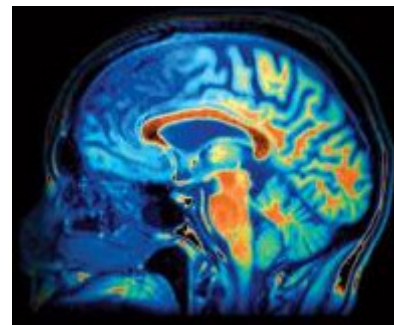
"On Earth, deltas and lakes are excellent collectors and preservers of signs of past life," said Di Achille. "If life ever arose on Mars, deltas may be the key to unlocking Mars' biological past."

Like a hole in the head: The return of trepanation

* 17 June 2009 by Arran Frood

IN THE early 1960s, a young Russian neurophysiologist called Yuri Moskalkenko travelled from the Soviet Union to the UK on a Royal Society exchange programme. During his stay, he co-authored a paper published in *Nature*. "Variation in blood volume and oxygen availability in the human brain" may not sound subversive, but it was the start of a radical idea.

Decades later, having worked in Soviet Russia and become president of the Sechenov Institute of Evolutionary Physiology and Biochemistry at the Russian Academy of Sciences in St Petersburg, Moskalkenko is back in the UK. Now collaborating with researchers at the Beckley Foundation in Oxford, his work is bearing fruit.



A hole in the skull could increase blood flow to the brain (Image: Zephyr / SPL)

And strange fruit it is. With funding from the foundation, he is exploring the idea that people with Alzheimer's disease could be treated by drilling a hole in their skull. In fact, he is so convinced of the benefits of trepanation that he claims it may help anyone from their mid-40s onwards to slow or even reverse the process of age-related cognitive decline. Can he be serious?

For thousands of years, trepanation has been performed for quasi-medical reasons such as releasing evil spirits that were believed to cause schizophrenia or migraine. Today it is used to prevent brain injury by relieving intracranial pressure, particularly after accidents involving head trauma.

In the popular imagination, though, it is considered crude, if not downright barbaric. Yet such is the desperation for effective treatments for dementia that drilling a hole in the skull is not even the strangest game in town (see "Desperate measures to treat dementia").

The problem is huge and growing. Alzheimer's, the most common form of dementia, affects 700,000 people in the UK and nearly 5 million in the US. In addition, 1 in 5 Americans over the age of 75 have mild cognitive impairment, which often leads to Alzheimer's. As people live longer, the numbers seem certain to grow. Yet we have few ideas about what causes dementia and even fewer about how to treat it. Most patients get a mixture of drugs and occupational therapy, which at best stalls the apparent progression of their illness by masking its symptoms.

The causes of dementia are many and poorly understood, but there is growing evidence that one factor is the flow of blood within the brain. As we age, cerebral blood flow decreases, and the earlier this happens the more likely someone is to develop early onset dementia. It remains unclear, however, whether declining cerebral blood flow is the cause, or an incidental effect of a more fundamental change. Moskalkenko's research indicates that cerebral blood flow is more closely correlated with age than with levels of dementia, so he decided to delve more deeply.

The brain's buffer

As well as delivering oxygen to the brain, cerebral blood flow has another vital role: the circulation and production of cerebrospinal fluid. This clear liquid surrounds the brain, carrying the nutrients that feed it and

removing the waste it produces, including the tau and beta-amyloid proteins that have been implicated in the formation of plaques found in the brains of people with Alzheimer's (Cerebrospinal Fluid Research, vol 5, p 10).

How blood flow influences cerebrospinal fluid flow can be gauged from something called "cranial compliance", a measure of the elasticity of the brain's vascular system. "The cranium is a bony cavity of fixed volume, with the brain taking up most of the space," says Robin Kennett, a neurophysiologist from the Oxford Radcliffe Hospitals in the UK. "Every time the heart beats and sends blood into the cranium, something else has to come out to prevent the pressure rising to levels that would damage the brain." So, as fresh blood flows into the brain's blood vessels, cerebrospinal fluid flows out into the space around the spinal cord through a hole in the base of the skull called the foramen magnum.

As we age, the proteins in the brain harden, preventing this system from working as it should. As a result, the flow of both blood and cerebrospinal fluid is reduced, impairing the delivery of oxygen and nutrients as well as the removal of waste. Moskalkenko's research suggests that this normally begins between the ages of 40 and 50. Moreover, in a study of 42 elderly people with dementia, he found that the severity of their cognitive disorder was strongly correlated with cranial compliance: those with the severest dementia had the lowest compliance (International Journal of Psychophysiology, vol 69, p 307). "Cranial compliance is a significant component of the origin of certain cases of brain pathology," he says.

This view gets qualified agreement from Conrad Johanson, a clinical neuroscientist at Brown University in Providence, Rhode Island. Although the link between low compliance and dementia has yet to be comprehensively shown, he says, "there's a gestalt that it's broadly true".

So where does trepanation come into all this? "A hole made in the bony cavity would act as a pressure-release valve," says Kennett, and this would alter the flow of fluids around the brain. This is exactly what Moskalkenko observed when he carried out one of the first neurophysiological studies on trepanation.

Moskalkenko studied 15 people who had undergone the procedure following head injuries. He found that their cranial compliance was around 20 per cent higher than the average for their age. Based on this, he calculates that a 4-square-centimetre hole increases cerebral blood flow by between 8 and 10 per cent, which is equivalent to 0.8 millilitres more blood per heartbeat (Human Physiology, vol 34, p 299). This, he says, shows that trepanation could be an effective treatment for Alzheimer's, and he even goes so far as to suggest that it might provide a "significant" improvement in the mental functions of anyone from their mid-40s, when cranial compliance starts to decline.

Spinal taps

Surprisingly, his most vociferous critics do not challenge his support for trepanation. Instead they question his ideas about how it works. Gerald Silverberg at the Stanford School of Medicine in California points out that drilling a hole in the skull may temporarily drain the cranial cavity of cerebrospinal fluid together with any toxins that may have accumulated in it, effectively flushing out the system. "Metabolite clearance, or the lack of it, is felt to be an important factor in the development of age-related dementias," he says. A similar intervention, known as a lumbar shunt or "spinal tap", in which a needle is inserted into the spinal column to remove cerebrospinal fluid, can dramatically improve the cognitive performance of people who undergo the procedure, Silverberg says. Spinal taps are normally used as a treatment for hydrocephalus - water on the brain - but Silverberg is now trying it out on people with Alzheimer's, and early studies suggest it helps (Neurology, vol 59, p 1139).

