# Infoteca's E-Journal

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CONTENTS

**New Measures of Scholarly Impact**

December 17, 2010

Higher education might be a high-end marketplace of ideas, but its mechanisms for taking inventory for that marketplace have been, until recently, relatively basic. The method for measuring the influence of journals and authors by counting the number of times their articles are cited by other articles — called the "impact factor" — has hardly changed since 1955, when it was created by Eugene Garfield, a University of Pennsylvania graduate student who went on to found the first citation database, the Institute for Scientific Information (now owned by Thomson Reuters).

But the way researchers read journal articles has changed, especially in the sciences. "If you look at the traffic, it's pretty clear that most scholarly communications is consumed online, not in print," says Johan Bollen, an associate professor of informatics at the Indiana University at Bloomington.

Bollen is principal investigator for MESUR (Metrics for Scholarly Usage of Resources), a project founded in 2006 on a grant from the Andrew W. Mellon Foundation, that is trying to shift how scholarly impact is measured away from citations — which he describes as inherently "backwards-looking … kind of like astronomers looking at a galaxy whose light reaches us 50 million years after the events that cause that light to happen" — and toward the sort of real-time usage metrics that Web-based consumption enables.

"If you look at the role citations have played in scholarly assessment, it's very clear that citations originated when most scholarly publications are printed and consumed via print," Bollen says.

These days, the availability of "usage data" — information on how many times a digital article has been downloaded, and in what context — means that people like Bollen can track the spread of an idea in a scholarly community using the same principles that epidemiologists use to track the spread of a virus in a village. Usage data do not just mean how many times an article is downloaded; they also mean breaking down the browsing patterns of researchers using the scholarly literature. Drawing from a database that includes 346,312,045 "user interactions" around digital versions of articles stored by Thomson Reuters and others, the MESUR team assessed journal impact across dozens of technical dimensions — such as "betweenness centrality," a metric that assesses whether a publication often serves as a bridge as scholars browse from article to article, a pattern that implies "strong interdisciplinary appeal, high influence, high prestige, and high popularity," according to Bollen.

Now that so much journal consumption is digital, the MESUR team is confident that its analysis paints a pretty good picture of influence in the scholarly community writ large, not just a tiny subset.

Bollen and his colleagues are not the only ones applying social network analysis to scholarly publishing. Eigenfactor, a project based at the University of Washington, measures the influence of scholarly journals using the old-fashioned method of counting citations, but adds an algorithmic wrinkle similar to the one that Google deploys in ranking search returns: when evaluating the impact of a journal, Eigenfactor takes into account how many times that journal is cited by other journals that are themselves frequently cited. (Google ranks search returns using a similar method, but with hyperlinks instead of citations.) The idea is to control for the fact that, as with Google, "a single citation from a high-quality journal may be more valuable than multiple citations from peripheral publications," wrote Carl T. Bergstrom, one of the project's developers, shortly after it launched in 2007. (Thomson Reuters has since incorporated Eigenfactor's weighted metrics into its famous annual Journal Citation Report, alongside Garfield's original impact formula.)

Jevin West, another member of the Eigenfactor development team, told *Inside Higher Ed* that Eigenfactor is currently looking into how to incorporate real-time usage data, as well as "citation-like references" from scholars on social networking sites. Shout-outs on scholarly blogs, Twitter, and Facebook, along with digital

dog-earing on social bookmarking sites such as CiteULike and Connotea, might also be used as proxies for influence. Those data are “not quite as clean or as well-defined as academic citations,” West says, but they could prove relevant to assessing the impact of a particular article. After all, scholars are not influenced only by the articles they end up formally citing in a paper.

Some online journals are already publishing social media impact metrics alongside their articles. The Public Library of Science, widely known as PloS, which publishes seven open-access journals, earlier this fall began sharing not only how many times an article has been cited by other academic articles, but also how many times it has been commented on, rated, blogged about, hyperlinked, and bookmarked online. And last week the publishing behemoth Springer, which publishes 1,750 digital journals, announced a real-time tracking application that shows where and when different articles are being downloaded.

Thomson Reuters, inheritor of Garfield's original citation database, says it is hardly ignoring the trends toward usage-based metrics. "We continue to follow the initiatives in the library and publishing communities regarding usage, access and download-based metrics," Marie McVeigh, director of the company's Journal Citation Reports, told *Inside Higher Ed* via e-mail, "not only for full text, but for the increasingly diverse range of materials that are a part of emerging methods of scholarly discourse."

**What Does This Mean?**

The trend toward data-driven assessment of scholarly communications has implications for how much university libraries are asked to pay, and are willing to pay, for different journals. For example, Eigenfactor uses its impact scores to rank journals based on how influential they are versus how much they cost — a potentially crucial variable for librarians who are deciding which subscriptions to renew at a time when journal prices are climbing and budgets are tight.

The American Chemical Society, which publishes 38 different journals, in 2008 started keeping track of how many times articles from each of its journals were being downloaded at individual campuses and setting different prices, based on usage, for each subscribing library.

This upset some librarians who saw their rates rise. But in some cases, librarians might be able to use their own institution’s usage data to their advantage. “Many librarians have informed me that they use usage data to build ratios for price-per-use,” says Roger Schonfeld, manager of research for the nonprofit Ithaka S+R. “If you have one provider that has a higher price than another provider, that would be a way of trying to estimate the value received from different resources.” Librarians might also use it as leverage when trying to negotiate a lower subscription rate, Schonfeld says.

There are also individual implications for the scholars who write the articles and the agencies that fund their research. Since it was founded by Garfield in 1955 and especially since citation databases went digital, various institutions have reportedly used the journal impact factor as a way of evaluating candidates for promotion and tenure based on where they’ve published, and granting agencies might take the number into account when deciding which scientists to sponsor.

Mendeley, a fast-growing online network that uses an algorithm to make recommendations to users based on their academic interests, is taking steps toward coming up with a system that rates the impact of individual scholars based on how well their articles have done. Such novel iterations of the "impact factor” should not be given undue weight in deciding who should get tenure or whose research should get funded, says Jan Reichelt, Mendeley’s president. But more data is better than less data.

“There’s this pressure to get data to make these decisions,” says Bollen, of MESUR. “And now we have the data.”

However, Bollen is careful to note that the value of all the data that come with online scholarly communications is not the ability to boil down the importance of a journal or a researcher to a single number. To the contrary, more layers of data mean it is possible to add more layers of nuance to the half-century tradition of measuring scholarly impact — a practice that has been criticized in the past for its simplicity.

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— Steve Kolowich

**http://www.insidehighered.com/news/2010/12/17/scholars_develop_new_metrics_for_journals_impact**

**The Benefits of Exercising Before Breakfast**

*By GRETCHEN REYNOLDS*

Ian Spanier/Getty Images

The holiday season brings many joys and, unfortunately, many countervailing dietary pitfalls. Even the fittest and most disciplined of us can succumb, indulging in more fat and calories than at any other time of the year. The health consequences, if the behavior is unchecked, can be swift and worrying. A recent study by scientists in Australia found that after only three days, an extremely high-fat, high-calorie diet can lead to increased blood sugar and insulin resistance, potentially increasing the risk for Type 2 diabetes. Waistlines also can expand at this time of year, prompting self-recrimination and unrealistic New Year's resolutions.

But a new study published in The Journal of Physiology suggests a more reliable and far simpler response. Run or bicycle before breakfast. Exercising in the morning, before eating, the study results show, seems to significantly lessen the ill effects of holiday Bacchanalias.

For the study, researchers in Belgium recruited 28 healthy, active young men and began stuffing them with a truly lousy diet, composed of 50 percent fat and 30 percent more calories, overall, than the men had been consuming. Some of the men agreed not to exercise during the experiment. The rest were assigned to one of two exercise groups. The groups' regimens were identical and exhausting. The men worked out four times a week in the mornings, running and cycling at a strenuous intensity. Two of the sessions lasted 90 minutes, the others, an hour. All of the workouts were supervised, so the energy expenditure of the two groups was identical.

Their early-morning routines, however, were not. One of the groups ate a hefty, carbohydrate-rich breakfast before exercising and continued to ingest carbohydrates, in the form of something like a sports drink, throughout their workouts. The second group worked out without eating first and drank only water during the training. They made up for their abstinence with breakfast later that morning, comparable in calories to the other group's trencherman portions.

The experiment lasted for six weeks. At the end, the nonexercising group was, to no one's surprise, super-sized, having packed on an average of more than six pounds. They had also developed insulin resistance —

their muscles were no longer responding well to insulin and weren't pulling sugar (or, more technically, glucose) out of the bloodstream efficiently — and they had begun storing extra fat within and between their muscle cells. Both insulin resistance and fat-marbled muscles are metabolically unhealthy conditions that can be precursors of diabetes.

The men who ate breakfast before exercising gained weight, too, although only about half as much as the control group. Like those sedentary big eaters, however, they had become more insulin-resistant and were storing a greater amount of fat in their muscles.

Only the group that exercised before breakfast gained almost no weight and showed no signs of insulin resistance. They also burned the fat they were taking in more efficiently. "Our current data," the study's authors wrote, "indicate that exercise training in the fasted state is more effective than exercise in the carbohydrate-fed state to stimulate glucose tolerance despite a hypercaloric high-fat diet."

Just how exercising before breakfast blunts the deleterious effects of overindulging is not completely understood, although this study points toward several intriguing explanations. For one, as has been known for some time, exercising in a fasted state (usually possible only before breakfast), coaxes the body to burn a greater percentage of fat for fuel during vigorous exercise, instead of relying primarily on carbohydrates. When you burn fat, you obviously don't store it in your muscles. In "our study, only the fasted group demonstrated beneficial metabolic adaptations, which eventually may enhance oxidative fatty acid turnover," said Peter Hespel, Ph.D., a professor in the Research Center for Exercise and Health at Catholic University Leuven in Belgium and senior author of the study.

At the same time, the fasting group showed increased levels of a muscle protein that "is responsible for insulin-stimulated glucose transport in muscle and thus plays a pivotal role in regulation of insulin sensitivity," Dr Hespel said.

In other words, working out before breakfast directly combated the two most detrimental effects of eating a high-fat, high-calorie diet. It also helped the men avoid gaining weight.

There are caveats, of course. Exercising on an empty stomach is unlikely to improve your performance during that workout. Carbohydrates are easier for working muscles to access and burn for energy than fat, which is why athletes typically eat a high-carbohydrate diet. The researchers also don't know whether the same benefits will accrue if you exercise at a more leisurely pace and for less time than in this study, although, according to Leonie Heilbronn, Ph.D., a professor at the University of Adelaide in Australia, who has extensively studied the effects of high-fat diets and wrote a commentary about the Belgian study, "I would predict low intensity is better than nothing."

So, unpleasant as the prospect may be, set your alarm after the next Christmas party to wake you early enough that you can run before sitting down to breakfast. "I would recommend this," Dr. Heilbronn concluded, "as a way of combating Christmas" and those insidiously delectable cookies.

http://well.blogs.nytimes.com/2010/12/15/phys-ed-the-benefits-of-exercising-before-breakfast/?ref=magazine

**Enough Is Enough**

December 17, 2010

In hopes of saving money and improving success rates, the California Community Colleges Chancellor's Office wants to limit the number of times students can retake a course.

Terri Carbaugh, a spokeswoman, told *Inside Higher Ed* in an interview Thursday that her office was currently researching the feasibility of making such a change to state regulations. She noted that Chancellor Jack Scott hopes to present a proposal to the Board of Governors early next year that would bar state reimbursement to community colleges for students who retake a course more than four times. She added that if community colleges wanted to allow students the opportunity to retake a course above this threshold, then they would have to find a way to pay for it without taxpayers' money.

"We're looking at every corner of the system to come up with efficiencies," said Carbaugh, noting that the idea for a policy change came to Scott from the letter of a disgruntled student who complained that he was unable to enroll in a course because of course re-takers. "We need to prioritize those students who go on to transfer or earn degrees."Last academic year, more than 33,000 unduplicated California community college students had retaken a single credit-bearing course more than five times in their academic careers. The state's 112 two-year institutions serve more than 2.5 million annually. The demographics of those who retook a course more than five times closely mirror the demographics of the enrollment of the community colleges statewide, Carbaugh said. The most-repeated courses were in physical education, but gateway courses in English and mathematics were not far behind.

Not only does the chancellor's office believe this policy change would improve graduation rates around the state, it also believes there would be a financial benefit. Carbaugh said current staff research suggests that to cap the number of times a student may repeat a course at four times would save the state about $1.5 million each year and free up roughly 740 student seats.Carbaugh acknowledged that the proposed change would pivot the state's community colleges slightly away from their traditionally open-access mission. Still, she argued that the restriction was all about fiscal accountability and improving student success, especially in these tough economic times for California.

"As much as we're here to provide access, we're also here to serve those who desire to transfer or earn a degree," Carbaugh said.Not everyone in the state, however, is eager for the possibility of mandated course repeat restrictions.

Mia McClellan, dean of student services at Southwestern College, in Chula Vista, noted that her institution has already made a decision on its own to limit course retakes, allowing only two attempts at passing a course.

"I feel horrible about doing this," McClellan said. "It does not match the mission of a community college, but I understand it financially. Being the economy that it is, you'd like to be able to offer more to more people, but we just can't because we're so dependent on the state for funding."

Any change to the state regulations regarding funding for course re-takers would have to be approved by the Board of Governors. Carbaugh noted, however, that Scott has made his position well known to community colleges around the state, and that some, such as Southwestern, have already altered their own policies.

— David Moltz

**http://www.insidehighered.com/news/2010/12/17/california_community_colleges_may_limit_retaking_of_courses**

**Satellite tracking campaign tests European abilities**

European Space Agency

An experimental tracking campaign using European facilities is helping determine how well existing telescopes and radars can work together to observe objects in Earth orbit. The results will be used to help design ESA's future Space Situational Awareness system.
On 29 November, experts from the Agency's Space Situational Awareness (SSA) Preparatory Programme began an experimental tracking campaign using scientific research telescopes and radars in five European countries. The campaign is testing how well existing facilities can track potential debris hazards in orbit using known satellites as targets.

A series of three overnight tests during November to February will see the radars and telescopes being used to track a dozen candidate 'objects' – existing satellites including ESA's GOCE, Artemis and Envisat. Other European satellite operators, including Eumetsat and SES-Astra, have agreed to the use of their satellites in the tracking campaign as well.

*Facilities in Sweden, UK, Switzerland, Spain and Cyprus*

To track objects in low orbit – just several hundred kilometres altitude – the campaign is making use of research radars operated by the European Incoherent Scatter Scientific Association (EISCAT) in Sweden and Norway, and by the Chilbolton Observatory in Hampshire, UK.

For objects in geostationary orbit – up to 36 000 km altitude – the tests will use optical telescopes, including ESA's own Optical Ground Station in Tenerife, Spain.

In addition, astronomical observatories in Spain (Observatorio Astronómico de Mallorca), Switzerland (Zimmerwald Observatory) and Troodos, Cyprus (British National Space Centre – Starbrook) will be used.

*Testing diverse sensors for interoperability*

Some of the radars and telescopes were originally designed for meteorological, ionospheric or astronomical studies, so their use for tracking objects in Earth orbit is complementary but has not been fully tested.

"A significant goal of the campaign is determining how well these facilities can provide tracking data and identifying any operational problems related to, for example, weather or interoperability issues," says Emmet Fletcher, Head of the Space Surveillance and Tracking (SST) Segment at ESA's SSA programme.

Fletcher says that knowing how a diverse network of independent sensors can work together is critical for designing the architecture of the future European hazard-tracking system.

Results from the campaign will be used to assess the potential performance of the current European infrastructure, and how the future SST tracking capability should be designed to best make use of such assets.

*About Europe's space hazard tracking capability*

Under the SSA Preparatory Programme, a main aim of the SST element is to provide an independent ability to promptly acquire and catalogue precise information on objects orbiting Earth. Using these data, a wide range of services will be provided by the future European SSA System, such as warning of potential collisions and alerting when and where debris reenters Earth's atmosphere. These data will be stored in a catalogue and made available to SSA customers across Europe.

The infrastructure required to provide these capabilities is referred to as the '‘SST Segment'. It comprises surveillance and tracking sensors, which could use radar or optical technology, to acquire raw data, which are then processed to correlate (or link) each observed object with ones already known, or to indicate a new object.

Initially, the SST Segment will obtain data using existing sensors. When the full SSA programme begins, additional systems may be developed and deployed as required to achieve the objective of European autonomy in this area. The decision for the continuation of the SSA Programme is planned to be taken at the next ESA Ministerial Council, foreseen in 2012.
http://www.esa.int/SPECIALS/SSA/SEMALXFMTGG_0.html

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91415&CultureCode=en

**Peer pressure can keep you healthy**

BioMed Central Limited

Hanging out with healthy friends could be the best way to keep fit. A study of 3610 Australian women, published in BioMed Central's open access *International Journal of Behavioral Nutrition and Physical Activity* found that physical activity and healthy eating behavior were both strongly affected by social norms. Kylie Ball, from Deakin University, Australia, worked with a team of researchers to survey the 18-46 year old women. She said, "The importance of social environmental influences on health-promoting behaviors such as physical activity and healthy eating has been increasingly recognized. Ours is one of the first studies to demonstrate the association of both social support and social norms with physical activity and eating behaviors".

The researchers tested the extent to which a fashion for healthy behavior among a person's contacts could influence their own lifestyle. The women who took part in the study were asked to rate how much they agreed with statements like "I often see other people walking in my neighborhood" and "Lots of women I know eat fast food often". Those women who moved in healthier circles were in turn more likely to eat well and get more exercise. According to Ball, "These findings suggest that healthy behavior may be contagious. The potential to modify social norms as an intervention lever for promoting increased engagement in physical activity and healthy eating is worthy of further investigation".

http://www.ijbnpa.org/

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91412&CultureCode=en

**China learning from Norway's mercury experience**

Research Council of Norway, The

Highly skilled basic science researchers from China are pooling their talents with analytical environmental researchers from Norway – and their findings are making their mark on Chinese environmental policy.

Since the early 1990s, Norwegian Thorbjørn Larssen has been collaborating with Chinese students and researchers to map pollutants and their environmental impacts in China. The key research questions he and his Chinese colleagues have been investigating all these years relate to the prevalence and spread of mercury. Their research has paid off with findings that have helped to convince Chinese authorities to cooperate actively within the UN Environment Programme (UNEP) on developing a global cooperation agreement on mercury waste.

Alarming mercury exposure

"It turns out the Chinese are most exposed to mercury when eating rice," explains Professor Larssen, "in contrast to Norwegians, who ingest nearly all their mercury through fish."

Methylation of mercury in nature and its subsequent uptake in the food chain are the common denominators of Chinese and Norwegian mercury exposure. Inorganic mercury converts to methylmercury under certain environmental conditions in wetlands such as Norway's marshes and China's rice fields. Methylmercury – a far more toxic compound than inorganic mercury – can be absorbed by, and accumulate in, living organisms such as fish and rice.

"It has long been known that methylmercury can form in Norwegian marshes and lake sediments and be taken up by fish. But our discovery – that methylation occurs in rice fields as well, and is thus the primary pathway of exposure for people eating rice – is new," says Professor Larssen, Senior Research Scientist at the Norwegian Institute for Water Research (NIVA) and Adjunct Professor in Environmental Chemistry at the University of Oslo.

Complementing strengths

Thorbjørn Larssen has only good things to say about the cooperative effort and knowledge sharing between Chinese and Norwegian researchers.

"Chinese researchers are leaders in some of the classical research disciplines. For instance, their research groups have a strong tradition in chemical analysis of pollutants. One reason for this is that China spends a

great deal on infrastructure and advanced instruments. In this respect we could learn a lot from them," says Professor Larssen.

"But the Chinese educational system does not teach critical thinking to pupils and students to the extent we do in Norway. Here, they have something to learn from us."

Billions are affected

"In our projects we have studied conditions in inland China, so we are quite certain that our findings apply to hundreds of millions of inland Chinese. But if it's true that rice is also the main pathway of mercury exposure in the other Asian countries where people eat rice three times a day, there are billions of people being exposed to the substance by this means."

Disrupts foetal development

Even low levels of mercury exposure have been shown to affect the human foetus. Data from studies in the Faroe Islands indicate that development of the foetal nervous system is somewhat delayed if the mother has ingested moderate amounts of mercury.

"The difference in development rate is not that great, so this is not very dangerous at the levels most individuals ingest through a normal diet. But on the scale of an entire society, high mercury exposure can mean losing some of the most brilliant minds."

Nevertheless, he does not worry excessively for the average Chinese:

"Most mainland Chinese are exposed to less mercury than are most Norwegians. Our team, however, works in particularly polluted mining areas where there truly is cause for concern."

High price for experience

Although little of the heavy industry on mainland Norway pollutes much today, highly polluting industrial activities were rampant just a few decades ago. For example, industrial methods at the zinc works in Odda (75 km inland of Bergen) turned nearby Sørfjord into one of the world's most polluted fjords. Today, by contrast, Odda's zinc production is one of the world's least polluting. Nevertheless, mercury concentrations remain high in the fjord's innermost recesses, and cautions against excessive consumption of fish and shellfish from the area still stand.

"This case from Norway's industrial past has equipped environmental researchers and politicians with valuable experience that is extremely relevant for China now, such as: How did we solve the technical and political problems of mercury discharge? How did the Norwegian authorities work: with or against the industry? And how did Norwegians deal with the problem of a polluting company that formed a cornerstone of the local community?"

Practical training, simple measures

Working with public Chinese research institutes, Dr Larssen and his colleagues have mapped the actual concentrations of mercury in the environment. They have given uncomplicated training to scientists and environmental management authorities alike on how to collect, interpret, analyse and communicate data.

"Through learning by doing, the authorities have understood that it is possible to accomplish something. In fact, the Chinese have an enormous potential to reduce discharges by implementing some simple yet highly effective countermeasures," asserts Professor Larssen.

"For instance, they have many slag piles from current or previous mercury production. These seep, and it is tremendously costly to move the piles and encapsulate them to remove the contamination completely. But we have shown them how they can mitigate the problem using straightforward, affordable measures."

"Firstly, they can reduce the seeping from the slag piles to some extent. They can also construct dams downstream, before the mercury enters a river. And they can get local farmers to avoid the common practice of growing rice immediately downstream from the slag piles. Much of the polluted water currently runs straight into the rice fields. If instead the farmers were to receive a little support to grow corn there, for instance, this would reduce exposure a great deal. Corn absorbs very little mercury," explains the professor, "whereas rice growing in water where mercury methylation is occurring takes up a lot of it."
Research influences policy

After a long process of building trust and establishing contacts, the professor and his Chinese research colleagues are now working to raise knowledge and awareness among the Chinese authorities about mercury and other pollutants.

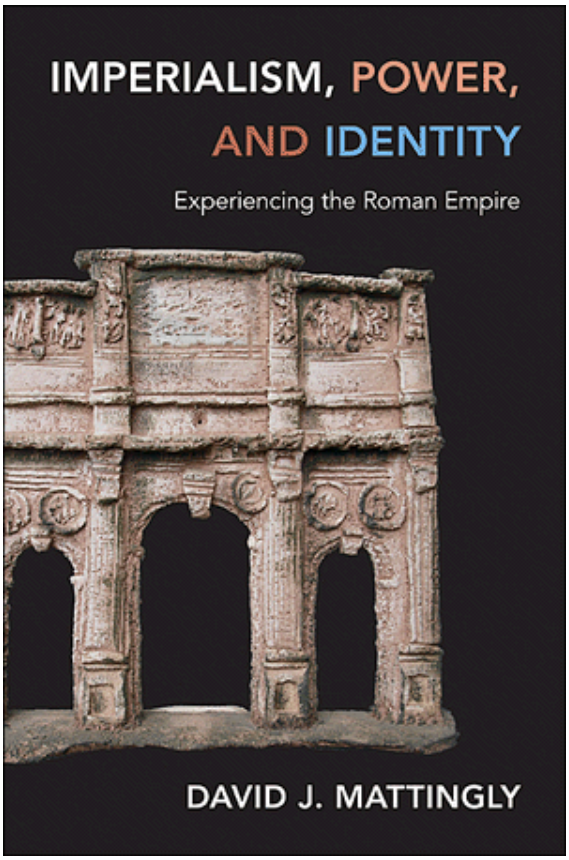
"Through the course of the four-year project period, the Chinese authorities have come to understand the need to act. Now they are cooperating within UNEP to develop a global cooperation agreement on mercury waste. This is excellent progress, and China now has one of the largest and most active delegations in the negotiations for the upcoming Mercury Convention," says Professor Larssen. The goal is to have drafted a wording by 2013.

"This process is incredibly important for China and the rest of the world. Over the next three years, the country will be collecting large amounts of data to assess the situation and the problems and opportunities this superpower has to reduce its discharges."

http://www.forskningsradet.no/en/Newsarticle/China_learning_from_Norways_mercury_experience/1253963176679?WT.mc_id=alphagalileo

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91388&CultureCode=en

**Imperialism, Power, and Identity: Experiencing the Roman Empire**
Leicester, University of




- **Título de publicación:** Imperialism, Power, and Identity: Experiencing the Roman Empire
- **Autor:** David J. Mattingly
- **Clase de publicación:** Libro (en rústica)
- **Fecha de publicación:** miércoles, 27 de octubre de 2010
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- **Número ISBN:** 978-0691146058
- **Precio:** 27,95 GBP Libras esterlinas

Despite what history has taught us about imperialism's destructive effects on colonial societies, many classicists continue to emphasize disproportionately the civilizing and assimilative nature of the Roman Empire and to hold a generally favorable view of Rome's impact on its subject peoples. *Imperialism, Power, and Identity* boldly challenges this view using insights from postcolonial studies of modern empires to offer a more nuanced understanding of Roman imperialism.
Rejecting outdated notions about Romanization, David Mattingly, Professor of Roman archaeology at the University of Leicester, focuses instead on the concept of identity to reveal a Roman society made up of far-flung populations whose experience of empire varied enormously. He examines the nature of power in Rome and the means by which the Roman state exploited the natural, mercantile, and human resources within its frontiers. Mattingly draws on his own archaeological work in Britain, Jordan, and North Africa and covers a broad range of topics, including sexual relations and violence; census-taking and taxation; mining and pollution; land and labor; and art and iconography. He shows how the lives of those under Rome's dominion were challenged, enhanced, or destroyed by the empire's power, and in doing so he redefines the meaning and significance of Rome in today's debates about globalization, power, and empire.

*Imperialism, Power, and Identity* advances a new agenda for classical studies, one that views Roman rule from the perspective of the ruled and not just the rulers.
David J. Mattingly is professor of Roman archaeology at the University of Leicester and a fellow of the British Academy. His many books include *Tripolitania*, *Farming the Desert*, *An Imperial Possession*, *Archaeology and Desertification*, and *The Cambridge Dictionary of Classical Civilization*.
Endorsements:
"Mattingly critically examines accepted ideas about the Roman Empire and evaluates them on the basis of recent archaeological analyses. He provides excellent, up-to-date discussions of such issues as Roman imperialism, colonialism, and the expression of identity through material culture. This book will be important in providing a set of new ideas about many current themes regarding the Roman world."--Peter S. Wells, author of *The Barbarians Speak: How the Conquered Peoples Shaped Roman Europe*
"This is an important book by a major scholar. David Mattingly is among the most prolific and skilled archaeologists of his generation, and very rare in the ability to produce wide-ranging works of synthesis that do not steer clear of controversy. The arguments that this book will spark are arguments that are worth having."--David S. Potter, author of *The Roman Empire at Bay*

*http://www.alphagalileo.org/ViewItem.aspx?ItemId=91382&CultureCode=en*

**Season of Birth May Have Long-Term Effects on Personality, Study Suggests**

*Crying newborn being held by doctor. (Credit: iStockphoto/Sean O'Riordan)*

ScienceDaily (Dec. 6, 2010) — The season in which babies are born can have a dramatic and persistent effect on how their biological clocks function.

That is the conclusion of a new study published online on Dec. 5 by the journal *Nature Neuroscience*. The experiment provides the first evidence for seasonal imprinting of biological clocks in mammals and was conducted by Professor of Biological Sciences Douglas McMahon, graduate student Chris Ciarleglio, post-doctoral fellow Karen Gamble and two undergraduate students at Vanderbilt University.

The imprinting effect, which was found in baby mice, may help explain the fact that people born in winter months have a higher risk of a number of neurological disorders including seasonal affective disorder (winter depression), bipolar depression and schizophrenia.

"Our biological clocks measure the day length and change our behavior according to the seasons. We were curious to see if light signals could shape the development of the biological clock," said McMahon.

In the experiment, groups of mouse pups were raised from birth to weaning in artificial winter or summer light cycles. After they were weaned, they were maintained in either the same cycle or the opposite cycle for 28 days. Once they were mature, the mice were placed in constant darkness and their activity patterns were observed.

The winter-born mice showed a consistent slowing of their daily activity period, regardless of whether they had been maintained on a winter light cycle, or had been shifted to summer cycle after weaning. When the scientists examined the master biological clocks in the mouse brains, using a gene that makes the clock cells glow green when active, they found a similar pattern: slowing of the gene clocks in winter-born mice compared to those born on a summer light cycle.

"What is particularly striking about our results is the fact that the imprinting affects both the animal's behavior and the cycling of the neurons in the master biological clock in their brains," said Ciarleglio.

In addition, their experiments found that the imprinting of clock gene activity near birth had dramatic effects on the reaction of the biological clock to changes in season later in life. The biological clocks and behavior of summer-born mice remain stable and aligned with the time of dusk while that of the winter-born mice varied widely when they were placed in a summer light cycle.

"The mice raised in the winter cycle show an exaggerated response to a change in season that is strikingly similar to that of human patients suffering from seasonal affective disorder," McMahon commented.

Exactly when the imprinting occurs during the three-week period leading up to weaning and whether the effect is temporary or permanent are questions the scientists intend to address in future experiments.

**Seasonality and Personality**

The new study raises an intriguing but highly speculative possibility: seasonal variations in the day/night cycle that individuals experience as their brains are developing may affect their personality.

"We know that the biological clock regulates mood in humans. If an imprinting mechanism similar to the one that we found in mice operates in humans, then it could not only have an effect on a number of behavioral disorders but also have a more general effect on personality," said McMahon.

"It's important to emphasize that, even though this sounds a bit like astrology, it is not: it's seasonal biology!" McMahon added.

Mice in this study were raised on artificial seasonal light cycles in the laboratory and the study was repeated at different times of the year. In humans, studies conducted in the northern and southern hemispheres have confirmed that it's the season of winter -- not the birth month -- that leads to increased risk of schizophrenia. There are many possible seasonal signals that could affect brain development, including exposure to flu virus. This study shows that seasonal light cycles can affect the development of a specific brain function.
"We know from previous studies that light can affect the development of other parts of the brain, for example the visual system. Our work shows that this is also true for the biological clock," said Ciarleglio.

**Background**

The experiment was performed with a special strain of genetically engineered mice that it took McMahon two years to develop. The mice have an extra gene inserted in their genome that produces a naturally fluorescent green protein causing the biological clock neurons in their brains to glow green when they are active. This allows the scientists to directly monitor the activity of the master biological clock, which is located in the middle of the brain behind the eyes in a small area called the suprachiasmatic nucleus (SCN).
For the study, the researchers took three groups of six to eight newborn pups each and placed them (and their mothers) in environments with controlled day/night cycles. One group was placed in a "summer" cycle with 16 hours of light and eight hours of dark; another group was placed in a "winter" cycle with eight hours of light and 16 hours of dark; and a third group was placed in an equinox cycle with 12 hours of light and 12 hours of darkness. They were kept in these environments for three weeks until they were weaned.
"When they are born, the brains of mice are less developed than those of a human baby. As a result, their brains are still being wired during this period," McMahon said.
Once they were weaned, half of the summer-born mice were kept on the summer cycle and half were switched to the winter cycle for the following 28 days as they matured. The winter-born mice were given the same treatment. The equinox-born mice were split into three groups and put into summer, winter and equinox cycles.
After the mice matured, they were placed into an environment of continuous darkness. This eliminated the day/night cues that normally reset biological clocks and allowed the scientists to determine their biological clock's intrinsic cycles.
The scientists found a substantial difference between the summer-born and winter-born groups.
The summer-born mice behaved the same whether they had been kept on the summer cycle or switched to the winter cycle. They started running at the time of dusk (as determined by their former day/night cycle), continued for ten hours and then rested for 14 hours.
The behavior of the winter-born mice was much different. Those who had been kept on the winter light cycle through maturation showed basically the same pattern as their summer cousins: They became active at the time of dusk and continued for 10 hours before resting. However, those who had been switched to a summer cycle remained active for an extra hour and a half.
When they looked at what was happening in the brains of the different groups, they found a strikingly similar pattern.
In the summer-born mice, the activity of the neurons in the SCN peaked at the time of dusk and continued for 10 hours. When the winter-born mice were matured in the winter cycle, their neuronal activity peaked one hour after the time of dusk and continued for 10 hours. But, in the winter-born mice switched to a summer cycle, the master bioclock's activity peaked two hours before the time of dusk and continued for 12 hours.
When they looked at the equinox group, the scientists found variations that fell midway between the summer and winter groups. Those subjected to a summer cycle when they matured had biological clocks that peaked one hour before the time of dusk and the biological clocks of those subjected to a winter cycle peaked a half hour after the time of dusk. In both cases the duration of SCN activity was 11 hours.
Their analysis showed that these variations are caused by alterations in the activity patterns of the individual neurons, rather than by network-level effects.
"It is quite striking how closely the neuronal wave form and period line up with their behavior," McMahon said.
###
Ciarleglio completed his graduate studies and is now assistant director of the Vanderbilt Brain Institute. The undergraduate contributors to the study were John Axley and Benjamin Strauss, who have graduated and gone

onto graduate school and medical school. Karen Gamble, the contributing post-doctoral fellow, is now a faculty member in the psychiatry department at the University of Alabama Birmingham.
The research was funded by grants from the National Institutes of Health and was conducted in association with the Silvio O. Conte Neuroscience Research Center at Vanderbilt.
***Disclaimer**: This article is not intended to provide medical advice, diagnosis or treatment. Views expressed here do not necessarily reflect those of ScienceDaily or its staff.*

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

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**Journal Reference**:

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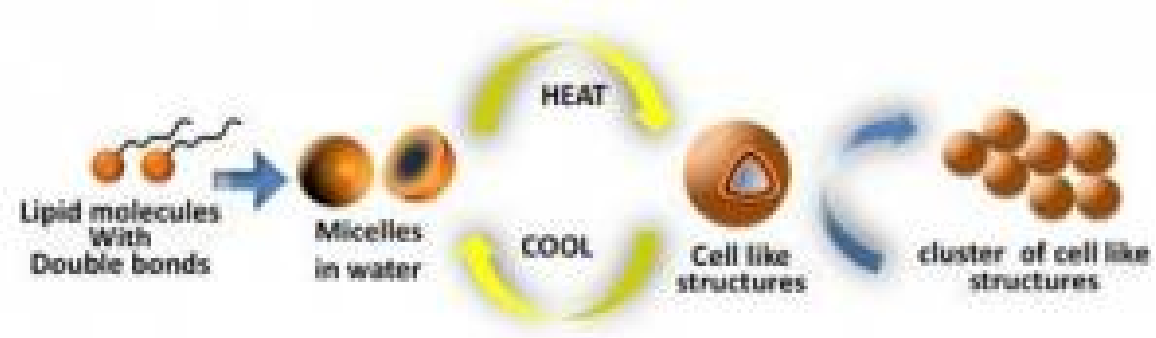
http://www.sciencedaily.com/releases/2010/12/101205202510.htm

**Chemists Design Molecule That Responds to Stimuli**




*A cartoon representation of reversible organization from synthetic lipid-like molecules to form cell-like structures (called vesicles) upon change in temperature. The cell like structures cluster together similar to toad eggs or Caviar-like morphologies upon maintaining a particular temperature. (Credit: Image courtesy of City College of New York)*

ScienceDaily (Nov. 23, 2010) — The venus flytrap plant captures its prey when it senses the presence of an insect on the tips of its leaves. An amphiphilic molecule designed by chemists at The City College of New York acts in a similar manner by changing its structure when heated slightly and, then, reverting to its original form when cooled.