Olivier Baledent, a neurophysiologist based at the University Hospital of Amiens, France, also questions Moskalkenko's focus on cranial compliance (Journal of Cerebral Blood Flow & Metabolism, vol 27, p 1563). Like Silverberg, he believes cerebrospinal fluid itself is key. Baledent's unpublished research shows that in people with mild cognitive impairment, there is reduced activity in a part of the brain called the choroid plexus, where cerebrospinal fluid is formed. He suspects this results in impaired fluid formation and reabsorption, leading to a build-up of toxins, and that a spinal tap may be able to stop or decrease dementia by improving fluid turnover. Trepanation could work in a similar way.

So will dementia patients and their families ever accept trepanation as a treatment for the condition? Johanson, who sees trepanation as no more alarming than a spinal tap, admits that it is always going to be a hard sell. "People think it's witchcraft when you drill a hole in the skull and patients are improving."

Harriet Millward, deputy chief executive of UK-based charity Alzheimer's Research Trust, is keeping an open mind. "The procedure has been understudied so far and, until further research has been undertaken, the possibility of beneficial effects remains open," she says. David Smith, a neuropharmacologist and head of the Oxford Project to Investigate Memory and Ageing, is even more receptive. "I think the observations look pretty robust," he says. In the absence of drug treatments for dementia, "these rather drastic surgical ones are worth considering", he says.

"The laser helmet"

As worn by sci-fi and fantasy author Terry Pratchett, who was diagnosed with posterior cortical atrophy, a rare type of Alzheimer's, in 2007. Inventor Gordon Dougal, director of British company Restorelite, says the device uses light at a wavelength of 1072 nanometres to penetrate the skull and repair brain cells damaged by the ageing processes.

Omental transposition

Not for the faint-hearted. It entails cutting into the omentum, a blood-vessel-rich part of the lower abdominal cavity, and stretching a strip of this tissue so that it can be "tunnelled" under the skin and laid directly onto the brain. The operation's pioneer, Harry Goldsmith from the University of Nevada, believes this increases cerebral blood flow, improving neuronal activity.

Cranial osteopathy

Manipulating the skull by hand. The practice controversially assumes that adult skull plates are not fused, but move a fraction. Mark Rosen, president of The Cranial Academy in Indianapolis, Indiana, says there is evidence that cranial osteopathy increases intracranial blood flow.

Standing on your head

Albert Hoffman, the discoverer of LSD, swore by it. So do many devotees of yoga. Studies have shown that some yoga breathing techniques can significantly increase cerebral blood flow. Whether hanging upside down for 15 minutes a day can stave off dementia is another matter.

Arran Froom is a freelance science writer based in the UK

Cash machines hacked to spew out card details

* 17 June 2009 by Paul Marks

"SKULDUGGERY," says Andrew Henwood, "is a very good word to describe what this extremely advanced, cleverly written malware gets up to. We've never seen anything like it."

What he has discovered is a devious piece of criminal coding that has been quietly at work in a clutch of cash machines at banks in Russia and Ukraine. It allows a gang member to walk up to an ATM, insert a "trigger" card, and use the machine's receipt printer to produce a list of all the debit card numbers used that day, including their start and expiry dates - and their PINs. Everything needed, in fact, to clone those cards and start emptying bank accounts. In some cases, the malicious software even allows the criminal to eject the machine's banknote storage cassette into the street.

The software is the latest move in a security arms race after banks and consumers got wise to the fitting of fake fascias onto ATMs. These fascias have been criminals' main way of using ATMs to get the details they need to clone cards. They contain a camera to spy on PINs being entered on the keypad, and a card reader to skim data from the card's magnetic stripe. It's big business: across Europe, losses due to such fraud grew by 11 per cent to €484 million in 2008, according to the European ATM Security Team (EAST), funded by the European Union and based in Edinburgh, UK (see graph).

Banks responded by investing in anti-skimming technology - which can detect a fake fascia overlay and disable the ATM. So crooks are developing new tricks, which are being uncovered by Henwood and his colleagues at SpiderLabs, a computer forensics research centre in London.

Part of Trustwave, a computer security firm based in Chicago and London, SpiderLabs was hired by a banking group from eastern Europe, after the group discovered heightened levels of card cloning and strange ATM behaviour across its branches in Russia and Ukraine.

After months poring over the Windows-based software in the bank's ATMs, Henwood and his team were astonished. They found a 50-kilobyte piece of malware disguised as a legitimate Windows program called *lsass.exe*. In a PC, this helps the Microsoft operating system cache session data - so users don't have to re-enter their passwords every time they get a new email, for example.

This is a clever choice of camouflage, says SpiderLabs' forensics manager Stephen Venter: to an IT staffer, *lsass.exe* doesn't look out of place in a Windows system, so routine checks wouldn't necessarily pick it up. Yet it has no useful function in an ATM.

Once installed, the malware implements a "card data harvesting" routine, SpiderLabs said in an alert to banks issued at the end of May. When a customer inserts their card, the malware records to hard disc its account number, start date, expiry date and three-digit security code, as well as the PIN entered.

"That PIN data gets encrypted when it is transmitted through to the bank," explains Henwood, "but inside the machine it's in the clear. So this little bugger just sits there stealing all the card data."

Inside the ATM the PIN is unencrypted. So this little bugger just sits there stealing all the card data

Equally ingenious is how the crooks harvest their stolen data - by using the ATM's receipt printer. Inserting a trigger card into the machine's slot causes the malware to launch a small window on the screen, with a variety

of options. The first is to print out a list of all recently used cards. The data on the printout is encrypted, so crime bosses could enlist low-level accomplices to visit ATMs to retrieve the printouts, safe in the knowledge that they cannot use the data to clone cards themselves.

Another option on the menu even lets criminals with extended "access privileges" eject the cash cassette, although this only works with older, front-loading ATMs.

The hardest bit for the criminals is installing the malware in the first place, as it requires physical access to the machine. That most likely means an inside job within a bank, or using bribes or threats to encourage shop staff to provide access to a standalone ATM in a shop or mall.

News of the card-data harvester has shocked banks and security analysts. "My reaction to this was: how the hell did they get that software in there?" says Lachlan Gunn, head of EAST. "It must involve insiders." Colin Whittaker, head of security at the UK's Association for Payment Clearing Services (APACs), agrees: "The levels they have gone to to corrupt ATM engineers and install this software is just incredible."

SpiderLabs' analysts studied lsass.exe malware on 20 ATMs. They found multiple variants, and warn that it is almost certainly programmed to evolve further. One big concern is that it will become network capable - able to spread from machine to machine over the closed networks used by banks.