The finding, reported in the journal *Angewandte Chemie,* points toward the possibility of designing adaptive soft materials in the lab that take their cues from how nature responds to stimuli, said Dr. George John, associate professor and corresponding author.

Professor John and colleagues designed the molecule, which has both water-adhering and water-repelling ends, from cardanol, a naturally available material found in cashew nut shell liquid. When mixed with water, the molecules formed a self-assembled structure called a micelle with a water-adhering exterior and water-repelling interior.

Warming the micelles to 50 degrees Celsius caused them to take on a three-dimensional structure known as a vesicle that was larger -- 200 -- 300 nm in diameter -- and viscous, much like oil. "The molecules would stick together, similar to caviar," Professor John said. "When we touched the material with a glass rod, we could draw it out in a thin strand, much like glue."

Allowing the material to cool resulted in the molecules reverting to their original micellar structure. When they were reheated, they would again take on the viscous form.

The change in structure resulted because, while heating caused the micelles to rearrange, they began to interlock in a bi-layer arrangement and eventually undergo curvature. Directional hydrogen bonding of the amide linkages and stacking of the aromatic ring groups, further stabilized the assembly.

The objective of the research is to study responsive systems, Professor John said. "If we can understand the influence of saturation at the bi-layer stage, we can regulate the adaptive response to stimuli." This will require investigating the number of micelles needed in a mixture and where they need to be positioned. Members of the team, besides Professor John, were: Dr. Sacha De Carlo, assistant professor of chemistry; Dr. Padmanava Pradhan, manager of CCNY's nuclear magnetic resonance facility; postdoctoral fellow Dr. Vijai Balachandran, and graduate student Swapnil Jadhav. The research was partially supported by the American Chemical Society Petroleum Research Fund.

***Disclaimer**: Views expressed in this article do not necessarily reflect those of ScienceDaily or its staff.*

**Story Source:**
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **City College of New York**.

**Journal Reference**:

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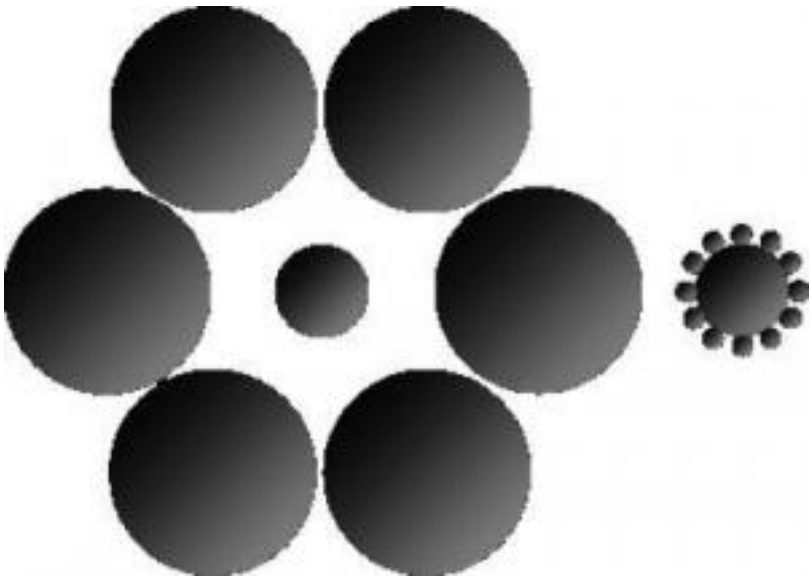
http://www.sciencedaily.com/releases/2010/11/101123151732.htm

**Brain's Architecture Makes Our View of the World Unique**



*The Ebbinghaus illusion. Most people will see the first circle as smaller than the second one Researchers found a strong link between the surface area of the primary visual cortex and the extent to which volunteers perceived the size illusion -- the smaller the area, the more pronounced the visual illusion. (Credit: Dr Samuel Schwarzkopf, UCL)*

ScienceDaily (Dec. 6, 2010) — Wellcome Trust scientists have shown for the first time that exactly how we see our environment depends on the size of the visual part of our brain.

We are all familiar with the idea that our thoughts and emotions differ from one person to another, but most people assume that how we perceive the visual world is usually very similar from person to person. However, the primary visual cortex -- the area at the back of the brain responsible for processing what we see in the world around us -- is known to differ in size by up to three times from one individual to the next.

Now, researchers at the Wellcome Trust Centre for Neuroimaging at UCL (University College London) have shown for the first time that the size of this area affects how we perceive our environment. Their study is published online December 5 in the journal *Nature Neuroscience*.

Dr D Samuel Schwarzkopf, Chen Song and Professor Geraint Rees showed a series of optical illusions to thirty healthy volunteers. These included the Ebbinghaus illusion, a well-known illusion in which two circles of the same size are each surrounded by circular 'petals'; one of the circles is surrounded by larger petals, the other by smaller petals. Most people will see the first circle as smaller than the second one

In a second optical illusion, the Ponzo illusion, the volunteers were shown two identically sized circles superimposed onto the image of a tunnel. In this illusion, the circle placed further back in the tunnel appears larger than that placed near the front.

By adapting these illusions, the researchers were able to show that individual volunteers saw the illusions differently. For example, some people saw a big (although illusory) difference in size between the two circles, but others barely saw any difference in apparent size.

Using functional magnetic resonance imaging (fMRI), the researchers were also able to measure the surface area of the primary visual cortex in each volunteer. They found a great deal of variability in the size of this area. Surprisingly, there was a strong link between its size and the extent to which volunteers perceived the size illusion -- the smaller the area, the more pronounced the visual illusion.

"Our work is the first to show that the size of part of a person's brain can predict how they perceive their visual environment," explains Dr Schwarzkopf.

"Optical illusions mystify and inspire our imagination, but in truth they show us that how we see the world is not necessarily physically accurate, but rather depends a lot on our brains. Illusions such as the ones we used

influence how big something looks; that is, they can trick us into believing that two identical objects have different sizes.
"We have shown that precisely how big something appears to you depends on the size of a brain area that is necessary for vision. How much your brain tricks you depends on how much 'real estate' your brain has put aside for visual processing."
***Disclaimer****: This article is not intended to provide medical advice, diagnosis or treatment. Views expressed here do not necessarily reflect those of ScienceDaily or its staff.*

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

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**Journal Reference**:

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http://www.sciencedaily.com/releases/2010/12/101205202512.htm

**Northern Wildfires Threaten Runaway Climate Change, Study Reveals**

*This is an image of wildfires in the Alaskan Interior. A new study reveals that climate change is causing these fires to burn more fiercely over the last decade which has resulted in an increase in greenhouse gases being pumped into the atmosphere. (Credit: Roger Ottmar, US Forest Service)*

ScienceDaily (Dec. 5, 2010) — Climate change is causing wildfires to burn more fiercely, pumping more greenhouse gases into the atmosphere than previously thought, according to a new study to be published in *Nature Geoscience* this week.

This is the first study to reveal that fires in the Alaskan interior -- an area spanning 18.5 million hectares -- have become more severe in the past 10 years, and have released much more carbon into the atmosphere than was stored by the region's forests over the same period.

"When most people think of wildfires, they think about trees burning, but most of what fuels a boreal fire is plant litter, moss and organic matter in surface soils," said University of Guelph professor Merritt Turetsky, lead author of the study.

"These findings are worrisome because about half the world's soil carbon is locked in northern permafrost and peatland soils. This is carbon that has accumulated in ecosystems a little bit at a time for thousands of years, but is being released very rapidly through increased burning."

The results of this study are important for countries currently meeting in Mexico for climate talks, added the integrative biology professor.

"Essentially this could represent a runaway climate change scenario in which warming is leading to larger and more intense fires, releasing more greenhouse gases and resulting in more warming. This cycle can be broken for a number of reasons, but likely not without dramatic changes to the boreal forest as we currently know it."

This study is part of a growing body of evidence that northern systems are bearing the brunt of climate change, said co-author Jennifer Harden, a U.S. Geological Survey scientist.

"This includes longer snow-free seasons, changes in vegetation, loss of ice and permafrost, and now fire, which is shifting these systems from a global carbon sink toward a carbon source."

The researchers visited almost 200 forest and peatland sites shortly after blazes were extinguished to measure how much biomass burnt.
"We've been chasing fires in this region for a number of years, which is how we amassed this unique data set," said Turetsky.
They also looked at fire records kept since the 1950s.
"Over the past 10 years, burned area has doubled in interior Alaska, mostly because of increased burning late in the fire season," said co-author Eric Kasischke, a University of Maryland professor. "This is the first study that has demonstrated that increases in burned area are clearly linked to increases in fire severity. This not only impacts carbon storage, but also will accelerate permafrost loss and changes in forest cover."
More severe burning also raises a number of health concerns, as fire emissions contain mercury and particulate matter that can cause respiratory issues, said Turetsky.
"We are hoping people will recognize the seriousness of climate change for northern regions and people living in them. Wildfire is going to play a more and more important role in shaping the north."
***Disclaimer****: Views expressed in this article do not necessarily reflect those of ScienceDaily or its staff.*

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

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1. Merritt R. Turetsky, Evan S. Kane, Jennifer W. Harden, Roger D. Ottmar, Kristen L. Manies, Elizabeth Hoy & Eric S. Kasischke. **Recent acceleration of biomass burning and carbon losses in Alaskan forests and peatlands**. *Nature Geoscience*, 05 December 2010 DOI: 10.1038/ngeo1027

http://www.sciencedaily.com/releases/2010/12/101205202514.htm

**Heat Helped Hasten Life's Beginnings on Earth, Research Suggests**

*Lava flow. (Credit: USGS)*

ScienceDaily (Dec. 5, 2010) — There has been controversy about whether life originated in a hot or cold environment, and about whether enough time has elapsed for life to have evolved to its present complexity. But new research at the University of North Carolina at Chapel Hill investigating the effect of temperature on extremely slow chemical reactions suggests that the time required for evolution on a warm earth is shorter than critics might expect.

The findings are published in the Dec. 1, 2010, online early edition of the *Proceedings of the National Academy of Sciences*.

Enzymes, proteins that jump-start chemical reactions, are essential to life within cells of the human body and throughout nature. These molecules have gradually evolved to become more sophisticated and specific, said lead investigator Richard Wolfenden, PhD, Alumni Distinguished Professor of biochemistry and biophysics at the UNC School of Medicine.

To appreciate how powerful modern enzymes are, and the process of how they evolved, scientists need to know how quickly reactions occur in their absence.

Wolfenden's group measured the speed of chemical reactions, estimating that some of them take more than 2 billion years without an enzyme.

In the process of measuring slow reaction rates, "it gradually dawned on us that the slowest reactions are also the most temperature-dependent," Wolfenden said.

In general, the amount of influence temperature has on reaction speeds varies drastically, the group found. In one slow reaction, for instance, raising the temperature from 25 to 100 degrees Celsius increases the rate 10 million fold. "That is a shocker," Wolfenden said. "That's what's going to surprise people most, as it did me."

That is surprising, Wolfenden said, because a textbook rule in chemistry -- for more than a century -- has been that the influence of temperature is modest. In particular, a doubling in reaction rate occurs when the temperature rises 10 degree Celsius, according to experiments done in 1866.

High temperatures were probably a crucial influence on reaction rates when life began forming in hot springs and submarine vents, Wolfenden said. Later, the cooling of the earth provided selective pressure for primitive enzymes to evolve and become more sophisticated, the Wolfenden's group hypothesizes.
Using two different reaction catalysts -- which are not protein enzymes but that may have resembled early precursors to enzymes -- the group put the hypothesis to the test. The catalyzed reactions are indeed far less sensitive to temperature, compared with reactions that are accelerated by catalysts. The results are consistent with our hypothesis, Wolfenden said.
Wolfenden's group plans to test the hypothesis using other catalysts. In the meantime, these findings are likely to influence how scientists think of the first primitive forms of life on earth, and may affect how researchers design and enhance the power of artificial catalysts, he added.
Study co-authors from UNC are Randy Stockbridge, PhD, Charles Lewis, Jr., PhD and research specialist Yang Yuan, MS. Support for the research came from the National Institute of General Medicine, a component of the National Institutes of Health.
***Disclaimer**: Views expressed in this article do not necessarily reflect those of ScienceDaily or its staff.*

**Story Source:**
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of North Carolina School of Medicine**.

**Journal Reference**:

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**Detroit Reading Corps Battles Poor Test Scores**

*Faced with catastrophic test scores, Detroit's schools determined that poor reading lay below the surface and mobilized a corps from the community to tackle the problem.*

By Paul Vachon

*A typical Detroit Reading Corps volunteer is a retired professional with an eagerness to contribute the community. (Detroit Public Schools)*

"These scores confirm that we have a reading emergency."

So last December said Robert Bobb, appointed by Michigan Gov. Jennifer Granholm in March 2009 to deal with Detroit Public Schools' persistent financial problems and has more recently exerted authority over academic matters.

Longtime observers of the school district and its 138,000 students spread out over more than 100 campuses are intimately aware of a persistent decline in student achievement, a trend now several decades long. This was underscored in late 2009 with a report released by the National Assessment of Educational Progress. The report shares the results of tests given to DPS fourth- and eighth-graders during the previous spring. Results showed these two groups of students displaying "below basic" competence in math skills, at 69 and 77 percent respectively.

The low scores in both areas suggested to school officials that reading posed the most foundational problem, preventing progress in math and other areas.

The news produced an uproar in the community. While the Detroit area normally is polarized on racial and political matters, dissatisfaction was voiced from both city and suburb.

"We want people to have not just a sense of urgency after seeing these scores, but a sense of outrage over these scores," Bobb said. "But we do not want these scores to paralyze us. On the contrary, knowing where our children are academically provides us the opportunity to strategically develop and tailor our academics to the specific needs of Detroit children. … There definitely has to be a cultural change."

His response included an aggressive remake of the schools, beginning with pre-kindergarten. This plan for early intervention led to the creation of the Call to Action for a new Reading Corps program, an initiative that depends on volunteers — most with no background in education — to tutor students in reading. Each volunteer is asked to serve at least an hour a week.

Bobb's stated goal was to recruit enough volunteers to provide 100,000 hours of service in the program's first year. More than 5,700 volunteers offered to help, representing over 650,000 hours of tutoring for 2010-11, the program's first full year of operation. Ethnically diverse, the volunteers were also geographically diverse, coming from 130 municipalities in southeast Michigan.

The program's organizers elected to implement the program progressively, beginning with pre-kindergarten students and expanding one grade level a year until 2015. During this period, observation by teachers and evaluation by way of the Michigan Educational Assessment Program will track each student's progress. Each child will continue with the same tutor if at all possible.

Since most tutors are not professional educators, organizers have set up a 30-minute structured module. After a brief introduction, the tutor reads to the child for 15 minutes and is asked to retell the story in their words.

This component of the session is the most crucial, according to Karen Feathers, associate professor of elementary education at Wayne State University. "When a child is read to, the impact is considerable. It stimulates the child's curiosity to the point that after a time, he or she will want to pick it up and read it themselves. Reading a book one level higher than the child's current level of proficiency actively engages their imagination."

This is followed by carefully paced instruction in letters, pronunciation and writing skills, where the student compiles a book of the entire alphabet over the course of several sessions. The session concludes with time to offer praise and encouragement.

To qualify as tutors, interested volunteers must undergo a criminal background check and complete up to three hours of training.

A typical volunteer is a retired professional with an eagerness to contribute the community. James Owen, a retired engineer from General Motors, epitomizes this spirit. "I view my service as an extension of my Christian faith," he says of his work with pre-kindergarteners at Van Zile Elementary School on Detroit's east side. "The help we give to kids today will be useful to them their whole lives," he adds, convinced of the long-term effectiveness of his efforts. Owen's determination is buoyed by the enthusiasm of the youngsters, who often compete to be chosen first for a tutoring session.

Despite this sentiment, Owen is realistic regarding the enormity of the challenge. "The lack of parental involvement is an obstacle we constantly battle. Many of today's parents were themselves raised in dysfunctional families that placed a low priority on education, so today we're dealing with the cumulative effect of that."

Education experts are uncertain of the effectiveness of uncertified tutors teaching reading to young students. According to Feathers, "While the effort being put forth by the DPS is certainly commendable, research

suggests that progress from instruction offered by volunteers often falls short of that offered by a trained professional."

At this point, student evaluation is mainly observational in nature. Teachers observe tutoring sessions and note student progress. Due to the fact that the program is in its infancy, no quantifiable data to its level of success is yet available.

"We are currently developing a statistical model which will be used to measure students' progress," explains Leaura Materassi, coordinator of the program. "When the charter students in the program reach the third grade, newly developed methods will test students to measure the program's effectiveness."

Statistics aside, to the people directly involved the effort represents a rekindling of hope for Detroit's schools — an optimism that springs from the city's timeless resiliency.
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*For more information on the Detroit Reading Corps program, visit http://www.detroitk12.org/readingcorps.*

http://www.miller-mccune.com/education/detroit-reading-corps-battles-poor-test-scores-25854/?utm_source=Newsletter138&utm_medium=email&utm_content=1207&utm_campaign=newsletters

**Minority Teachers: Hard to Get and Hard to Keep**

*Why are black and Latino teachers leaving in droves? Because they want more autonomy in poor urban schools, researchers say.*

By Melinda Burns

*Recruitment may be up, but teachers of color are changing schools and abandoning the profession at higher rates than whites, researchers say. (The Desktop Studio / istockphoto.com)*

"Our teachers should be excellent, and they should look like America," said the Secretary of Education in 1998, during the administration of President Bill Clinton.

It was an admirable goal, backed by federal money, yet it is still out of reach today despite a ballooning number of minority teachers in the workplace. Too many are going in one door and out the other, researchers say.

"Teachers of color are literally at risk: They're leaving, and they're leaving in droves," said Betty Achinstein, a researcher at the University of California, Santa Cruz, and the co-author of *Change(d) Agents: New Teachers of Color in Urban Schools*, a forthcoming book from Teachers College Press. "It's a deep concern, if we care at all about the imperative to diversify the teacher workforce."

During the past 20 years, the number of teachers of color has doubled to 640,000, while the number of white teachers has gone up 40 percent, according to a new and unpublished study from the University of Pennsylvania. Yet teachers of color still represent only 17 percent of the teaching workforce, even as the population of students of color has exploded.

Recruitment is up, but it's a revolving door. For the past two decades, the Penn study shows, minority teachers, mainly blacks and Latinos, have been changing schools and abandoning the profession at higher rates than whites. What's more, the turnover gap is widening.

"There's been a victory for recruitment but not a victory for retention," said Richard Ingersoll, a Penn professor of education and an expert on school organization and accountability. "If we want to solve this minority teaching shortage that's been long discussed, then there's going to have to be more focus on retention. We're hiring more minority teachers but also losing more of them. It's like a leaky bucket."

Why the high turnover? The new research from Penn and UC Santa Cruz suggests that teachers of color are leaving because of poor working conditions in the high-poverty, high-minority urban schools where they are concentrated. They want more influence over school direction and more autonomy in the classroom to teach what works.

"Teachers are told, 'You've got to teach to state-mandated standards and in accord with the pacing guides,'" said Rodney Ogawa, a UC Santa Cruz professor of education and the co-author of *Change(d) Agents*, which is based on a five-year study of 18 new teachers of color in California. "It eliminates a lot of opportunities. The teachers, like the kids, have to check their culture at the door. It's like the old cloakrooms where you used to hang up your coat, only it's this 'culture room' where you go and stash everything and then operate as if it's not there. When you go home, you pick up the stuff and leave."

According to the Penn study, more than half of all public school minority teachers are working in high-poverty, high-minority urban schools, compared to only one-fifth of white teachers, though white teachers still make up the majority of teachers in those schools.

Past studies have shown that teachers of colors are drawn to poor urban schools out of a desire to "give back" to their communities, and they tend to stay there longer than whites. But previous research by Ingersoll found that in 1995 and 2005, minority teachers had turnover rates that were 20 percent and 18 percent higher, respectively, than for whites, which was puzzling.

Ingersoll and May's new analysis confirms that trend and shows that 19.3 percent of teachers of color changed schools or left the profession during the 2008-09 school year, compared to 15.6 percent of white teachers. That means the turnover rate for minority teachers was 24 percent higher than for whites that year.

"The reality is, the minority teachers are not more likely than white teachers to stay in those tough places," Ingersoll said. "They're more likely to get jobs there, but when it comes to the decision to leave, the demographics seem to be a nonfactor. What's really driving the turnover is that these are jobs with problems."

So, even as poor urban schools are under pressure under the federal No Child Left Behind Act to produce higher test scores, many of the most committed and effective teachers in those schools appear to be giving up on them. Ingersoll and his co-author, Henry May, an assistant professor of education at Penn, are now looking into whether these are the unintended effects of No Child Left Behind.

"You have to give the faculty more input and treat them like professionals," Ingersoll said. "Teachers are like cogs in a machine."

The Penn study shows that white teachers are more likely than minority teachers to leave schools that are having problems with student discipline. Whites also are more likely to leave because of the demographics of the faculty and student body, while teachers of color never leave for that reason. A feeling of powerlessness over both school direction and classroom instruction feeds turnover rates in both groups, but much more so among minority teachers.

Ingersoll and May's study, still in draft form, has been presented for review to the Penn Consortium for Policy Research in Education and the Center for Research in the Interest of Underserved Students at UC Santa Cruz. It is based on data from the National Center for Education Statistics, the largest and most comprehensive source of information available on school staffing in the U.S.

The shortage of minority teachers in the country is longstanding. People of color represent a third of the U.S. population and 40 percent of students in U.S. public schools. But they represent only 17 percent of teachers. Blacks and Latinos each comprise 7 percentage points of that total, followed by Asians, 1.5 percent; Native Americans, 0.6 percent; Native Hawaiians and Pacific Islanders, 0.2 percent; and others, 0.7 percent.

U.S. Secretary of Education Arne Duncan recently drew attention to the problem. "It is especially troubling that less than 2 percent of our nation's 3.2 million teachers are African-American males. On average, roughly 300,000 new teachers are hired a year in America — and just 4,500 of them are black males. It is not good for any of our country's children that only one in 50 teachers is a black man."

There are some bright spots, of course. For example, the California Teachers Corps, a nonprofit umbrella group for 70 alternative teacher certification programs, placed 5,000 teachers in public schools in the present school year, and nearly half of them were minorities, President Catherine Kearney said. Recruitment of teachers of color is on the rise, she said, and most get jobs in urban schools. Alternative certification allows people with a bachelor's degree to teach while they are studying for a credential. The corps provides teachers with two years of training and support, and the retention rate is 80 percent, Kearney said.

"We recruit older individuals who are serving in their own communities, leaders who don't have to learn a new environment and a new culture," she said.

But nationwide, there's an exodus of new teachers, and it cuts across color lines. Between 40 and 50 percent of all teachers, including whites, leave the profession within five years. It may be costing the country $7 billion every year to replace them.

According to a research review earlier this year by UC Santa Cruz and the New Teacher Center, a national nonprofit group based in Santa Cruz, 80 percent of new teachers of color work in schools where at least half the students are children of color, compared to 35 percent of new white teachers.

And an emerging body of research, highlighted in a new research review by Ana María Villegas, a professor of education at Montclair State University, and Jacqueline Jordan Irvine, a professor of urban education at Emory University, suggests that teachers of color as a group produce better academic results with students of color than do white teachers. They have higher expectations for minority students and can use their "insider knowledge" to build on students' racial, cultural and linguistic backgrounds, improving K-12 attendance and college attendance rates.

"Teachers of color are valuable," Villegas said. "When you have had the experience of being 'the other' in a society, not being the mainstream, you bring in some insights as to how kids feel in schools."

To date, more than 35 states have adopted policies aimed at hiring more minority teachers, but there is no national directive.

"There ought to be some kind of federal policy that encourages the recruitment of people of color into teaching, with money behind it so that you can provide scholarships," Villegas said. "If it weren't for people of color, I don't know who would teach in urban schools. The instability in the teaching force would be so much larger. Teachers of color have expressed a commitment to working in urban schools, whereas many white teachers don't feel that commitment."

On the ground, though, it can be hard to survive in those schools. The 18 teachers of color who were interviewed and observed over five years by Achinstein and Ogawa had teaching credentials, master's degrees, commitment and high standards to spare, but they were frustrated by standardized tests and scripted lessons. Some said their supervisors objected when they tried to include anything that was "not in the manual." Others were ordered to focus on students who could improve their test scores, and leave the rest behind. They said administrators watched them closely to make sure they were following "district mandates."

Of the 18, three left teaching and five others changed schools within five years, citing, in part, the negative attitudes of school administrators toward students of color.

"I was really struck by the teachers of color who wanted to use texts that related to the lives of their kids and build on their linguistic assets, and found they couldn't because of school policies and structural barriers." Achinstein said. "They're taking on school roles against their will in ways that perpetuate inequality."

In one vivid example, Achinstein and Ogawa reported the experiences of a new Latina teacher of English as a Second Language in a high-poverty middle school in California. The teacher had grown up in the neighborhood, but she described feeling isolated and marginalized in her job in a "boot-camp-like" environment at school.

In violation of state policy, this new teacher was not assigned to a mentor. She had trouble keeping up with the curriculum because her students needed more time to review. When she attempted to arrange a meeting with parents at a local restaurant, she met with resistance from the school administration. The assistant principal told her she was "not understanding policy and procedure," and began observing her classroom four times a week.

The "double bind" for this Latina teacher became painfully clear during a period of community demonstrations against national proposals to criminalize undocumented workers. Administrators placed the school on "lockdown" with the gates closed and students confined to their classrooms. On one occasion, 300 students walked out anyway. When the Latina teacher tried to enforce school rules and stop them from jumping over a fence, they called her a "traitor."

"I felt bad, and I couldn't do anything to talk to them," she told researchers.

The teacher is still at the same school, but she's studying to be an administrator now.

"She wants to change the system," Ogawa said. "She thinks that perhaps as a principal she can have more influence to change the school and take down the fences."

http://www.miller-mccune.com/education/minority-teachers-hard-to-get-and-hard-to-keep-25852/

**Teacher Training Too Academic, Not Practical**

*In examining what's ailing American teaching, a blue-ribbon panel decided that teachers should be trained the same way we train doctors — through clinical practice.*

By Emily Badger

*Experts suggest that teacher training has become disconnected from the experience in K-12 classrooms. (The Desktop Studio/istockphoto)*

Much of the furor over how to fix local education systems has focused on teacher evaluation. How do we hold teachers accountable and reward them for student achievement? Should they be paid according to how well their students perform on standardized tests? And is it fair game to publish any metric that evaluates them that way — teacher names and all — in, say, the *Los Angeles Times*?

The National Council for Accreditation of Teacher Education is floating another idea, one that looks not at how teachers are evaluated in the classroom, but the way they're taught before they get there. What if, at colleges and universities all across the country, teachers were instead prepared the same way future doctors are: through clinical practice?

"We think we ought to look to fields like medicine, nursing, architecture, clinical psychology," said James Cibulka, president of NCATE. "Teaching is a profession of practice, like these other professions."

Cibulka corralled a panel to study the idea nearly a year ago, and last week the group released its full report in Washington, calling for a total revamp of the way American teachers are, well, taught to teach.

"We're determined that this is not a report that's going to sit on a shelf and collect dust," Cibulka said. "It is ambitious, and transforming an enterprise is never an easy thing. But I think it's become so evident to a variety of stakeholders that the nation's needs make it imperative that we move forward in this way, that we believe that this report is potentially historic. It's a game-changer."

The report, "Transforming Teacher Education through Clinical Practice," was co-chaired by Nancy Zimpher, chancellor of the State University of New York, and Dwight Jones, Colorado's commissioner of education. The full panel similarly reflects an array of state officials, university leaders, teachers, union representatives and critics of teacher education.

Their central concern is that teacher training has become disconnected from the experience in K-12 classrooms. And it is because of this gap, Cibulka believes, that many teachers in their first few years abandon the profession.

It would be unthinkable, on the other hand, to train doctors and nurses exclusively at the blackboard and then expect them to thrive in a working, chaotic hospital. Many would-be educators do a semester of student teaching, but that program is typically offered as an add-on to the main curriculum and not a recurring thread throughout it.

"It is time," the panel concludes, "to fundamentally redesign preparation programs to support the close coupling of practice, content, theory and pedagogy."

This does not mean, Cibulka stresses, "an old apprenticeship model where you go and watch what a teacher does."

Preparing teachers to work with children through clinical practice and case studies seems almost common sense. So why aren't we already doing this?

"From an historical perspective," Cibulka explained, "what happened when the normal schools became state colleges, and the state colleges became universities, the preparation of teachers became more academic in the traditional sense of the delivery of courses and credit hours."

The price of this evolution has been that growing gap between reality in the school system and theory in education departments. Now, to change that, the NCATE must simultaneously seed its ideas in local school districts and on college campuses. Eight states, including California, Ohio and Tennessee, have signed on to pursue the plan. This week, Cibulka was preaching it at a conference of university presidents, and last week he was visiting a national organization of state school officers.

The idea comes with some unknowns — clinical education would be more expensive than the existing model, although the report adds that it would also be more cost-effective in the long run (reducing, for instance, teacher drop-out rates and the need for teacher retraining). But it's unclear if any of this added cost would be passed on to the aspiring teachers themselves who — unlike doctors — aren't expected to make the kind of money that can pay off pricey clinical tuition.

http://www.miller-mccune.com/culture-society/teacher-training-too-academic-not-practical-enough-2-25613/

**The Physics of Terror**

**After studying four decades of terrorism, Aaron Clauset thinks he's found mathematical patterns that can help governments prevent and prepare for major terror attacks. The U.S. government seems to agree.**

By Michael Haederle

*Aaron Clauset is one of a handful of U.S. and European scientists searching for universal patterns hidden in human conflicts — patterns that might one day allow them to predict long-term threats. (slagheap/Flickr.com)*

Last summer, physicist Aaron Clauset was telling a group of undergraduates who were touring the Santa Fe Institute about the unexpected mathematical symmetries he had found while studying global terrorist attacks over the past four decades. Their professor made a comment that brought Clauset up short. "He was surprised that I could think about such a morbid topic in such a dry, scientific way," Clauset recalls. "And I hadn't even thought about that. It was just … I think in some ways, in order to do this, you have to separate yourself from the emotional aspects of it."

If the professor's remark gave Clauset pause, it was the briefest instant of hesitation in a still-unfolding scientific career marked by a string of self-assured, virtuoso performances. At 31, he has published in fields as diverse as paleobiology, physics, computer science, artificial intelligence and statistics, spent four busy years as a research fellow at the Santa Fe Institute and secured a spot at a University of Colorado think tank.

He also has the unusual distinction (at least for a scientist) of having once been a cast member on a reality television show.

But it is his terrorism research that seems to be getting Clauset the most attention these days. He is one of a handful of U.S. and European scientists searching for universal patterns hidden in human conflicts — patterns that might one day allow them to predict long-term threats. Rather than study historical grievances, violent ideologies and social networks the way most counterterrorism researchers do, Clauset and his colleagues disregard the unique traits of terrorist groups and focus entirely on outcomes — the violence they commit.

Call it the physics of terrorism.

"When you start averaging over the differences, you see there are patterns in the way terrorists' campaigns progress and the frequency and severity of the attacks," he says. "This gives you hope that terrorism is understandable from a scientific perspective." The research is no mere academic exercise. Clauset hopes, for example, that his work will enable predictions of when terrorists might get their hands on a nuclear, biological or chemical weapon — and when they might use it.

It is a bird's-eye view, a strategic vision — a bit blurry in its details — rather than a tactical one. As legions of counterinsurgency analysts and operatives are trying, *24*-style, to avert the next strike by al-Qaeda or the Taliban, Clauset's method is unlikely to predict exactly where or when an attack might occur. Instead, he deals in probabilities that unfold over months, years and decades — probability calculations that nevertheless could help government agencies make crucial decisions about how to allocate resources to prevent big attacks or deal with their fallout.

"I would really like to be able to get some broad sketch of what the next 50 years of conflict is going to look like, because that's what the long-term planners need to know," he says.

This comprehensive approach explains why Clauset — more of a friendly, super-smart hipster than a Dr. Strangelove — has been invited to consult with the Department of Defense, the Department of Homeland Security and other government agencies. "His is some of the most important research in the statistics of complex adaptive systems being done today," says Ken Comer, a deputy director of the Joint Improvised Explosive Device Defeat Organization, or JIEDDO, which is leading the defense department's all-out effort to combat IEDs. Because Clauset has shown that terrorism obeys the arcane laws that seem to govern complex systems, it follows that ordinary predictive tools are useless for guessing when and where terrorists might strike. That knowledge saves the government critical time and resources, Comer says: "He keeps me from going down some blind alleys."

We're sitting on a shaded porch at the hilltop campus of the Santa Fe Institute, the fabled theory shop set up in 1984 by a band of researchers from nearby Los Alamos National Laboratory. On this warm, clear summer afternoon, it seems like we can see half of northern New Mexico, with rugged mountain ranges 50 or 60 miles away standing out in stark relief against blue sky. In such a serene setting, it seems surreal to be comparing the lethal tactics and timing of the Tamil Tigers with those of the Taliban, Hamas and the Irish Republican Army, but that is how Clauset has spent much of his time over the past seven years.

After mapping tens of thousands of global terrorism incidents, he and his collaborators have discovered that terrorism can be described by what mathematicians call a power law. Unlike the familiar bell curve — where most events tend to cluster around the average, with only a small number at the margins — a power law distribution produces a wide range of highly dissimilar events.

A graph comparing the severity of terrorist attacks — how many die — and their frequency produces an L-shaped relationship that mathematicians often describe as having a "long" or "heavy" tail. One would expect to see thousands of small attacks that kill no one or at most a handful of people, a few hundred events that kill a dozen people, a few dozen events that kill a hundred, and a handful of 9/11-scale attacks.

Using this power law relationship — called "scale invariance" — the risk of a large attack can be estimated by studying the frequency of small attacks. It's a calculation that turns the usual thinking about terrorism on its head. "The conventional viewpoint has been there is 'little terrorism' and 'big terrorism,' and little terrorism doesn't tell you anything about big terrorism," Clauset explains. "The power law says that's not true."

Massive acts of violence, like 9/11 or the devastating 1995 bombing of the U.S. embassy in Nairobi, obey the same statistical rules as a small-scale IED attack that kills no one, Clauset's work suggests. "The power law form gives you a very simple extrapolation rule for statistically connecting the two," he says.

Although the U.S. and European nations have remained for years in a semipermanent state of high alert, the majority of terrorist attacks actually occur in the developing world, the data show — yet they are not the most severe. "Terrorist attacks happen less often in the developed world, but when they do happen, they're often bigger than in the developing world," Clauset says. "That was striking. We have no explanation for why that was the case."

The size of terrorist groups is also an important variable. "The bigger they are, the faster they attack," he says. "Most groups probably start small. They attack, they gain notoriety, they get some recruits and they get bigger. Once they reach a certain size, they can last longer."