The discovery of the malware is likely to force banks to change their approach to ATM security. Past efforts have focused on developing "high-end security engineering" to authenticate customers' identities, says Whittaker. "We haven't perhaps given the ATMs' physical infrastructure much attention."

The malware is hidden in various Windows utilities, so it is unlikely to be caught by virus checkers. But banks will almost certainly introduce strong audit trails for the staff and engineers who have physical access to the guts of ATMs, for example, and block any USB connections to the ATM computers, so external pen drives cannot be connected to upload malware.

They need to move fast; SpiderLabs expects the technology to spread from eastern Europe to the US and Asia. European countries using chip-and-PIN cards will initially be immune because these ATMs encrypt PINs as they are typed, but it probably won't take hackers long to get around this too.

Giant sperm stretch back millions of years

* 19:00 18 June 2009 by Ewen Callaway

There's sperm and then there's super sperm – gigantic reproductive cells many times longer than the minute crustaceans that produce them. Now, scientists have discovered that ostracods, or seed shrimp, have been cranking out these giant sperm for at least 100 million years.

The outsized cells likely increase a male's chances of impregnating a female in the face of intense competition from sperm from other males.

Yet researchers thought that this "bigger is better" reproductive strategy couldn't last for long, certainly not 100 million years, says Renate Matzke-Karasz, a biologist at Ludwig Maximilians University in Munich, who led the study. "We would expect the development of these strange things to stop at a certain point and it would not be an advantageous anymore."



Tiny shrimp have been pumping out gigantic sperm cells for millions of years (Image: Renate Matzke-Karasz)

Big investment

Males invest vast stores of energy in making the super sperm and females must maintain similarly large ducts to store the cells for later fertilization.

"It seems to be a successful strategy and this is strange," says Matzke-Karasz, whose team constructed three-dimensional images of millimetre-long male and female ostracod fossils from the Cretaceous-era Santana formation in north-eastern Brazil. It's rare for internal organs to exist in a fossil, but the ostracods' calcified carapaces may have enabled their preservation.

The images, made by firing X-ray beams through intact fossils, clearly show two large sperm pumps called Zenker organs. The pumps resemble those found in contemporary species of giant sperm-producing species of ostracods, which devote a third of their body volume to reproduction.

The female fossils, for their part, boast a pair of large seminal receptacles, which "must have been filled with sperm in order to be preserved," Matzke-Karasz and her colleagues say.

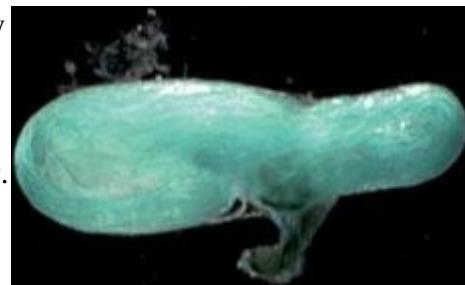
Sexual competition

Matzke-Karasz says it's impossible to know just how long their sperm cells were, but closely related species that are still around produce sperm at least the length of their body. Such a long history for giant sperm points to intense sexual competition between males, she says. Females gather sperm from multiple males before fertilizing their eggs, but researchers don't have a clue what determines success.

"It would be very interesting to find out which sperm the female actually uses, if she takes the first one or those of the last mating partner," says Matzke-Karasz, who plans to perform DNA paternity tests on offspring.

James Morin, an ostracod expert at Cornell University in Ithaca, New York, is less surprised to discover that giant sperm has been around so long.

"If it works, there's no reason to get rid of it," he says, noting that a 425 million-year-old ostracod fossil contains the world's oldest penis. "You could make the same argument for copulatory limbs."



Female freshwater ostracods store the giant sperm in two "seminal receptacles" until they are needed to fertilise the eggs. When filled, these receptacles make up more than a third of the female's body length (Image : Renate Matzke-Karasz)

Journal reference: Science (DOI: 10.1126/science.1173898)

Using math to take the lag out of jet lag

Researchers at Brigham and Women's Hospital and the University of Michigan have developed a software program that prescribes a regimen for avoiding jet lag using timed light exposure. The method is described in an article published June 19 in the open-access journal PLoS Computational Biology.

Traveling across several time zones can cause an individual to experience jet lag, which includes trouble sleeping at night and difficulty remaining awake during the day. These effects largely reflect desynchronization between the body's internal time clock and local environmental cues.

The program, which seeks to re-synchronize the body with its new environment, considers inputs like background light level and the number of time zones traveled. Then, based on a mathematical model, the program gives users exact times of the day when they should apply countermeasures such as bright light to intervene and reduce the effects of jet lag.

Timed light exposure is a well known synchronization method, and when used properly, this intervention can reset an individual's internal clock to align with local time. The result is more efficient sleep, a decrease in fatigue, and an increase in cognitive performance. Poorly timed light exposure can prolong the re-synchronization process.

Using their computational method, researchers simulated shifting sleep-wake schedules and the subsequent light interventions for realigning internal clocks with local time. They found that the mathematical computation resulted in quicker design of schedules and also predictions of substantial performance improvements. They were able to show that the computation provided the optimal result for timing light exposure to reduce jet lag symptoms.

"Using this computation in a prototyped software application allows a user to set a background light level and the number of time zones traveled to obtain a recommendation of when to expose a subject to bright light, such as the bright lights sometimes used to treat Seasonal Affective Disorder" said lead-author Dennis Dean. "Although this method is not yet available to the public, it has direct implications for designing schedules for jet lag, shift-work, and extreme environments, such as in space, undersea or in polar regions."

"This work shows how interventions can cut the number of days needed to adjust to a new time zone by half," said co-author Daniel Forger.

The next phase of this research includes the addition of interventions such as naps, caffeine and melatonin to help the process of realigning the internal body clock while reducing decreased performance experienced during travel across time zones.

To learn more about why sleep matters, the science behind it and how to improve your sleep, visit

<http://healthysleep.med.harvard.edu/>. **FINANCIAL DISCLOSURE:** The work described in this article was supported by US AFOSR F49620-95-1-0388 and F49620-95-1-0388, NASA Cooperative Agreement NCC 9 with NSBRI HPF-00405, NIH M01-RR02635 and NIH R01-NS36590. EBK is also supported by NIH K02-HD045459. DBF is an AFOSR Young investigator. DAD is also supported by T32 HL07901-10. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. **COMPETING INTERESTS:** The authors have declared that no competing interests exist. <http://dx.plos.org/10.1371/journal.pcbi.1000418> (link will go live upon embargo lift)

Health clues found in Big Tobacco's files

*** 18 June 2009 by MacGregor Campbell**

SECRET research by the tobacco industry designed to pump up sales to "social smokers" is being used for an unlikely purpose: to design anti-smoking strategies.