Yet gaining experience in committing violence doesn't necessarily make terrorists more lethally efficient. "The severity of attacks for groups that have done a hundred attacks, versus the severity of attacks in groups that have done 10 attacks is no different," he says. "They don't actually get any better at killing people. They just try more often."

When terror attacks are broken down by weapon types, explosives are responsible for 44 percent of the deaths, while firearms account for 36 percent, their study shows. The remaining 20 percent include unconventional weapons, chemical or biological weapons, fire and knives.

Why, I ask, should there be these regular patterns in terrorist attacks among unrelated groups, irrespective of geography or ideology? It is a question Clauset gets asked frequently.

"It may be that there is something fundamental at play, that a notion like self-organized criticality is somewhere lurking underneath," he responds. "I'm skeptical of that hypothesis for terrorism, in particular, but it may be the answer in the end. I don't know." If terrorist attacks really are power-law distributed, he says, a more likely possibility is that "there might be some kind of fundamental social or political process underneath that creates this very special kind of pattern."

"My childhood wasn't one of these stereotypical scientist childhoods where I was taking things apart," says Clauset, who grew up in Winston-Salem, N.C., the child of two scientifically minded educators. He did embrace computers at a young age, learning to program on an Apple IIc. Later, he discovered physics, astrophysics and cosmology with an early CD-ROM.

At Haverford College, he hoped to double major in physics and sociology, but he grew disenchanted with the latter after taking only two courses. "Even Newtonian mechanics is more advanced than the best social theory we have, and Newtonian mechanics is 300 years old," he says.

Clauset's love affair with computer modeling began when he tried simulating evolution with algorithms. "I was fascinated by the idea that I could have an ecosystem inside my computer," he says. "I could leave in the evening and come back the next morning, and something weird would have happened overnight." He moved

on to the University of New Mexico for his doctorate, drawn in part by its proximity to the Santa Fe Institute, a place where he could hone his skills in evolutionary computation.

On a trip to New York in 2004, he happened to visit an actress friend who worked for an agency that was casting *Average Joe*, an NBC reality series. "She got tickled with the idea of me going on it, and after a couple of days, convinced me to try," he says. After an audition, he was invited to join the cast.

The premise: A group of regular-looking guys would compete for the heart of a beautiful, unattached woman (a redheaded car-show model, in this case). Clauset — tall, on the skinny side, with gold-rim glasses framing his wide-set blue eyes — fit the bill as the wonky computer scientist wading into the deep end of the dating pool. He made it through two episodes of competition before being eliminated.

Physicist Aaron Clauset

He still gets teased about it, yielding a scientific insight of a different order: "I learned a very valuable lesson, which is that a little bit of embarrassment on your part leads to a lot of enjoyment on your friends' part." Romance won out in the real world, though. Last year, he married Lisa Mullings, a nutrition educator who, until recently, worked for the state of New Mexico. "I often joke that Lisa's having a more important impact on the world than I am," he says.

In December 2006, Clauset took a postdoctoral fellowship at the Santa Fe Institute, an incubator for big ideas that brings together scholars with vastly different backgrounds — from computer scientists and physicists to linguists, economists and anthropologists. "You're encouraged to think outside the box and interact with people from other disciplines — to find new ways of attacking old questions and to come up with new questions that no one had thought of before," he says.

That may be as good a description as any of what goes on inside the notoriously hard-to-define institute, which is housed in a 1950s Santa Fe Territorial-style mansion with a new wing grafted on to provide quarters for nearly 100 faculty, fellows, visitors and staff. Visitors commonly encounter major-league science talent, like Murray Gell-Mann, the Nobel Prize-winning physicist who helped found the institute, but on this afternoon I notice novelist-in-residence Cormac McCarthy shyly mingling at the 3 p.m. tea, a daily ritual

meant to draw people out of their offices. Valerie Plame Wilson, whose career as a covert CIA officer was torpedoed by I. Lewis "Scooter" Libby's indiscretion, works in the development office.

One of Clauset's first projects at the institute was an effort to tease out simple evolutionary rules governing mammalian body size. He saw a tradeoff between the survival advantages of animal species that grow larger — and thus better able to regulate body temperature, control food sources and avoid predation — and the disadvantages, which include smaller population, lower birth rate and increased sensitivity to environmental changes. "You have a few really big things, like elephants and whales, and many, many small things, like mice and other kinds of rodents," Clauset says. "This tradeoff is what generates this asymmetric pattern."

Over the past two years, Clauset has published a series of papers calculating the effects of macro-evolutionary forces with a simple model that intentionally omits many of the classic processes recognized in evolution, such as competition among species, geography, predation and population dynamics. "It all comes back to this idea that you don't have to know all the details of processes in order to understand how the interactions lead to patterns," he says.

His computer model generates a curve that nicely matches the real-world size distributions for some 4,000 recent mammalian species. "You don't often see models do that," he says. "They usually require more tinkering." Clauset, who claims he hasn't taken a biology course since the 10th grade, expects to deepen his understanding of biology in his new role as an assistant professor at the Colorado Initiative in Molecular Biotechnology, an interdisciplinary research center at the University of Colorado in Boulder.

He and some collaborators there are trying to see if genetic algorithms can be used to shape bacterial evolution, with the admittedly ambitious hope that their metabolism could be coaxed into reversing the combustion cycle, turning carbon dioxide back into fuel. It's classic Clauset, careering between abstract theoretical questions and real-world threats as imminent as terrorism and global climate change. "I like to have one foot in both worlds," he says. "I like to do things that increase understanding, but I want to do things that have an impact as well."

Ever since the retired Athenian general Thucydides sat down to ponder the catastrophic, nearly 30-year-long war that enveloped the Hellenic world 2,400 years ago, people have sought to comprehend human conflict. Why do wars arise, and why do they persist? What determines who wins and who loses?

For the most part, these questions have been addressed by social scientists — historians, political scientists, sociologists, economists and the like. But 60 years ago, Lewis Fry Richardson, a British physicist, mathematician and pacifist who had served as an ambulance driver in World War I, published *Statistics of Deadly Quarrels*, in which he compiled data on most of the wars from 1820 to 1950, classifying them by their magnitude. Among other things, Richardson found there were many more small conflicts than large ones.

Clauset had never heard of this research when he and a computer scientist friend named Maxwell Young started talking about modeling terrorism in 2003, about the time the U.S. invaded Iraq. Clauset realized he could apply the same simplified, data-averaging technique to terrorism as he had to mammalian body sizes. "It all comes back to this idea that you don't have to know all the details of processes in order to understand how the interactions lead to patterns," Clauset says. "It turns out no one had really thought about taking this approach to thinking about terrorism — looking at the big patterns."

Standard counterterrorism research approaches its subject in essentially human terms: Why do people resort to violence or join terrorist groups? Are they poor, disenfranchised or uneducated? "They're really interested in the 'why' questions," Clauset says. "I said to myself, 'I don't care why people do it. I want to know how. Given that they're going to do it, what do they do? When do they do it? How big do they do it?'"

Clauset and Young (later joined by University of Essex political scientist Kristian Gleditsch) found a database of worldwide terrorist attacks that had been maintained by the Oklahoma City-based Memorial Institute for the Prevention of Terrorism. A U.S. Department of Homeland Security training partner, MIPT recorded 36,018 terrorist events in 187 countries from 1968 to 2008, of which 13,407 attacks had killed at least one person.

Plotting the frequency of the 13,000 lethal attacks against their severity yielded an unexpected pattern: The more frequent attacks resulted in relatively fewer deaths, while the infrequent big attacks killed the most people, Clauset found. Such scale-invariant patterns can be detected in many phenomena that follow power laws: the variety of global languages, urban populations, financial markets and earthquakes, for example.

The researchers tried slicing the data in different ways, cataloguing attacks in industrialized versus nonindustrialized countries, as well as by the kind of weapon used, and were surprised to find that the most severe attacks were clustered in the developed world. Clauset has a theory about why that might be. “On the one hand, you have the physics of population density fluctuation — where people go, when they’re there and how many people are there at that time,” he says. “Then you have targeting, which is strategic. The terrorists can choose where they put the bomb and when it goes off.”

Because terrorists aim for high-density (hence high-visibility) targets, “the bombs are attracted to where the people are” — trains and airplanes, for example.

Clauset finds this model intellectually satisfying. “It’s bridging this world between the physics side of things and the social-science, motivation-behavioral side of things,” he says, “and it’s the combination of those two effects that gives you what we see.”

Where the identity of the perpetrators could be determined, he has also found that contemporary “fourth wave” terrorism fueled by religious extremism differs in a critical respect from earlier waves — 19th-century anarchism, the anti-colonialist insurgencies of the early 20th century and Cold War-era revolutionary movements. “Religious groups accelerate their attacks faster than secular groups,” Clauset explains. “We come back to this growth dynamic: Religious groups grow faster than secular groups, and this may be because of that pool of people that are sympathetic to the rationale.”

Clauset soon came to realize that his findings about terrorist groups were an extension of Richardson’s broader research into human conflicts. “He really started all this,” he says. “I draw a line from what I’m doing right back to him. He was an inspiration in many ways.”

This is all fascinating, I tell Clauset, but I have to ask: Just how significant are these findings? After all, most counterterrorism researchers are grappling in real time with the most urgent of problems — how to avert mass carnage in the next terror attack. “I can’t tell you whether next Tuesday there’s going to be an attack somewhere, or who’s going do it, or why they’re going do it,” he concedes. “I can tell you about the overall patterns, which allows me to do some interesting things, like ask, ‘What’s the risk of events the size of 9/11? How often do they happen? Are there patterns in the past that let us paint a broad picture about what might happen in the future?’”

With information on frequency and patterns, decision-makers can better allocate resources to deal with serious long-term threats, he says. There is, for example, a “very real” danger of an attack even more devastating than the 9/11 plane hijackings, in which nearly 3,000 died. “The danger comes from nuclear, primarily,” he says. “It’s well within the realm of possibility within the next 50 years that a low-yield nuclear bomb is detonated as a terrorist attack somewhere in the world.” Such a bomb could kills tens of thousands of people, depending on when and where it goes off.

Clearly, that is an eventuality society might want to be prepared for.

On the other hand, Clauset's findings might also take some of the terror out of terrorism, which draws its power from its shadowy, unpredictable nature. For example, knowing a group's size should enable governments and law enforcement to gauge the true threat it poses (because the power law proves that size determines the frequency with which it can attack).

"It tells you that while a lot of things are flexible — different terrorist organizations are very different — there are a couple of things that they can't change," Clauset says. "That means that even if they know that we know this, they can't do anything about it."

Yet he has learned the hard way to be wary of claiming too much. In a 2005 draft of their paper, Clauset and his collaborators projected that another 9/11-magnitude attack would occur within seven years, a finding that sparked newspaper headlines ("Physicists Predict Next 9/11 In Seven Years"). Clauset now says there were too many uncertainties in the data to make such a specific prediction. "What we had said was, if the future is exactly like the past and the assumptions of the model are correct, this is what you would expect," he says. "But that number I don't trust."

Comer, deputy director of the government's anti-IED effort, says Clauset's new approach to modeling terrorism arrived at the right time. "The interesting part of it all is we didn't commission Aaron to start working that topic," Comer says. "We were looking for researchers doing an advanced statistical reconstruction of our kinds of data and came upon his research." But, Comer says, Clauset clearly grasped the import of his own work: "When we did finally show up at Santa Fe Institute to chat with him, he said, 'I was wondering how long it would take the Department of Defense to look me up.'"

The war in Afghanistan, where NATO troops have suffered hundreds of casualties in IED attacks, represents a model of asymmetrical warfare in which the "enemy" might be farmers by day — or even government policemen — and Taliban fighters by night. Leadership structures are less important to the overall movement because individuals or small cells are making their own tactical decisions, so analysis based on the model of opposing armies tackling one another head-on is nearly useless, Comer says. "This is so far beyond the typical quantitative analysis that the DOD has done for decades," he says, "[that] we'd better be talking to the Aaron Clausets of the world."

Gary LaFree, who directs the National Consortium for the Study of Terrorism and Responses to Terrorism at the University of Maryland, says his center is considering funding one of Clauset's projects. A criminologist by training, LaFree calls the discovery of power-law distributions in terrorism a "paradigm shift" that extends to other kinds of criminal behavior. "You don't get the 'aha' moments very often in the business," he says, "but this is one of them."

LaFree notes that ever since 9/11, policymakers have focused their planning on preventing another epic attack, spending billions of dollars, but that response is based on a distorted view of the threat. "The typical terrorist attack involves zero casualties, occurs in Latin America and involves groups in existence for less than a year," he says. "If you base public policy around 9/11, most of the time you're wasting your energy."

LaFree predicts Clauset's work will change the way social scientists look at crime and terrorism — eventually. "I think it's going to take some time," he says, "because it's a pretty big departure from the way people think about these things."

Some people in the counterterrorism establishment are politely skeptical about Clauset's work. Walter L. Perry, a senior information scientist at RAND Corporation who has worked with battlefield commanders in Iraq to make next-day predictions of when and where insurgents might mount IED attacks, says the predictive

power of mathematics-based forecasts improves when more is known. “We talk about getting inside the enemy’s decision-making loop,” he says. With the Iraq project, “we looked at more recent historical data. What happened six months ago was of no use to us. We looked at what took place within the last month.”

Their model achieved 35 percent accuracy, Perry says, information for which the commanders were grateful. It’s a classic example of applied operations research, a field that RAND in its earliest incarnation helped develop during World War II.

The level of abstraction used by Clauset and other researchers makes Perry uncomfortable. “If they could do it, it would be useful,” he says of their long-range forecasting. “I’m a little bit skeptical that something like that can actually be done. The groups that do these terrorist attacks are loose cannons: There’s no two alike, and it’s all very localized and depends on local grievances.” Inevitably, he says, such long-term modeling implicitly assumes that the past is prologue to the future — and that’s a big assumption.

Clauset finds such objections familiar; after all, reviewers for some academic journals have rejected his papers, and analysts trained in the social sciences often deny that there might be impersonal patterns to human behavior. He finds the reliance on social-dynamic analysis in much of the counterterrorism establishment “discouraging.”

“There’s a sort of belief that if we can map the friendship network of Afghanistan, we’ll know who to kill,” he says. “I think that’s misguided.”

Clauset has his own theories about why common patterns emerge among global terrorist groups, one of which involves organizational dynamics. “There are fundamental constraints on the behavior of terrorist organizations that look very similar to the kinds of constraints that startup companies face — that all social groups in some ways face,” he says. “This limit is manpower.”

Like small companies, Clauset says, terrorist groups are made up of highly motivated people looking to make a product — terror attacks. “Both of these face the problem that they need to grow, or they’re going to die,” he says. With small groups, if a key member leaves, it’s a major blow; with a larger work force, one person’s departure doesn’t matter as much.

That’s why the U.S. decapitation strategy has failed to subdue insurgent groups, he believes. “Someone was joking a few years back about how we’ve killed the No. 3 al-Qaeda guy in Iraq 20 times,” he says. “They keep replacing him with somebody else. We need to understand the phenomenon, not the network. The network is the manifestation of the phenomenon.”

These ideas were given powerful expression in a high-profile paper published by Army Maj. Gen. Michael T. Flynn and several collaborators in January 2010. Called “Fixing Intel: A Blueprint for Making Intelligence Relevant in Afghanistan,” the paper argued that military intelligence units are fixated on identifying the individuals responsible for IED attacks without probing the larger social context within which those people operate.

“Analysts painstakingly diagram insurgent networks and recommend individuals who should be killed or captured,” they wrote. While aerial drones scan the countryside 24/7 in the hope of spotting insurgents burying bombs, “relying on them exclusively baits intelligence shops into reacting to enemy tactics at the expense of finding ways to strike at the very heart of the insurgency.

“These labor-intensive efforts, employed in isolation, fail to advance the war strategy and, as a result, expose more troops to danger over the long run.”

One measure of the seriousness with which the defense establishment regards Clauset's research is the number of entities for whom he has consulted. In addition to the anti-explosive device group JIEDDO and START, the University of Maryland's terrorism study consortium, they include the Defense Advanced Research Projects Agency, the U.S. Naval War College's Strategic Studies Group and the science and technology office of the Department of Homeland Security.

He has also collaborated with The MITRE Corporation, a McLean, Va., nonprofit that oversees highly classified research contracts for the Defense Department and other national security agencies. Brian F. Tivnan, chief engineer in MITRE's modeling and simulation department, says he followed the work of Clauset and Neil Johnson, a University of Miami physicist who has published his own mathematical model of terrorism, for some time before convening a meeting of top researchers and defense officials at the Santa Fe Institute in August 2009. Along with Clauset, Johnson and Comer, the participants included Peter Dodds and Chris Danforth, University of Vermont computational social scientists who have developed tools for measuring the collective mood of a population based on Internet data, Tivnan says.

There's one not necessarily obvious benefit to this type of data-driven terrorism research: It is less prone to the ideological distortion that accompanies more subjective analyses, says Tivnan, who emphasizes he can speak for himself and MITRE, but not for government agencies. "When we start thinking about the implications for national security, it first broadens the perspective beyond Sept. 11, 2001, in the United States," he says. "Analytically, we've looked at other kinds of conflict and terrorism itself for several decades. Aaron did a magnificent job in characterizing the dynamics of terrorism over the better part of four decades. From a scientific standpoint, it forces the conversation to remain analytical and apolitical, which is very important."

Working as he does almost within sight of the Los Alamos lab where the first atomic weapon was designed, Clauset is aware of the real-world implications of his research, and he says that scientists working in and around national security need to be careful. Johnson, for example, has speculated that his own model might indicate whether small teams of peacekeeping troops should be deployed to fight individual terrorist cells, Clauset says. "Many of the things he suggests are not things the model predicts at all," he says. While such a suggestion might be reasonable and echo established counter-insurgency doctrine, it's also advice that, if acted upon, could get troops killed.

"That's where I would exercise caution," Clauset says. "Some people make strong claims about what their models show. I don't know if policymakers are sensitive to these issues. Like many people, they trust scientists to be conservative and cautious. Scientists trust the policymakers to be conservative and cautious.

"The end result is that probably, over the last eight years, a lot of people have been killed that didn't need to be killed — whether on our side or on everybody else's side."

In regard to his own research, he says, any timeline of prediction is so long that no one would be directly targeted for elimination as a result of his advice. Still, there are times when he sets aside the abstractions with which he is most comfortable.

"It is weird when you step back and say, 'There are thinking, social beings in these organizations, they have families and causes and ideals and so on.' And I'm thinking about them as being a little bit like particles.

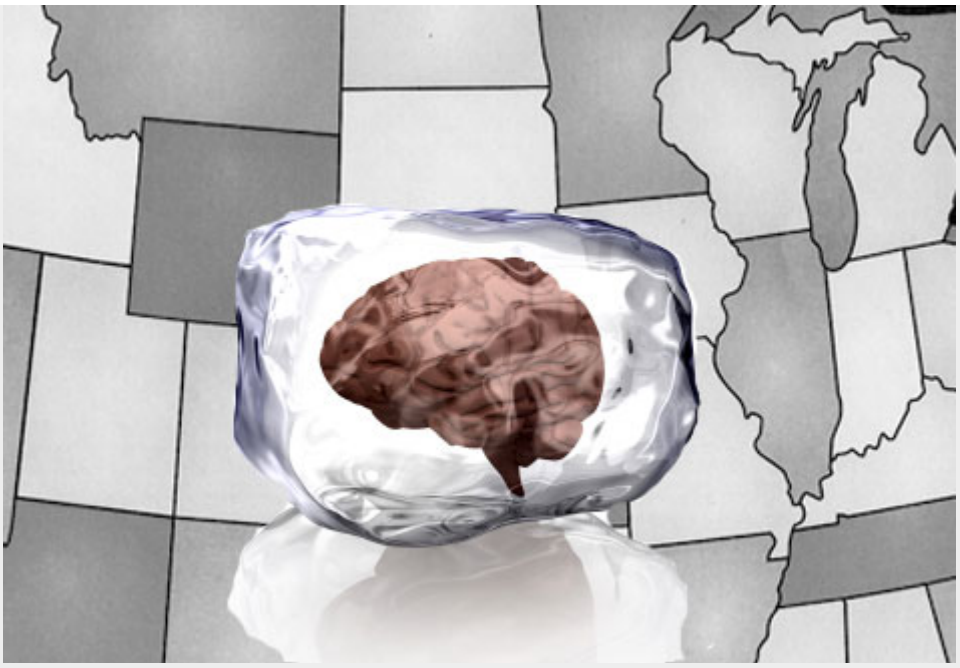
"But," he says, "the patterns speak for themselves."

**http://www.miller-mccune.com/culture-society/the-physics-of-terror-25955/**

**A Compensation for Cold Weather: Higher IQs**

*New research finds that within the U.S., those states with cooler temperatures tend to have populations with higher IQs.*

**Share and Enjoy:**
By Tom Jacobs



*A significant negative association was found between state IQs and year-round temperatures. (erzetic/istockphoto)*

With the red state/blue state divide rapidly devolving into a cliché, it's clearly time to find a new way to splice the nation into subsections. Try this adversarial alignment on for size:

Smart states/dumb states. Which is to say, cold states/warm states.

It turns out those benumbed residents of Maine, Montana and Minnesota have something to brag about. A paper recently published in the journal *Psychological Reports* concludes that of the 48 contiguous United States, those with cooler average temperatures tend to have populations with higher IQs.

A research team led by psychologist Joseph Ryan of the University of Central Missouri calculated the mean year-round temperature for each state and compared it with estimated IQs. Those scores were measured by a standardized test, the National Assessment of Educational Progress, which is administered to fourth-, eighth- and 12th-graders across the nation.

Ryan and his colleagues then controlled for certain variables that could skew the results, including gross state product (which measures economic productivity), the percentages of black, Hispanic and Asian residents, and the average pupil-to-teacher ratio in the state's schools.

Even with such factors removed from the equation, "a significant negative association was found between state IQs and year-round temperatures," they report. "Thus, as environmental temperature decreases, the state IQ tended to increase."

"While expected," they add, "these results are difficult to explain."

Expected? In a sense, yes. The results mirror those of an internationally focused 2006 study, which examined the relationship between climate and IQ in more than 120 countries. Donald Templer of the California School of Professional Psychology reported nations with lower temperatures tend to have higher IQs.

Ryan's research found that same formula applies within the U.S. But it also calls into question the conclusions that have been drawn from such earlier studies.

"Previous research has attributed the relationship between climate and IQ to the evolutionary process," Ryan and his colleagues note. As the theory goes, the ancestors of Swedes and Norwegians who were clever and resourceful enough to survive in that harsh climate passed down those heightened mental abilities to their descendants.

But as Ryan notes, less than 2 percent of the U.S. population is composed of indigenous people, which makes it unlikely that greater intelligence is a matter of climate-induced adaptation. "Perhaps individuals from colder climates in Europe and Asia tended to migrate to similar colder climates in the USA," they speculate.

Of course, plenty of people have also migrated from frigid climates to Florida and California. What's more, any cognitive challenges posed by colder climates were largely eliminated many generations ago. "It is difficult to see why the correlation between IQ and temperature persists," the researchers concede.

It's worth noting that IQ is only one measure of intelligence, and its critics contend it measures little more than the ability to take tests. In another newly published paper, Eliza Byington and Will Felps challenge the notion that IQ tests are truly predictive of academic or career success.

"IQ-reflective tests are used in primary and secondary schools to sort students into groups, and by universities and employers to select between applicants," they note in the journal *Research in Organizational Behavior*. "We argue that (these processes) allow individuals with high IQ scores to receive greater access to developmental resources, enabling them to acquire additional capabilities over time, and ultimately perform their jobs better."

But even if the validity of the IQ test is questionable, the relationship between a state's scores and its average temperature remains an intriguing puzzle. Perhaps it's time to set up an institute to look at it further. Sounds like a job for those bitterly cold brainiacs at North Dakota State University at Fargo.

http://www.miller-mccune.com/culture-society/a-compensation-for-cold-weather-higher-iqs-25414/

**The Politics of Bilingual Education**

*A reader's experience leads him to question the premise of our recent article on bilingual education in schools.*

By Miller-McCune Readers

*Students at UCLA Community School learn in English and Spanish, stay in multi-age dens for two years at a time and receive individualized instruction. (David Lauridsen)*

I can't help thinking that Angilee Shah picked the data that would support her bias on bilingual education rather than approaching the issue with an open mind ("A New School of Thought," July-August 2010). During a year in Paris, my brother and I attended 10th and seventh grades, respectively, at the international section of the Lycee de Sevres. For English speakers, the bilingual teaching lasted all of three months. For the many non-English-speaking students from around the world, the teaching was effectively immersion, although we all benefited from simple but very effective audiovisual French lessons. Everyone was comfortable in French by Christmastime and quite fluent by the end of the school year, contrary to those who think bilingual ed needs to continue for years.

Conversely, my sister, then 3, learned no French at all at a bilingual nursery school. Years later, my parents returned to Paris, where my sister attended 10th grade in a bilingual school, again learning no French. She began speaking French only after she put herself into a French school.

In her "analysis," Shah failed to control for confounding variables, such as individual instruction. Of course kids learn better with individual instruction, but just because you mix that up with bilingual education doesn't mean the bilingual education is responsible for the benefits.

One danger of forcing bilingual education to grow beyond a niche is that it would reduce the pool of exceptional teachers. Anytime teachers have to meet additional requirements, there will be fewer teachers who meet those requirements. That would be fine if the extra requirements selected for people with superior teaching abilities. But speaking a second language does not, outside of teaching that language.

Part of my skepticism about bilingual ed comes from my sense that the movement is fueled more by political goals having to do with immigration than by a genuine desire to help kids learn. For example, in the mid-'00s, The Boston Globe quoted a Hispanic leader saying that bilingual ed's importance lay in teaching his community's children their heritage.

In any event, Shah's article was short on critical thinking — in sharp contrast to most of the rest of your reporting. I'm disappointed that you would relax your standards.

**David C. Holzman**
*Lexington, Mass.*

**The reason for Cyber Command**
Although [it's] interesting to see an article downplaying the threats of cyber-terrorism and cyber-attacks ("Don't Panic. It's Only the Internet." September-October 2010), an important distinction must be made as to the Department of Defense's purpose in creating U.S. Cyber Command. Many of the nonmilitary cyberthreats, such as those to banking networks or the stock exchange, will still be managed and investigated by the U.S. Department of Homeland Security. The Defense Department's goal with U.S. CYBERCOM is to protect the .mil domain infrastructure and thousands of DoD networks worldwide.

Our national security depends on a delicate infrastructure of secret Internets like the Intelink, the U.S. Intelligence Communities secret Internet, and the SIPRNet, the military's secret Internet, where stolen data can be devastating to men and women on the battleground.

**Dave Pearson** *is an emergency room physician in Charlotte, N.C., and a member of the U.S. Counterterrorism Advisory Team.*

**Your next reading assignment: the Stanford cyber-security draft**
[Michael Scott] Moore is fantastically optimistic that governments can "make sure major control systems … are not connected to the public Web" and that this would solve the larger problem of cybersecurity. Moreover, he mistakenly assumes that any treaty would necessarily be as intrusive or constraining as those proposed by Adm. McConnell or the Russians.

He is right that claims of imminent cyberwar or cyber-pocalypse are overblown, but it will, in fact, be necessary to formalize international cooperation on the problem if the Internet is to continue to operate freely and openly as it does now. Moore, however, is wrong that "a hacker who can set a logic bomb can also cover his tracks"; this is largely due to the lack of cooperation among countries, rather than something intrinsic to the Internet. In particular, while individual hackers may be tough to find, it is entirely possible to sanction non-cooperating countries.

Cooperation is both necessary and feasible, but it has to be the right sort of cooperation. There is a solid proposal for such, the Stanford draft, which is modeled on the agreements governing civil aviation. The Stanford draft takes the Internet as is and does not seek to reshape or restructure it or to enhance governments' abilities to collect data on states. It helps make the Internet a safer place for ordinary users, not governments and militaries.

**M. Townes**
*Via Miller-McCune.com*

**Praying that Vegas never opens a Middle East branch**
I must say that I can't believe how greedy people are. They talked about how they would run the pipeline from the Red Sea and then they want to build a copy of Las Vegas alongside the pipeline ("Resurrecting the

Dead Sea," September-October 2010). Are they crazy? Don't they realize that this will defeat the purpose? Where do they think they are going to get the power to run the lights, games and water for the tourists?

I couldn't believe that the Jordan River is nothing more than a sewer. I broke down and cried while I was reading this article. I really hope that they can come up with an idea that will work — without adding any more hotels or crops — before that whole area goes down in a sinkhole.

I'll be praying for them.

**Mary Ann Coute**
*Via Miller-McCune.com*

**Make the trains fast and the routes short**
I'm Spanish and have used AVE [high-speed rail] since its introduction to travel from Seville to Madrid ("A Track to the Future," September-October 2010). It is still not a way to travel through the country, but it is the best choice for 300- to 400-kilometer trips. To translate it to your country, [high-speed rail] has to be made to connect short distances. Don't think to connect all the country at once! To move from one coast to the other you will always prefer to fly, so only the heavy-traffic routes should be executed first.

And most important: Can you reach the business center of your cities with railways and build a rail station there? Otherwise, the benefits we have in Spain (reaching the real center of our cities faster than by flying) won't be of use.

**Guido Cimadomo**
*Via Miller-McCune.com*

**No, Thank You. All of you.**
We recently sent e-mail surveys to 3,478 *Miller-McCune* subscribers and 6,570 Miller-McCune.com readers, receiving 1,477 responses that will help us improve both publications. Thanks, genuinely, to all the participants, including Kevin Vodak of Chicago, the lucky survey respondent randomly chosen to receive a free 32-gigabyte iPad. "Thank you so much for the good news, and for your good work," Vodak wrote us. "Miller-McCune provides a great service to those of us interested in research-based analysis, cutting through the political rhetoric on a number of issues."

http://www.miller-mccune.com/culture-society/the-politics-of-bilingual-education-24936/

**A Day in the Life of a Sleepy Student**

*They'll have better attendance, wreck fewer cars and be more agreeable. All we have to do is let high school students sleep in.*

By Colleen Shaddox

*Ethan Bronson, an honor student and captain of the baseball team, in his school's cafeteria at 7:30 a.m. (Gale Zucker)*

*At 5:15 a.m., Della frisks around the kitchen wagging her tail, far more chipper than the rest of the family right now. Ethan has pulled on a hoodie and makes his way downstairs to grab a granola bar "so I don't get hungry during my workout." This is not breakfast. It's hours until breakfast. Ethan alternates between texting a friend to confirm his class schedule for the day, packing equipment into his sports bag and talking with his parents.*

*The 17-year-old jokes about getting his own car over the summer.*

*"Ethan fantasizes in the morning," his father says dryly as he scans the newspaper.*

*A soft-spoken kid with deep brown eyes, Ethan flashes his dad a smile. "I'm tired," the boy admits, propping an elbow on the kitchen island.*

Ethan Boroson is an honor student and captain of the baseball team, the kind of boy who makes teachers and other students smile on sight. Though often tired, he's succeeding. But most high school students fare less well, and lack of sleep is one of the reasons. Mary Carskadon, a professor of psychiatry and human behavior at Brown University and director of chronobiology and sleep research at Bradley Hospital, studies sleep in adolescents and has found that many of them "live in a state of jet lag continually."

The consensus in the field — informed by a large Centers for Disease Control and Prevention survey of American teens — is that adolescents need about nine hours and 15 minutes of sleep a night, but most get less. Teens are caught in a tug of war between their biology and rules and schedules put in place by adults. Biology is losing.

Adults are disinclined to sleep during the day. Teenagers, however, are hard-wired to be night owls. Their circadian rhythms are timed later than those of other age groups and will remain so into their early 20s. When adults who work a typical day shift start winding down in the evening, an adolescent's energy and alertness are peaking. The average adolescent isn't ready — or perhaps even able — to go to sleep until 11 p.m. or later.

Hormones play a role. Our brains produce the hormone melatonin as they prepare to sleep. Synthetic forms are sold over the counter as a sleep aid. Carskadon found that melatonin levels in adolescents don't rise until about 10:30 p.m. Sending your teen to bed at 10 is likely to lead to tossing and turning but not much sleep until the body agrees it is time. If a child who can't sleep until 11 p.m. needs to rise at 6 a.m. to catch a bus, that provides just seven hours of sleep — two hours less than the average adolescent needs.

**Changing School Start Times Causes Alarm**

If, as the science says, teens are more alert and healthier when they sleep later, why haven't more high schools adjusted their start times? The answer to that question lies in a mix of logistics and politics. See Colleen Shaddox's story titled "Delaying School Start Times Causes Alarm" on Miller-McCune.com.

Furthermore, melatonin secretion is still high in adolescents in the early morning hours. During these hours, teens may be in the "rapid eye movement" phase, a period characterized by a high-quality form of sleep that the mind and body need to be fully refreshed. Many parents can testify to just how difficult it is to rouse a sleeping teenager.

Typical high schools in the United States open at about 7:30 a.m. But some communities have adjusted school start times in an effort to synch high school students' schedules to their body clocks, and the quantitative results have been largely positive, including better attendance and reduced traffic accidents. There is also anecdotal testimony from teachers and parents that better-rested teens are more cheerful and cooperative teens. The change comes with logistical challenges, though. As school districts around the country debate later start times, meetings tend to get heated.

***5:45 a.m.*** *Ethan's school, Cheshire Academy, is about a half-hour from his home in New Haven, Conn. Some mornings, Ethan drives himself; on others, his parents drive, allowing him to catch a nap. This morning, a doe sprints across Whitney Avenue. "Wow," Ethan says. "I've never seen that before." During the height of the day, Whitney is busy, but at this hour, only the car Ethan is riding in needs to brake for the deer.*

*On the drive, he talks, as usual, about baseball. Ethan is the second baseman for Cheshire Academy's Fighting Cats. According to his coach, Ethan would take practice swings in the batting cage all night if allowed. As it is, Ethan spends his Sunday — the only day he doesn't have other commitments — working out with a private hitting coach. "I want to play ball in college," Ethan explains. "I need to get strong for that." He's on his way to a before-school conditioning program where he's trying to bulk up with weightlifting and other exercises.*

*He does this four days a week. On the fifth day, a cardio workout is scheduled, but Ethan skips it. "I need to gain weight," says the wiry infielder. On cardio mornings, Ethan gets to sleep late — waking at 6:10 a.m. to catch a 7:15 a.m. bus.*

Carskadon describes interviewing adolescents about sleep habits and being amazed. "They use magical thinking because that's all they have," she says. "They have no science." One boy told her that he alternates sleeping for 20 minutes and studying for 20 minutes to get through his homework. "That was just not going to help him study or sleep," she says.

Learning more about sleep would ultimately, she believes, lead us all to an inescapable conclusion: "Sleep is brain food. You cannot replace it with anything else."

Carskadon says teens become masters of grabbing sleep when they can. Ethan's friends talk about using free periods for napping in their own cars or in the dorm rooms of friends who board at the school. They are all forever playing catch-up with their sleep deficits — but they never really do seem to catch up.

6:30 a.m. — Ethan hits the weight room. (Gale Zucker)

***6:30 a.m.*** *Metallica's "Enter Sandman" is blasting on the boombox as Ethan walks into the weight room. High-decibel metal alternates with high decibel hip-hop as teen boys take turns doing curls, jumping onto platforms while holding medicine balls and lifting bar weights. Varsity baseball coach Daniel O'Dea makes the rounds as they progress through the stations and offers tips about keeping knees bent, backs straight. Sweat and Axe Body Spray compete for odor dominance. This goes on for about 45 minutes until O'Dea shuts off the music and calls the boys into the center of the room. He tells them that their consistency in showing up for these early morning sessions, which are not mandatory, is the key to getting results. They form a circle, put their hands in and shout together, "Hard work!"*

It's the middle of the NBA playoffs, and the Boston Celtics are coming on strong, so there are a lot of late nights for area students. It's best not to mention staying up past midnight for a West Coast game in Mary Carskadon's earshot, though — especially if you follow up with an observation that you can get by on only a few hours' sleep a night.