In 1998, 46 US states sued the big tobacco companies for costs incurred when treating smoking-related health problems. As part of the resulting settlement the industry was forced to make public more than 10 million internal documents.

Now Rebecca Schane, a public health researcher at the University of California, San Francisco, and colleagues have identified 170 documents from this collection that record what Big Tobacco knew about people for whom smoking was primarily a social activity. Though the figures were gathered for marketing purposes, they add to what health researchers know. "The tobacco companies have done a good job identifying these smokers," says Schane.

Health researchers had previously assumed social smokers were of university age and either went on to become addicts, or soon quit. The documents paint a different picture, suggesting that a considerable number continue to smoke socially well into their thirties and beyond.

The files reveal that social smokers make up 10 to 23 per cent of smokers in particular age groups (*American Journal of Preventive Medicine*, DOI: 10.1016/j.amepre.2009.03.020). This is the first time the extent of social smoking across all ages has been known, says Schane.

Several companies used the research to make multimillion-dollar marketing decisions, a sign that the industry had faith in it, the researchers say. Nancy Rigotti, a tobacco researcher at Harvard Medical School in Boston, agrees that such research has value.

Schane hopes the study will help clinicians identify social smokers, and drive anti-smoking strategies. For example, she suggests that social smokers may not respond to strategies that emphasise the health risks of smoking because they don't identify themselves as smokers.

Could the orang-utan be our closest relative?

17 June 2009 by [Graham Lawton](#)

THESE days, we tend to accept without question that humans are "[the third chimpanzee](#)". The term, coined by author Jared Diamond, refers to the notion that our closest relatives are the two chimpanzee species - the common chimp and the bonobo. But could we actually be "the second orang" - more closely related to orang-utans than chimps?

That is the controversial claim made this week by [Jeffrey Schwartz](#) of the University of Pittsburgh in Pennsylvania and [John Grehan](#) of the Buffalo Museum of Science in New York (*Journal of Biogeography*, DOI: 10.1111/j.1365-2699.2009.02141.x, [in press](#))

The idea flies in the face of mainstream scientific opinion, not least a wealth of DNA evidence pointing to our close relationship to chimps. Schwartz and Grehan do not deny the similarity between human and chimp genomes, but argue that the DNA evidence is problematic and that traditional taxonomy unequivocally tells us that our closest living relatives are orang-utans.

The researchers say the evidence of genetic similarity between humans and chimps is problematic

Human evolution and phylogenomics researchers have so far given the paper a rough reception. Some declined to comment on it, saying they did not want to dignify the paper. One described it as "preposterous nonsense" and another as "loopy".

Are we the "third chimp" or the "second orang"? Controversial new research suggests that we may be more closely related to the orang-utan than realised (Image: Newspix / Rex Features)

Others were less dismissive, though, agreeing that at least some of the ideas were worth discussing, if only to confirm the overwhelming evidence in favour of the orthodox view.

The *Journal of Biogeography's* editors defended the decision to publish the paper, arguing that it is the best way to subject Schwartz and Grehan's argument to proper scientific scrutiny. Editor Robert Whittaker told *New Scientist* he had done some "soul searching" but eventually decided it was best to air the ideas.

In the orthodox account of human origins, our species belongs to a group of African apes that also includes chimps, bonobos and gorillas. Chimps and bonobos are our [closest living relatives](#), sharing a common ancestor with us up to about 6 million years ago (see diagram). This version of events is strongly supported by DNA evidence showing that the human genome sequence is most similar to that of the chimp, followed by gorillas, with orangs the least similar of the three.

Schwartz and Grehan say that genome similarities cannot be taken as conclusive evidence of the closeness of our evolutionary relationships to the other great apes. In their scenario, around 13 million years ago, an orang-like ape lived across a huge swathe of land stretching from southern Africa to south-east Asia via southern Europe and central Asia (see map). This population evolved into different species, before extinctions in Europe



and central Asia split the original geographical range and left rump populations in east Africa and south-east Asia. The African population evolved into the human lineage while the Asian one evolved into orang-utans.

In this scenario, the other African apes are a separate lineage that split off from ours long before 13 million years ago, making orangs our closest living relative and the chimps and gorillas more distant.

This claim hinges on two contentious arguments. One is that DNA sequence similarity is not necessarily an indicator of evolutionary relatedness. The other is that, biologically, humans are more like orangs than chimps.

The first of these is the most problematic, as almost everybody accepts genome sequences as the most reliable indicator of evolutionary relatedness. Humans share 98.4 per cent of their [DNA with chimps](#), 97.5 per cent with gorillas and 96.5 per cent with orang-utans. This is widely taken as unassailable proof.

Grehan, however, argues that this is not scientifically justified. He points out that traditional taxonomy makes a distinction between two types of similarity - "derived novelties" and "primitive retentions". Derived novelties are traits shared by two closely related species and are taken to have evolved in a recent common ancestor. Primitive retentions are older traits with a deeper evolutionary past shared by a larger group of species.

The problem with molecular systematics, says Grehan, is it fails to distinguish between the two. "It does not matter that more DNA similarities may be found between humans and chimpanzees if these similarities are really primitive retentions," he says. The fact that humans and orang-utans are less genetically similar could be because orangs evolved more rapidly after splitting from a common ancestor with hominins.

Nonsense, says Maryellen Ruvolo, a human evolutionary biologist at Harvard University. "We know a lot about how DNA sequences change over time," and can distinguish between primitive retentions and derived novelties. Furthermore, she argues, the latest DNA sequence information indicates that humans share more derived novelties with chimps than with orang-utans.

David Reich, a geneticist at Harvard, agrees. "The molecular data overwhelmingly reject the notion that orang-utans are our closest relatives," he says.

The other half of the argument is a taxonomic analysis comparing the anatomies of humans, chimps, bonobos, orangs and 14 extinct species of ape. Based on this, Grehan and Schwartz argue that *Homo* species, orangs and australopithecines cluster into one "clade" with chimps and gorillas in another.

They say that many anatomical features we share with orang-utans appear to be recent novelties rather than primitive retentions. "There are a few features uniquely shared with chimps, but the bulk come out as [shared with] orangs," says Schwartz.

There are a few features shared with chimps but the bulk come out as shared with orangs

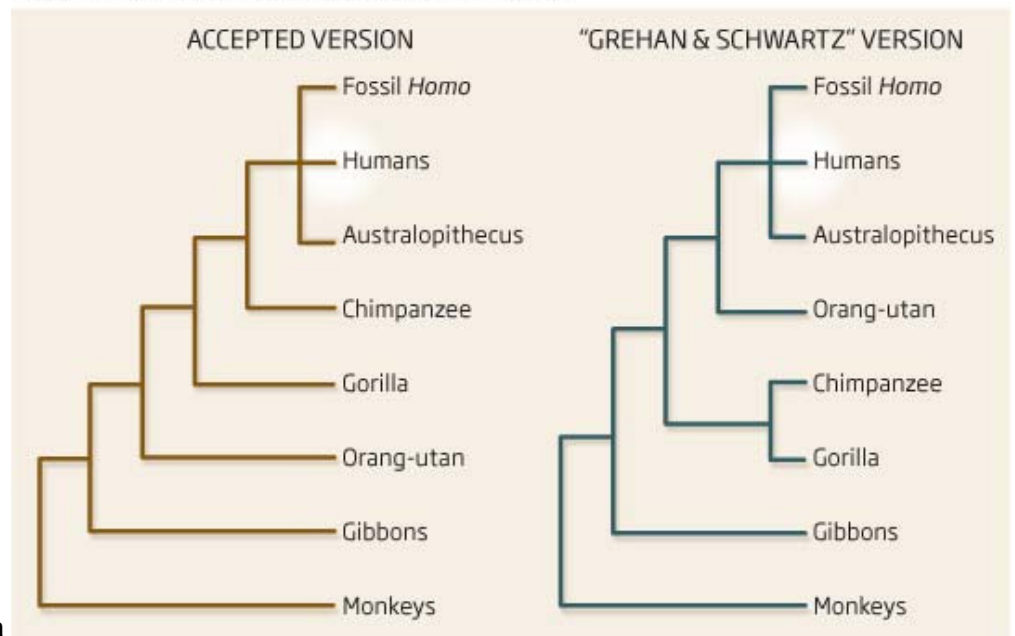
These include features of anatomy, reproductive biology and behaviour. For example, among the great apes only humans and orangs have thick tooth enamel, long hair, male facial hair, concealed ovulation, a preference

Our orang-like ancestor

Humans and orang-utans may have evolved from "rump" populations of an orang-like ancestor, according to Jeffrey Schwartz and John Grehan's theory



How humans fit into the family tree of apes



for private, face-to-face mating, and an ability to construct shelters and beds. Mainstream opinion is these are due to parallel evolution.

According to Robin Crompton, an anatomist at the University of Liverpool, UK, Grehan and Schwartz's selection of species for phylogenetic analysis is "strange", and misses out key extinct species such as *Proconsul*, considered to be the ancestor of all great apes. Even so, the paper appears to contain some good ideas, he says. "The biogeographic ideas are really quite interesting."

Ultimately, Grehan and Schwartz accept their claims are extraordinary but say they are worthy of proper consideration. "It's up for testing and debate," says Schwartz.

Editorial: [In praise of scientific heresy](#)

Chimps still new to the family

The idea that chimps are our closest living relatives is so entrenched that it is easy to forget that the notion was only accepted into the story of human evolution relatively recently.

Darwin himself proposed that humans evolved in Africa and shared a common ancestor with chimps and gorillas. Later biologists disagreed, though, arguing that the human lineage was so different from the other great apes that it must have been evolving on a separate trajectory for many millions of years.

In the mid-1960s, palaeontologists Elwyn Simons and David Pilbeam proposed that an extinct ape called *Ramapithecus*, which lived in what is now India and Pakistan up to about 8.5 million years ago, was a close relative of humans and possibly a direct ancestor. This gained widespread acceptance until new specimens showed it had an orang-utan-like face, whereupon the idea was quickly dropped.

Around the same time, molecular techniques started hinting at a close affinity between humans and chimps. This has been the orthodox position for more than 30 years.

Not everybody accepts it, however. Jeffrey Schwartz of the University of Pittsburgh, Pennsylvania, has been arguing [since the early 1980s](#) that oranges are our closest living relatives (*Nature*, [DOI: 10.1038/308501a0](#)). His latest research paper continues that theme.

Why some monkeys are better liars

* 16:21 18 June 2009 by **Catherine Brahic**

Monkeys may see, hear and speak no evil, but they sure can be naughty, according to the first study to compare the ability of monkeys to deceive others in order to get food.

Intentional deceit is not restricted to humans, say Federica Amici and colleagues of Liverpool John Moores University in the UK. Some monkeys use simple forms of deceit, and the ability depends not on how closely related they are to humans, but on their social structure.

Amici's team put up to 10 monkeys from three different primate species through the same experiment designed to test their ability to deceive dominant monkeys.

Secret stash

Spider monkeys, brown capuchins and long-tailed macaques were shown how to access food that was hidden or just out of reach. They were then put in cages with a socially higher-ranking monkey from the same species. Dominant monkeys in all three species would normally have priority over food, but in this case they did not know how to get to it.

Subordinate monkeys of all three species went straight for the food when their dominant partner was not around. But as soon as the dominant monkey was introduced, they held back. This suggests they were intentionally withholding information in order to get the food for themselves.

The best deceivers were the macaques, which have a very strict social structure. Dominant individuals in macaque groups have very little tolerance for subordinates and claim priority to all resources for themselves.

Going hungry

"The point [of deceit] is to withhold information in a constructive way, to eventually get the food yourself," says Filippo Aureli also of John Moores University.

However, if this is why the subordinate macaques didn't access the hidden food in the presence of dominants, it didn't work very well. "The subordinate long-tailed macaques almost never got the food," says Aureli. In the absence of dominant individuals, subordinate macaques went straight to the hidden larders. But when their dominant partners were introduced into the cage they became so secretive they only rarely attempted to get the food for themselves.

For spider monkeys, the strategy worked. Subordinates waited until the dominant monkey was on the other side of the cage before going for the food and ultimately ate more than the subordinates of two other species.

Aureli and Amici believe this is because spider monkey social structure is both tolerant and fluid. Spider monkeys do not spend their entire lives with the same group. Groups frequently form, split into subgroups and

reshuffle. This may make them more cunning, says Aureli. "When two subgroups merge, they need to reassess the information they have – who is around, who is not, and who the dominant individuals are."

Aureli believes the results suggest that deceit is driven by social evolution. He points out that spider monkeys and humans are evolutionarily very distinct, but have similar flexible social structures. Deceit, he says, evolved independently in very distinct animal species and the common driver may well be how the animals organise themselves socially.

'Not rocket science'

Richard Byrne, an evolutionary psychologist at the University of St Andrews, UK, points out that the researchers "very wisely" do not speculate about how the monkeys learned to deceive, and whether they can recognise that they know something that the other monkeys don't – an ability known as "theory of mind".