"I don't want to hear that," insists the sleep researcher, who likens it to boasting about a vitamin deficiency. Sleep is a need, she says, not a luxury. Sleep deprivation is linked to poor memory and decreased alertness. Lack of REM sleep has also been shown to cause information processing and memory problems. So when high school students start classes bright and early, just how much are they actually learning?

***7:30 a.m.*** *Ethan sits at a crowded table and puts down his tray, which holds at least two breakfasts — pancakes, eggs and toast, and a line of orange juices. Now in his fresh-pressed shirt and tie, he stabs a pancake with his fork and eats it like a Popsicle.*

*He's worked hard already, and the day hasn't really started yet. The boys huddle around one student who's playing a clip of Conan O'Brien on his smart phone. They laugh and check homework until 8 a.m., when it's time to head to class.*

*Ethan walks across the school's campus, which looks like a miniature college, with rolling expanses of green dotted with red-brick buildings. He walks inside the humanities building. A few classmates are lined up by the door of their American Studies class.*

*"You think pop quiz today?" a girl asks anxiously.*

*Ethan grimaces.*

*The teacher arrives and announces that he has laryngitis. So instead of a lecture, the class will be watching a video.*

*"Yes!" exclaim several students in unison.*

*It's an episode of the television show Boston Legal that touches on censorship, privacy and the right to die. They'll be discussing it, or trying to, when the class meets next. Once the shades go down in the room, eyelids begin drooping. Ethan's head rests on his notebook for a moment before he catches himself and sits upright.*

Sleepiness can be measured. The Multiple Sleep Latency Test is the standard, and Carskadon has administered the test to thousands of adolescents, many of whom volunteer for overnight studies at her sleep research center. Carskadon studied a group of middle schoolers who started the day at 8:25 a.m., and then re-evaluated them a year later when they were due in high school for a 7:20 a.m. bell. They scored higher on the latency test in high school. In other words, they were more prone to simply fall asleep during the day.

At Cheshire Academy, as at many schools, a rotating schedule means that no course gets stuck in first period five days a week. It's an acknowledgment by educators that first period is not the ideal time for teaching or learning.

***9:10 a.m.*** *Ethan's pre-calculus class is moving fast. The teacher is working through the process of determining the area under a curve. "Do you agree?" he asks his nine students at almost every stage of the calculations. They call out figures and questions. They seem tremendously engaged, even though there's a fair bit of yawning.*

Minneapolis is a rich source of data on the difference schedules make in teen health and achievement. The city moved its high school starts forward from 7:15 a.m. to 8:40 a.m. during the 1997-98 school year. Scientists at the University of Minnesota did extensive research on the effects. Scientists asked students about feelings and behaviors associated with depression, such as being too tired to do things or feeling hopeless about the future. Minneapolis students reported fewer of these depressive signs than peers with earlier start times.

8 a.m. — Ethan on his way to class at Cheshire Academy. (Gale Zucker)

Attendance improved overall. More students stayed enrolled in the same high school after the hours change — a factor associated with higher graduation rates and better test scores. This may be a consequence of the district's attendance policy; students with eight unexcused absences or tardies in a semester were automatically dropped from the class or classes they were missing. Students on the verge of having eight strikes would routinely transfer to other schools. "At times, there have been so many students shuffling from school to school that the transferred transcripts could not keep up with all the moves," writes Kyla Wahlstrom of the Center for Applied Research and Educational Improvement at the University of Minnesota in an analysis of the schedule change. "Having a later start for the first hour of class appears to enable more students to not oversleep and to arrive at school on time."

There was a slight uptick in grades, but it was not statistically significant. Participation in sports and other extracurricular activities stayed the same, even though those activities were starting later. Principals reported fewer disciplinary problems, and nurses and counselors saw a reduction in students seeking help with relationship difficulties involving peers or parents. Though suburban parents were generally more supportive of the change than urban parents, both groups noted their children were "easier to live with."

In Minneapolis, as elsewhere, there was fear that high schoolers with a later start time would simply stay up later at night. In fact, a 10:45 p.m. bedtime was typical before and after the change. But most students slept an hour later in the morning after the schedule change, thus picking up five more hours of sleep a week.

***11 a.m.*** *"This is my one free period where I don't have any friends, so I get a lot of work done," Ethan says as he walks into school library, where the only sound is the white noise of the copy machine. He finds himself*

*a terminal at the back wall and begins searching the Internet for pictures of Roberto Clemente. He's doing a PowerPoint presentation on the ballplayer for Spanish class.*

*The quiet is broken when two students in conversation descend the stairs.*

*"I have my … tutor tonight at 4. So I have to floor it to Hamden," says one girl as she rushes on her way.*

*Ethan's just come from Spanish class, where the students were highly impressed by Ms. Alexandro's ability to catch a student texting under his desk, pocket the offending cell phone and continue on with her teaching without missing a beat. Technology competes for kids' attention every minute of the day. A week earlier, Cheshire had a power outage. Teachers talk about this almost nostalgically. No Facebook, no videos. It was easy to get the boarding students to bed on time.*

Children have defied bedtimes since the invention of the flashlight and the comic book, but Carskadon believes that the interactive technologies available to kids now may be more stimulating. Computer and video games, for example, can increase levels of dopamine, a brain chemical that plays a critical role in regulating sleep.

9:10 a.m. — Ethan in class. (Gale Zucker)

Carskadon says she'd like to be able to wave a magic wand and shut down the Internet every night. Cheshire Academy does shut down Internet service in the dorms after bedtime. A lower-tech solution, Carskadon suggests, is having a family cell phone box into which every member drops his or her phone in the evening.

**Noon.** *"I go to bed at 8:45," declares Beck Bond, a 17-year-old junior. His lunch table erupts in skeptical laughter. "That's like when I get home," says one boy. "I've talked with you on Facebook later than that," Ethan insists. Beck reconsiders. He stays up later when Lost is on — and maybe a few other shows. "I'm not a night owl," he maintains.*

*Between tossing straw wrappers and insults at each other, these young men are organizing their busy lives. A teacher comes by to tell Beck that the tennis team will be in an All-New England tournament. They're working out travel arrangements for the Saturday match.*

*"Beck's never won a game," Ethan says. (Later, when Beck is out of earshot, Ethan makes sure I know that his friend is one of the top-ranked players in the state.) Beck grabs his heart like a silent movie actor and predicts that Ethan will win the baseball Coach's Award, a recognition more of sportsmanship than talent. "He might not be the tallest, but he has the biggest heart on the team," he says, wiping away a stage tear.*

*Ethan passes around a petition to get himself on the ballot for class vice president. Other kids come by, collecting pledges for a breast cancer fundraiser. The cafeteria is awash in signup sheets.*

Part-time employment seems to be a culprit in sleep deprivation; research has shown that students who put in more hours on the job get less sleep than their peers. There are also after-school activities. Ethan is constantly discussing scheduling issues with his friends. Most of the discussion is about things the students choose, but are not required, to do.

Remember, though: This is a prep school, and these days, college-bound students need to be involved in extra-curricular activities. Consultant Katherine Cohen runs a firm, IvyWise, that helps students prepare to apply for college. Admissions officers want to see that a student has had an impact on his or her high school or community, Cohen says. There's no "magic number" of activities, she says; the important thing is to exhibit commitment and leadership. "It's rarely just one," she adds, "unless you're a star in that one activity."

***1:30 p.m.*** *Students are dreading social studies. It's taught in lecture format, and it's right after lunch — a double whammy to their ability to stay alert. They file in around a boardroom-style table. Some are still finishing dessert. "Pop quiz?" one asks shyly.*

*This time there's no reprieve. The teacher asks them to put away their books and take out a piece of paper.*

*"What caused the Cold War?" he asks.*

Ethan's schedule isn't typical. He goes to a private school, and his devotion to athletics makes his days especially full. We approached two different public school districts where students volunteered to participate in the story, but in both cases administrators would not let *Miller-McCune* spend the day with a student because we would "disrupt the educational process." Cheshire Academy Headmaster Doug Rogers quickly gave us permission to report on campus because of his interest in sleep science.

Beginning in the 2010-11 school year, Cheshire Academy will move its start time forward a half-hour, making the first class 8:30 a.m., about an hour later than most public schools in the area. Cheshire will accommodate later start times by shortening the day slightly and extending the school year by four days. No academic time will be lost. Athletic practices will be cut by only 15 minutes per week. Rogers is hopeful that better-rested athletes will have an edge.

Many prep schools are embracing later start times in response to adolescent sleep research. Those that have already made the change are seeing persuasive results. St. George's School in Rhode Island, for example, did a nine-week trial, moving its start time forward to 8:30 a.m. During that period, fewer students reported daytime sleepiness. Tardiness, dorm infractions and other disciplinary measures dropped. St. George's decided to make the schedule change permanent.

Cheshire had a brief flirtation with the new schedule when cases of H1N1 flu began to show up in Connecticut during the winter of 2009-10. Rogers temporarily instituted a later start time during the height of

the flu season. “We got healthier faster,” Rogers said. His rationale for the change is that later start times support academics and health, and he plans to track indicators to measure changes in both areas. He also foresees an intangible benefit. “If you’re better rested, you can summon a little generosity of spirit,” the headmaster says.

***3:30 p.m.*** *It’s transition time. Ethan and his friends shoot hoops in the gym. There’s only one girl among the players, but others keep drifting in to make small talk with the boys, who generally seem more interested in jump shots. One girl is upset with Beck about a misinterpreted text message. He just keeps shooting baskets.*

*“Do you have a lacrosse game today?” he asks.*

*“No, I have one tomorrow, if you would like to attend,” she says, with mock formality.*

Changing its schedule was relatively easy for Cheshire Academy, which has no elementary program and doesn’t need to consider town politics in decision-making. For public schools, the process is rockier. Bus schedules are often a major sticking point. Transpar Group, a consultancy that helps districts reconfigure bus patterns to cut costs, often hears from districts interested in moving high school start times. But most decide in the end not to do it, according to the group’s chief financial officer, Jeff McHenry.

***4 p.m.*** *Baseball practice is lightly attended because many of the players are at a junior varsity game. Ethan spends time hitting off a tee and later in a cage. His brother, Zach, a college student and Cheshire Academy alum, is in the gym helping a player with his throwing form. Zach will drive Ethan home, where physics, Spanish and English homework await the younger brother.*

A North Carolina study found that drivers under the age of 25 cause more than half of all traffic accidents that involve falling asleep at the wheel. States deal with the safety issues raised by teens who drive in a variety of ways, including increases in the legal driving age or limits on the circumstances in which teens can drive (for example, only in the daytime).

Fred Danner and Barbara Phillips, a psychologist and a medical doctor, respectively, at the University of Kentucky, compared students in Fayette County, which had moved its high school start time to 8:30 a.m., with their peers across Kentucky, who generally went to school earlier. Car crashes involving high school-aged drivers in Fayette County went down 16.5 percent in a period when accidents among that age group statewide rose by 7.8 percent.

***5:15 p.m.*** *Linda Goodman, Ethan’s mother, is preparing a yam-and-chicken casserole while he snacks on Fruit Loops. He’s going to relax until dinner, then tackle that homework. So when does Ethan just socialize? “I went to the movies Friday night,” he says, adding that Sundays are often a good time to get together with friends.*

*He’s got an upcoming birthday party. A freshman approached him today fishing for an invitation. Ethan smiled at the younger student indulgently, “You can come, sure,” he said.*

*“OK, but I’m not driving yet. How will I get there?” the would-be partygoer asked.*

*“I don’t know,” said Ethan, who drew the line at providing taxi service to underclassmen. “But if you get a ride, you can certainly come.”*

*Ethan does not work during the school year, but will have a part-time job at his father’s architectural firm this summer. His baseball schedule is intense over the summer, as well, when he plays with a competitive Amateur Athletic Union team.*

Sleep deprivation is part of military training, because combat requires functioning with little or no sleep. But several branches have taken a hard look at adolescent sleep research, given that most recruits are young adults and likely to have later-phased sleep patterns. Research conducted at the United States Navy's Recruit Training Command at Great Lakes, Ill., convinced the Navy to give trainees more shut-eye. Recruits went from a six-hour sleep schedule to eight hours. Under the eight-hour regimen, standardized test scores improved 11 percent.

***9 p.m.*** *After some computer and television time, Ethan digs into his physics homework. It's a light night, about an hour's work, because he's gotten a lot done during his free period.*

Do years of inadequate sleep have a long-term consequence? "We don't know for sure," Carskadon says. She points to adult diseases that experts know are linked to sleep, such as depression and obesity. The research simply does not exist to determine if poor sleep in adolescence plays a role here.

***10:30 p.m.*** *Ethan calls it a night and heads upstairs to bed. "Sometimes I'll be on Facebook or just talking to people for like a little bit," he says. Tonight he forgoes both. It takes him about a half-hour to go to sleep. Tomorrow morning, he'll start all over again at 5 a.m.*

http://www.miller-mccune.com/culture-society/a-day-in-the-life-of-a-sleepy-student-23743/

**Bacteria 'R' Us**

*Emerging research shows that bacteria have powers to engineer the environment, to communicate and to affect human well-being. They may even think.*

By Valerie Brown

*(Illustration by Bryan Christie)*

*Today's revelation in the journal* Science *that researchers have found a bacterium in California's Mono Lake that can thrive on arsenic — usually implicated in killing life, not sustaining it — is quickly revolutionizing our conception of what is life and where it might be found. To help in deciphering the direct contribution bacteria make to human life, we're reposting this story which originally debuted on Oct. 18.*

A few scientists noticed in the late 1960s that the marine bacteria *Vibrio fischeri* appeared to coordinate among themselves the production of chemicals that produced bioluminescence, waiting until a certain number of them were in the neighborhood before firing up their light-making machinery. This behavior was eventually dubbed "quorum sensing." It was one of the first in what has turned out to be a long list of ways in which bacteria talk to each other and to other organisms.

Some populations of *V. fischeri* put this skill to a remarkable use: They live in the light-sensing organs of the bobtail squid. This squid, a charming nocturnal denizen of shallow Hawaiian waters, relies on *V. fischeri* to calculate the light shining from above and emit exactly the same amount of light downward, masking the squid from being seen by predators swimming beneath them.

For their lighting services, *V. fischeri* get a protected environment rich in essential nutrients. Each dawn, the squid evict all their *V. fischeri* to prevent overpopulation. During the day, the bacteria recolonize the light-sensing organ and detect a fresh quorum, once again ready to camouflage the squid by night.

This tale of bobtail squid would be just another mildly jaw-dropping story in a natural world full of marvels if it weren't a portal into an unsuspected realm that has profound consequences for human beings. Regardless of the scale at which we explore the biosphere — whether we delve into the global ocean or the internal seas of individual organisms — bacteria are now known to be larger players than humans ever imagined.

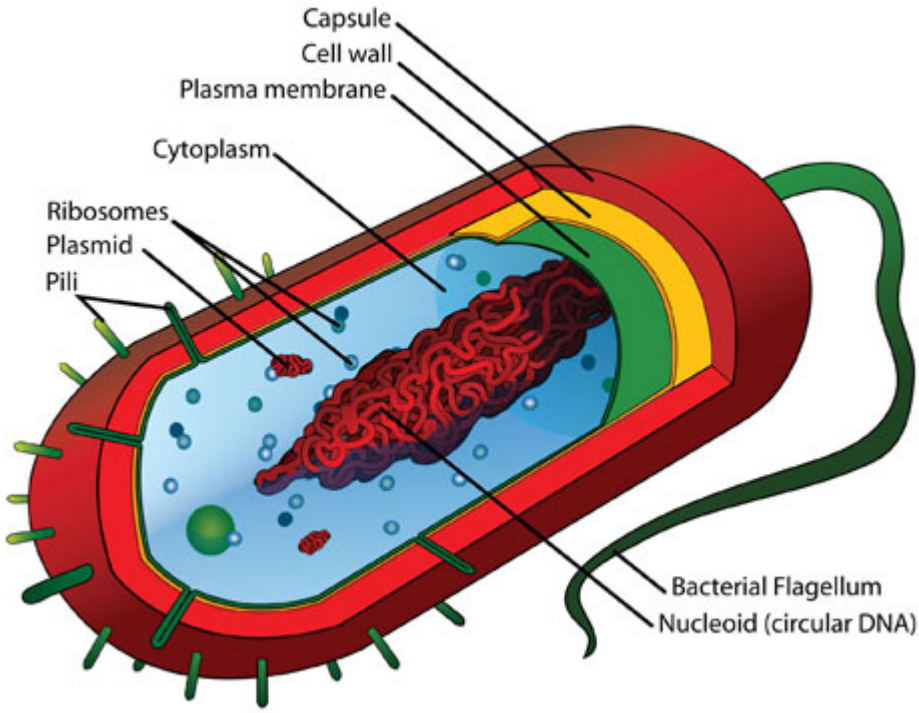
Strictly by the numbers, the vast majority — estimated by many scientists at 90 percent — of the cells in what you think of as your body are actually bacteria, not human cells. The number of bacterial species in the human gut is estimated to be about 40,000, according to Daniel Frank and Norman Pace, writing in the January 2008 *Current Opinion in Gastroenterology*. The total number of individual bacterial cells in the gut is projected to be on the order of 100 trillion, according to Xing Yang and colleagues at the Shanghai Center for Bioinformation Technology, reporting in the June 2009 issue of *PLoS One*, a peer-reviewed online science journal. Xing calculated a ballpark figure for the number of unique bacterial genes in a human gut at about 9 million.