"Suppose in all the cases where they rushed in and grabbed the food they got beaten on the head and lost the food," says Byrne. "It wouldn't take a rocket scientist to work out that there are times when it's best not to act. They might have learnt that it's a good idea not to act without understanding why."

The results may hint at the sort of society that theory of mind evolved in, though. They show that deceit is also more likely to pay off in a less dictatorial society. "This could mean that it's more likely that the theory of mind light went on in a society full of complex social tactics," says Byrne.

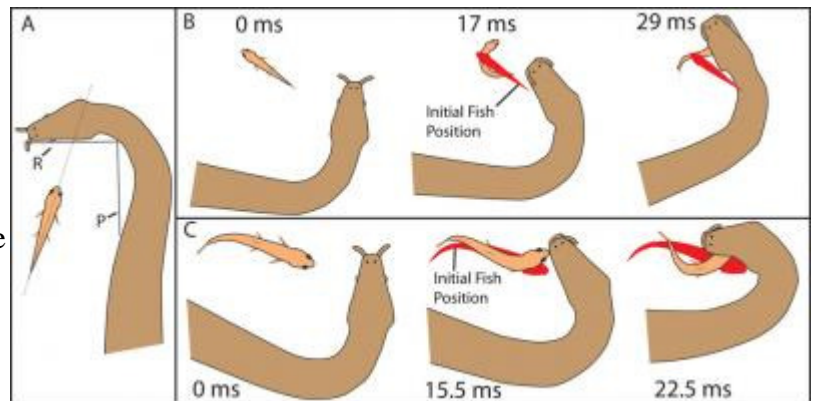
Journal reference: Proceedings of the Royal Society B (DOI: 10.1098/rspb.2009.0759)

Discovery of a water snake that startles fish in a way that makes them flee into its jaws

Forget the old folk tales about snakes hypnotizing their prey. The tentacled snake from South East Asia has developed a more effective technique. The small water snake has found a way to startle its prey so that the fish turn toward the snake's head to flee instead of turning away. In addition, the fish's reaction is so predictable that the snake actually aims its strike at the position where the fish's head will be instead of tracking its actual movement.

"I haven't been able to find reports of any other predators that exhibit a similar ability to influence and predict the future behavior of their prey," says Kenneth Catania, associate professor of biological sciences at Vanderbilt University, who has used high-speed video to deconstruct the snake's unusual hunting technique.

His observations are published this week in the online early edition of the *Proceedings of the National Academy of Sciences*.



This diagram of two of tentacled snake attacks shows how it strikes at the location where it expects the fish's head to be instead of tracking its movement. Kenneth Catania

Catania, who is the recipient of a MacArthur "genius" award, studies the brains and behavior of species with extreme specializations. He was attracted to the tentacled snake because it is the only snake that comes equipped with a pair of short tentacles on its nose and he was curious about their function.

"Before I begin a study on a new species, it is my practice to spend some time simply observing its basic behavior," Catania explains. The snake forms an unusual "J" shape with its head at the bottom of the "J" when it is fishing. Then it remains completely motionless until a fish swims into the area near the hook of the "J." That is when the snake strikes.

The snakes' motions take only a few hundredths of a second and are too fast for the human eye to follow. However, its prey reacts even faster, in a few thousandths of a second. In fact, fish are famous for the rapidity of their escape response and it has been extensively studied. These studies have found that many fish have a special circuit in their brains that initiates the escape, which biologists call the "C-start." Fish ears sense the sound pressure on each side of their body. When the ear on one side detects a disturbance, it sends a message to the fishes' muscles causing its body to bend into a C-shape facing in the opposite direction so it can begin swimming away from danger as quickly as possible.

Catania is the first scientist to study this particular predator-prey interaction with the aid of a high-speed video camera. When he began examining the movements of the snake and its prey in slow motion, he saw something peculiar. When the fish that the snake targets turn to flee, most of them turn toward the snake's head and many literally swim into its jaws! In 120 trials with four different snakes, in fact, he discovered that an amazing 78 percent of the fish turned toward the snake's head instead of turning away.

Next, the biologist noticed that the first part of its body that the snake moves is not its head. Instead, it flexes a point midway down its body. Using a sensitive hydrophone that he put in the aquarium, he confirmed that this

body fake produces sound waves intense enough to trigger the fish's C-start response. Because these sound waves come from the side opposite the snake's head, this reflex action drives the fish to turn and swim directly toward the snake's mouth. "Once the C-start begins, the fish can't turn back," Catania says. "The snake has found a way to use the fish's escape reflex to its advantage."

As he studied the snake's actions even closer, he made an even more remarkable discovery. When it strikes, the snake doesn't aim for the fish's initial position and then adjust its direction as the fish moves – the way most predators do. Instead it heads directly for the location where it expects the fish's head to be.

"The best evidence for this is the cases when the snake misses," says Catania. "Not all the targeted fish react with a C-start and the snake almost always misses those that don't react reflexively."

Catania's next step will be to determine whether this predictive capability is hard-wired or learned. To do so, he hopes to obtain some baby snakes that have just hatched and videotape their first efforts to catch prey.

Note: To view the high-speed video go to <http://sitemason.vanderbilt.edu/news/video/2009/06/18/video-tentacled-snake-in-action.82827>

Sleeping on a complex decision may be a bad choice

19 June 2009 by [Nora Schultz](#), Berlin

SLEEPING on a complex decision may not help you make the best choice after all. So say two studies that question the evidence for unconscious decision-making.

The "unconscious thought" theory for making complex decisions was proposed in a 2006 study by [Ap Dijksterhuis](#) at the University of Amsterdam in the Netherlands, and colleagues. The team showed volunteers a series of cars and their attributes on a screen, before asking half of them to think carefully about choosing the best [car](#), and the other half to solve anagrams - a distraction technique to allow unconscious processing. Those in the anagram group were more likely to choose the cars with the best attributes, leading the researchers to conclude that it is best to leave [tough choices to the unconscious](#) (*Science*, vol 311, p 1005).

Now two teams have questioned this conclusion. Instead, they suggest that the volunteers made their decisions when they first viewed the data, based on an immediate gut instinct. Those in the anagram group simply recalled this original decision when asked to choose. Those in the "thinking" group, however, reconsidered their first impressions while the details of the cars faded from their memory, which led to poorer choices. "What Dijksterhuis ignored is that people might already decide when they first hear about the cars, and not after thinking about it or solving anagrams," says psychologist [Daniel Lassiter](#) of Ohio University in Athens.

To test this hypothesis, Lassiter and his colleagues repeated Dijksterhuis's experiment with a twist: they told the volunteers to memorise the cars' attributes while viewing them, thus distracting their attention from making an immediate decision.

The small tweak made a big difference. In contrast to Dijksterhuis's experiment, students made better choices when they spent time thinking, rather than solving anagrams (*Psychological Science*, vol 20, p 671). Lassiter says this is strong evidence against the idea that unconscious deliberation is superior to conscious decision-making. He questions whether unconscious thought exists at all.

Research explores interactions between nanomaterials, biological systems

Review article calls for measures to enable safe design of nanomaterials

The recent explosion in the development of nanomaterials with enhanced performance characteristics for use in commercial and medical applications has increased the likelihood of people coming into direct contact with these materials.

There are currently more than 800 products on the market - including clothes, skin lotions and cleaning products - claiming to have at least one nanocomponent, and therapeutic nanocarriers have been designed for targeted drug delivery inside the human body. Human exposure to nanomaterials, which are smaller than one one-thousandth the diameter of a human hair, raises some important questions, including whether these "nano-bio" interactions could have adverse health effects.

Now, researchers at UCLA and the California NanoSystems Institute (CNSI), along with colleagues in academia and industry, have taken a proactive role in examining the current understanding of the nano-bio interface to identify the potential risks of engineered nanomaterials and to explore design methods that will lead to safer and more effective nanoparticles for use in a variety of treatments and products.

In a research review published in the July issue of the journal *Nature Materials* (and currently available online), the team provides a comprehensive overview of current knowledge on the physical and chemical properties of nanomaterials that allow them to undergo interactions with biological molecules and bioprocesses. "What we have established here is a blueprint that will serve to educate the first generation of nanobiologists," said Dr. Andre Nel, leader of the team and chief of the division of nanomedicine at the David Geffen School of Medicine at UCLA and the California NanoSystems Institute.

Despite remarkable advances in nanoscience, relatively little is known about the intracellular activity and function of engineered nanomaterials, an area of study particularly important for the development of effective and safe nanoparticle drug-delivery systems. Much of the current knowledge derives from the study of tagged or labeled nanoparticles and their effects on cells after cellular uptake - without any detailed understanding of what these interactions may lead to, good or bad.

The review article examines the variety of ways in which nanomaterials interface with biological systems and presents a roadmap of the physical and chemical properties of the materials that could lead to potentially hazardous or advantageous interactions at the nano-bio interface. A better understanding of the biological impact, combined with appropriate stewardship, will allow for more informed decisions about design features for the safe use of nanotechnology.

In addition to Nel, the team included Tian Xia, a researcher in UCLA's nanomedicine division, UCLA associate professor of civil and environmental engineering Eric Hoek, Lutz Mädler of the University of Bremen, Darrell Velegol of Penn State University, Ponisseril Somasundaran of Columbia University, Fred Klessig of Pennsylvania Bio Systems, Vince Castranova of the National Institute for Occupational Safety and Health, and Mike Thompson of FEI Co.

"We are committed to ensuring that nanotechnology is introduced and implemented in a responsible and safe manner," said Nel, who also directs the Center for Environmental Implications of Nanotechnology, which is funded by the National Science Foundation and the Environmental Protection Agency and is headquartered at the CNSI.

"Based on our rapidly improving understanding of nano-bio interactions, we have done a thorough examination of the literature and our own research progress to identify measures that could be taken for safe design of nanomaterials," he said. "Not only will this improve the implementation and acceptance of this technology, but it will also provide the cornerstone of developing new and improved nanoscale therapeutic devices, such as drug-delivering nanoparticles."

The review article spotlighted several important research advancements:

- * A classification of the interactions when nanomaterials contact and bind to biological systems will help scientists understand how man-made materials may react when exposed to cells, tissues and various life forms in different natural environmental contexts.

- * When nanomaterials enter a biological fluid - for example, blood, plasma or interstitial fluid - the materials' surface may be coated with proteins. Understanding how these protein layers change the properties of the nanomaterials and the ways in which they interact in the body can provide valuable information on how to alter the protein coatings to allow for targeted delivery of nanomaterials to specific tissues, such as in cancer treatments.

- * Physicochemical properties such as size, charge, shape and other characteristics could greatly affect the ability of nanomaterials to enter a cell; this could determine whether a material can be useful in nanomedicine applications or could cause harm if taken in by life forms in an ecosystem or food chain.

- * Nanoparticles can elicit a wide range of intracellular responses, depending on their properties, concentrations and interactions with biological molecules. These properties and their relationships to cellular function can induce cellular damage or induce advantageous cellular responses, such as increased energy production and growth.

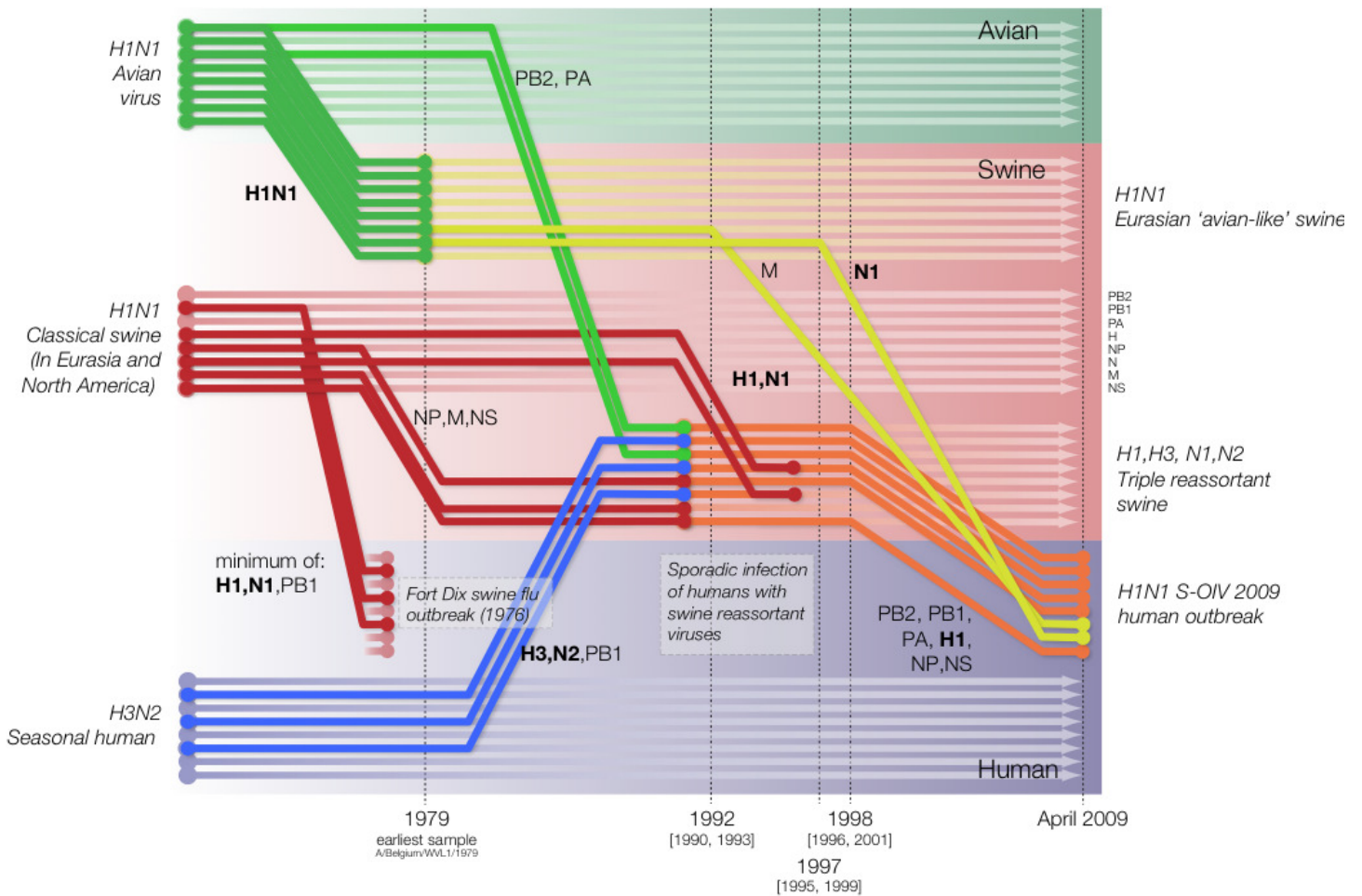
Based on the link between certain nanomaterial properties and potential toxic effects, the team asserts that scientists can reengineer specific nanomaterial properties that are hazardous while maintaining catalytically useful function for industrial use.

As an example of a safe design feature, some nanoparticles now receive a surface coating designed to improve safety by preventing bioreactivity. Nanoparticles in cosmetic formulations such as suntan lotions, for instance, may be coated with a water-repelling polymer to reduce direct contact with human skin. An extension of this principle uses polymers and detergents to decrease cellular uptake. However, there is the potential that when the coating wears off, the material may become hazardous. It is therefore important to consider improving the stability of coating substances. Coating nanoparticles with protective shells is also an effective means of preventing the breakup of materials that could release toxic substances upon dissolution.

"Instead of waiting for knowledge to unfold randomly, we can already begin to view the events at nano-bio interface as a discoverable scientific platform that can be used for setting up a deliberate inorganic-organic roadmap to new, better and safer products," Nel said. "What we can identify by understanding the rules that shape the nano-bio interface will have a massive impact on the ability to develop safe nanomaterials in the future."

Flu Finding Supports 'One World, One Health' View of People and Animals

By Andrew C. Revkin



This chart shows how pieces of different viruses combined over several decades to form the H1N1 strain that has emerged as a human pandemic. The green band is avian, red is swine and gray human. [Click here for a larger version with much more background.](#) From Smith et al. 2009 Nature, in press: doi:10.1038/nature08182. Copyright S.J.Lycett and A.Rambaut.

A new study of the evolution of the H1N1 strain of influenza virus that moved from pigs to people this spring and has since spread worldwide reveals the need for taking a “one health” approach to humans and the animals around us, experts suggest. The official decision today by the World Health Organization to designate the current outbreak a global flu pandemic reinforces the point.

The “one world, one health” initiative is an effort to boost and coordinate surveillance for potentially dangerous viruses and other pathogens that can mix and jump among livestock, birds, agricultural workers and the broader human community. On a planet heading toward nine billion people knit by aviation and trade into a single community, such an approach is vital, according to a growing array of experts.

The new study, published in Nature, traced the sequence of gene handoffs among swine and birds that resulted in the virus that is circulating now in humans. It bluntly concludes that inadequate monitoring of livestock helped the viral threat grow long before the current outbreak.

Despite widespread influenza surveillance in humans, the lack of systematic swine surveillance allowed for the undetected persistence and evolution of this potentially pandemic strain for many years.

(The paper also supports earlier conclusions that the virus was not the result of laboratory manipulation, as some scientists had asserted a few months ago.)

If the world, and the United States in particular, is to ramp up surveillance for brewing health threats outside the human species, there’s a problem: a shortage of veterinarians.

Once again, governments and societies are being challenged to prepare for low-probability but potentially catastrophic events through sustained proactive efforts, whether building a new base of specialists in animal disease or work now to limit losses in inevitable earthquakes.

Observatory

Getting Mosquitoes to Poison Their Own Larvae

By HENRY FOUNTAIN

Controlling the mosquito that's largely responsible for infecting people with the dengue fever virus isn't easy. That's because the bug, *Aedes aegypti*, has evolved in parallel with humans, living around them and breeding in even the smallest puddles of water — rainwater in a discarded can, say, or the saucer under a flower pot.

With so many potential breeding sites, spreading pesticide can be a painstaking, door-to-door activity. But Gregor J. Devine of Rothamsted Research, an agricultural institute in Britain, had a different idea: why not let the mosquitoes do the work?

Building on laboratory studies that showed that adult mosquitoes could pick up an insecticide and transfer it, he and his colleagues conducted field experiments in Iquitos, Peru, using pyriproxyfen, a compound that kills larvae but is not harmful to adult mosquitoes (or to people, either, in the amounts used).



Researchers used a cemetery in Peru as a "dissemination station" to test whether mosquitoes would spread an insecticide that kills larvae but not adult mosquitoes. Greg Devine

After getting a meal of blood from a human, a female *A. aegypti* likes to find a dark, damp spot to rest while its eggs develop, buzzing off later to find water to deposit the eggs in. Dr. Devine said their work, described in *The Proceedings of the National Academy of Sciences*, took advantage of this routine.

He and his team set up "dissemination stations," consisting of dark, damp cloths dusted with pyriproxyfen, in the nooks and crannies of above-ground tombs in a cemetery. When a female rested on the cloth, its legs picked up some of the pesticide, which came off when it later landed in a breeding pool. The researchers found that putting stations in as little as 3 percent of the available spots in the cemetery resulted in coverage of almost all the breeding habitats in the immediate area, and mortality of up to 98 percent of the mosquito larvae.

Dr. Devine said the technique may be useful for controlling *A. aegypti* in conjunction with other eradication methods and may also help control mosquito species that spread other diseases, like malaria.