In fact, most of the life on the planet is probably composed of bacteria. They have been found making a living in Cretaceous-era sediments below the bottom of the ocean and in ice-covered Antarctic lakes, inside volcanoes, miles high in the atmosphere, teeming in the oceans — and within every other life-form on Earth.

These facts by themselves may trigger existential shock: People are partly made of pond scum. But beyond that psychic trauma, a new and astonishing vista unfolds. In a series of recent findings, researchers describe bacteria that communicate in sophisticated ways, take concerted action, influence human physiology, alter human thinking and work together to bioengineer the environment. These findings may foreshadow new medical procedures that encourage bacterial participation in human health. They clearly set out a new understanding of the way in which life has developed on Earth to date, and of the power microbes have to regulate both the global environment and the internal environment of the human beings they inhabit and influence so profoundly.

There's such ferment afoot in microbiology today that even the classification of the primary domains of life and the relationships among those domains are subjects of disagreement. For the purposes of this article, we'll focus on the fundamental difference between two major types of life-forms: those that have a cell wall but few or no internal subdivisions, and those that possess cells containing a nucleus, mitochondria, chloroplasts and other smaller substructures, or organelles. The former life-forms — often termed prokaryotes — include bacteria and the most ancient of Earth's life-forms, the archaea. (Until the 1970s, archaea and bacteria were classed together, but the chemistry of archaean cell walls and other features are quite different from bacteria, enabling them to live in extreme environments such as Yellowstone's mud pots and hyperacidic mine tailings.) Everything but archaea and bacteria, from plants and animals to fungi and malaria parasites, is classified as a eukaryote.

Science has determined that life arose and became complex through a process generally known as evolution, but biologists are engaged in an energetic debate about the form of that evolution. In essence, the argument centers on whether the biosphere should be characterized as a tree of life or an interactive web. In the tree construct, every living thing springs from a common ancestor, organisms evolve slowly by means of random mutations, and genes are passed on from parent to offspring (that is to say, vertically). The farther away from the common ancestor, generally speaking, the more complex the life-form, with humans at the apex of complexity.




The prokaryotes are a group of organisms that lack a cell nucleus or other membrane-bound organelles. (wikimedia)

The tree-of-life notion remains a reasonable fit for the eukaryotes, but emerging knowledge about bacteria suggests that the micro-biosphere is much more like a web, with information of all kinds, including genes, traveling in all directions simultaneously. Microbes also appear to take a much more active role in their own evolution than the so-called "higher" animals. This flies in the face of the more radical versions of Darwinism, which posit that the environment, and nothing else, selects genes, and that there is no intelligence, divine or otherwise, behind evolution — especially not in the form of organisms themselves making intentional changes to their heritable scaffolding. To suggest that organisms as primitive as bacteria are capable of controlling their own evolution is obviously silly.

Isn't it?

In terms of the pace of evolutionary change, one advantage the single-celled have over complex organisms is reproductive speed. Unlike eukaryotes, bacteria usually reproduce by cloning, which simply copies the single parent's entire set of genes. If conditions are favorable, a population of bacteria can double every 20 minutes or so.

Achieving genetic diversity is a whole different thing. Most eukaryotes engage in sex, which combines reproduction with genetic mixing. This produces offspring carrying half of each parent's genes. But bacteria don't have sex, they transfer genes among themselves horizontally — and they do a lot of transferring. The primary method most bacteria use is called "conjugation," a process in which genetic material is transferred between two bacteria that are in contact. It's as close as they come to sex (although, as far as we know, lacking the romance; it's more like downloading handy little apps from a cool website). In principle, every bacterium can exchange genes with every other bacterium on the planet. A side effect of this reality: The

notion of separate bacterial species is somewhat shaky, although the term is still in use for lack of a better alternative.

The Titanic, draped with colonies of bacteria. (Courtesy of Lori Johnson, RMS Titanic Expedition 2003, NOAA-OE)

And bacteria don't just get together for "file sharing." Even before quorum sensing was discovered in *V. fischeri*, scientists had noted many examples of coordinated action, such as "swarming," in which a colony of bacteria moves as a unit across a surface, and the development of "fruiting bodies," in which bacteria glom together to form inert spores as a means of surviving severe environmental conditions. Since the dominant paradigm assumed that bacteria were dumb, discrete individuals, these phenomena tended to be glossed over until *Vibrio*'s highly sophisticated census-taking focused new attention on coordinated bacterial behavior. Group behavior has now been demonstrated so widely that many microbiologists view bacteria as multicellular organisms, much of whose activity — from gene swapping to swarming to biofilm construction — is mediated by a wide variety of chemical communications.

Bacteria use chemicals to talk to each other and to nonbacterial cells as well. These exchanges work much as human language does, says Herbert Levine of the University of California, San Diego's Center for Theoretical Biological Physics. With colleagues from Tel Aviv University, Levine proposed in the August 2004 *Trends in Microbiology* that bacteria "maintain linguistic communication," enabling them to engage in intentional behavior both singly and in groups. In other words, they have "social intelligence."

Bacteria can live solitary lives, of course, but they prefer to aggregate in biofilms, also known as "slime cities." Biofilms usually form on a surface, whether it's the inner lining of the intestines or inside water pipes or on your teeth. In these close-knit colonies, bacteria coordinate group production of a slimy translucent coating and fibers called "curli" and "pili" that attach the colony to something else. Biofilms can harbor multiple types of bacteria as well as fungi and protists (microscopic eukaryotes). A complex vascular system for transporting nutrients and chemical signals through a biofilm may also develop. As Tim Friend described in his book *The Third Domain*, explorers diving to the wreck of the *Titanic* found these features in "rusticles" — draped colonies of microbes — feeding on the iron in the *Titanic*'s hull and skeleton, more than 2 miles under the surface.

The abilities of bacteria are interesting to understand in their own right, and knowing how bacteria function in the biosphere may lead to new sources of energy or ways to degrade toxic chemicals, for example. But emerging evidence on the role of bacteria in human physiology brings the wonder and promise — and the hazards of misunderstanding them — up close and personal.

Because in a very real sense, bacteria are us.

In 2007, the National Institutes of Health began an ambitious program called the Human Microbiome Project, which aims to take a census of all the microorganisms that normally live in and on the human body. Most of these live in the digestive tract, but researchers have also discovered unique populations adapted to the inside of the elbow and the back of the knee. Even the left and right hands have their own distinct biota, and the microbiomes of men and women differ. The import of this distribution of microorganisms is unclear, but its existence reinforces the notion that humans should start thinking of themselves as ecosystems, rather than discrete individuals.

As of early 2010, the Human Microbiome Project had collected samples of microbial DNA from about 300 people and had sequenced or prepared to sequence the genomes of about 500 bacterial strains from these samples. Fifteen studies of microbial involvement in human disease have been funded. "These sorts of trials take time," says Microbiome Project program director Susan Garges, so clinical treatments based on the research from the project could be years off unless, she says, "in the shorter term, specific microorganisms are associated with a disease state." In that case, protocols for clinical diagnosis and treatment might be accelerated.

But the microbiome project is not just about disease-causing microbes such as *E. coli* and *Staphylococcus* strains. Many of the organisms it is identifying are responsible for regulating the digestive tract and keeping humans healthy in a variety of ways.

The human gut is filled with large numbers of a wide variety of bacteria; clearly those that cause disease must rank high on the priority list of those to be studied, but the picture emerging from new research is that pathogens and beneficial bacteria are not necessarily mutually exclusive organisms. A microbe's effects on the human body can depend on conditions. And if you approach the human body as an ecosystem, some researchers are finding, it may be possible to tune that system and prevent many diseases — from acute infections to chronic debilitating conditions — and even to foster mental health, through bacteria.

Recent research has shown that gut microbes control or influence nutrient supply to the human host, the development of mature intestinal cells and blood vessels, the stimulation and maturation of the immune system, and blood levels of lipids such as cholesterol. They are, therefore, intimately involved in the bodily functions that tend to be out of kilter in modern society: metabolism, cardiovascular processes and defense against disease. Many researchers are coming to view such diseases as manifestations of imbalance in the ecology of the microbes inhabiting the human body. If further evidence bears this out, medicine is about to undergo a profound paradigm shift, and medical treatment could regularly involve kindness to microbes.

Still, in practice, the medical notion of friendly microbes has yet to extend much past the idea that eating yogurt is good for you. For most doctors and medical microbiologists, microbes are enemies in a permanent war. Medicine certainly has good reason to view microbes as dangerous, since the germ theory of disease and the subsequent development of antibiotics are two of medical science's greatest accomplishments.

But there's a problem: The paradigm isn't working very well anymore. Not only are bacteria becoming antibiotic-resistant, but antibiotics are creating other problems. Approximately 25 percent of people treated with antibiotics for an infection develop diarrhea. Moreover, people who contract infections just by being hospitalized are at risk of developing chronic infections in the form of biofilms. These not only gum up the works of devices such as IV tubes, stents and catheters, but also protect their constituent microbes from antibiotics.

In addition to antibiotic-resistant *E. coli* and *Salmonella* that often spread through our food supply, common pathogens that make doctors' blood run cold include *Pseudomonas aeruginosa* and *Clostridium difficile*. *P. aeruginosa* is responsible for about 40 percent of all fatalities from hospital-acquired infections. *C. difficile* is the culprit in at least a quarter of diarrhea cases caused by antibiotics. A 2007 study by the Los Angeles County Department of Public Health found that mortality rates from *C. difficile* infections in the United States quadrupled between 1999 and 2004. *C. difficile* will invade an antibiotic-cleansed colon and "poke holes in it," says Vincent Young, a gastrointestinal infection specialist at the University of Michigan. Some people in this situation rush to the bathroom 20 times a day. "It's not just an inconvenience," Young says.

Many researchers are focusing on inflammatory bowel disorders to understand how the balance between the intestinal microbes and their human hosts becomes deranged. Incidence of these diseases has sharply increased since about the mid-20th century, just about the time the industrialized world started eating highly processed foods and antibiotics came into widespread use. For example, in bowel disorders such as Crohn's disease and ulcerative colitis, excessive inflammation leads to severe pain, diarrhea and vulnerability to opportunistic germs. Standard treatments include powerful steroids like prednisone, surgical removal of the colon and heavy treatment with antibiotics.

But a more ecological approach is beginning to offer hope. *P. aeruginosa* and *C. difficile* are common residents of human bodies and under normal circumstances are benign. So what turns them into enemies? Most of the time, says John Alverdy, an intestinal and critical-care surgeon at the University of Chicago, bacteria "have to have a reason to hurt you." Surgery is just such a reason. A surgical patient's normal metabolism is altered; usually nutrients are provided intravenously instead of through the digestive system, so in a patient being fed by an IV drip, the gut bacteria perceive their sustenance disappearing. A decline in available nutrients alarms them. And surgery triggers the release of stress compounds that bacteria also sense, Alverdy says. Chemotherapy and radiation have similar effects. When threatened, bacteria become defensive, often producing toxins that make the host even sicker. They also tend to speed up their acquisition of and purging of genes when under external selection pressure, of which antibiotics are an obvious and powerful example.

Alverdy is finding success in treating patients with a strategy he calls "ecologic neutrality." In research reported in the August 2008 *Surgery*, he was able to prevent *P. aeruginosa* from turning virulent in surgically stressed mice by dosing them with polyethylene glycol, which supplies the bacteria with phosphate, one of their primary needs. "Once they sense there's plenty of phosphate," he says, "they figure everybody must be happy here." The treated mice in his experiments, unlike the controls, did not contract fatal infections.

Some researchers are even exploring the idea of stool transplants — that is, introducing a healthy person's gut bacteria into a sick person's intestines via the donor's feces. Although there are not many peer-reviewed studies of this rather disturbing concept, a review in the July 2004 *Journal of Clinical Gastroenterology* by Australian researcher Thomas Borody found that in a large majority of the cases reported in the medical literature, fecal transplants resulted in almost immediate and long-lasting relief for people suffering from

inflammatory bowel conditions and for those with chronic antibiotic-induced diarrhea. (There's definitely a market for fecal transplants. When one scientist mentioned the success of the procedure in an interview with *The Wall Street Journal*, he was inundated with calls from desperate patients begging for the treatment, even though he does not practice the therapy.)

If new therapies based on human microbial ecology just lessened antibiotic resistance and relieved the suffering of people with intestinal disorders, they would constitute miraculous advances. But the intensifying focus on the role of bacteria in human health is turning up other possible avenues for improving health.

Gut bacteria play a role in obesity, which affects about a third of American adults. The gut bacteria populations of the obese are less diverse than those of normal-weight people. Researchers have found that children whose fecal bacteria are composed more of *Staphylococcus aureus* than *Bifidobacteria* at birth are more likely to become overweight later in life. Interestingly, one study found that the microbiota of obese adults were very different from the bacteria populations of both normal-weight people and obese people who had had gastric bypass surgery. Researchers from Arizona State University and the Mayo Clinic noted that in obese people, there appeared to be a cooperative relationship between hydrogen-producing bacteria and the one archaean resident of the human gut, a hydrogen-consuming, methane-producing organism. The archaean partner makes fermentation of indigestible polysaccharides (which are complex carbohydrates) more efficient, and the extra fermentation products are converted to fat by the intestines. It appears that obese people's gut microbes are just too good at their jobs.

Research in animals supports the idea that gut bacteria play a role in weight regulation. According to recent research by Emory University pathologist Andrew Gewirtz and his colleagues, mice bred without a gene that allows them to detect the presence of gut bacteria unexpectedly became overweight and suffered from high blood pressure, high triglycerides and high cholesterol. When given access to a high-fat diet, they developed full-blown diabetes. Fecal transplants from these mice to normal mice transferred the health problems.

Despite these fascinating hints, scientists don't yet know whether changes in microbial equilibrium are the chicken or the egg — that is, whether they cause or are caused by obesity — making it unclear whether restoring a proper gut ecosystem can become a magic bullet to fire against obesity.

Researchers have found several reasons to believe that bacteria affect the mental health of humans. For one thing, bacteria produce some of the same types of neurotransmitters that regulate the function of the human brain. The human intestine contains a network of neurons, and the gut network routinely communicates with the brain. Gut bacteria affect that communication. "The bugs are talking to each other, and they're talking to their host, and their host talks back," Young says. The phrase "gut feeling" is probably, literally true.

For example, it's been known for a while that sick people get depressed and anxious. This seems so obvious as to be a no-brainer, but research suggests that some of the fear and fatigue associated with infections stems from immune responses affecting the brain.

Mark Lyte of the Texas Tech University School of Pharmacy noticed that lab mice dosed with *Campylobacter jejuni*, bacteria that are commonly a cause of food poisoning, were more anxious than control mice. After several experiments, Lyte's team concluded that the vagus nerve, which extends into the colon, was probably transmitting the news of a gut infection to the brain areas involved in emotions. Reporting their results in the August 2007 *Brain, Behavior and Immunity*, the team also conjectured that the anxiety often exhibited by victims of bowel disorders may operate on the same network, which is not under conscious control.

Even more intriguingly, there have long been hints that some bacteria, including *Bifidobacteria* commonly found in yogurt, can improve mood. A common soil microbe, *Mycobacterium vaccae*, has recently been found to cheer up lab mice in experiments by Christopher Lowry, an integrative physiology professor at the University of Colorado at Boulder. Lowry and colleagues showed that infection with *M. vaccae* "alters stress-

related emotional behavior" in mice by activating neurons producing serotonin, the neurotransmitter affected by Prozac.

Since the days of Pasteur and Koch, to be classified as disease-causing, a bacterium has had to be grown in culture, isolated from all other organisms. As it turns out, however, very few bacteria can be grown in the relatively austere conditions of laboratories. In fact, only about 0.1 percent of all bacteria are currently culturable. Many bacteria don't do well in monoculture, preferring to live in mixed communities of microorganisms. Those living in extreme temperatures and pressures require very specialized equipment to grow in a typical lab.

Developments in gene sequencing have cast light into the murk of the bacterial world. Instead of the old-school method of isolating and growing each type of bacteria separately, microbiologists are just dipping into biological stews to see what genes they contain. Through metagenomics — the high-throughput technology used to sequence the human genome — they analyze multiple samples of genetic material simultaneously, at high speed and low cost.

Beyond the universe of bacterial genes recently discovered in the human gut, surveys of marine microbes are producing similarly staggering numbers of genes and species. This spring, J. Craig Venter and co-authors reported that samples of seawater taken near Bermuda yielded 150 new types of bacteria and more than a million previously unknown genes — this in an area of open ocean thought to be low in nutrients and sparsely populated by microorganisms.

R. John Parkes, a researcher at the University of Cardiff, Wales, studies microbes found in core samples collected by the Ocean Drilling Program from rocks deep below the ocean floor. "For a long time, these deep sediments were thought to be devoid of any life at all," he says. There's life down there, all right, but talk about slow metabolism: When Parke analyzed 4.7 million-year-old organic sediment in the Mediterranean, he estimated the average time it took for resident microbes to reproduce by cell division at *120,000 years*. And he reported finding living bacteria just over a mile *below* the seafloor, in sediments 111 million years old and at temperatures of 140 to 212 degrees Fahrenheit.

Most of the ocean floor — about 70 percent of the Earth's surface — is covered with such sediments, formed by the constant rain of sand and other particles through the water column. Below the sediments are layers of igneous rocks that ooze from long cracks on the seafloor. It's counterintuitive, to put it mildly, to imagine anything would live in this formerly molten rock where it meets the staggering pressure and cold of the lightless deep. But guess what? There may be more life in these rocks at the gates of hell than there is in the relatively paradisiacal environments above.

Oregon State University microbiology professor Stephen Giovannoni and his graduate student Olivia Mason used metagenomics to survey microbes in basalt along the East Pacific Rise southwest of Mexico, in the Juan de Fuca strait off the coast of Washington state and elsewhere. They found that the communities in the rocks were clearly distinct from the sorts of bacteria common in seawater and, as Mason wrote in her 2008 doctoral dissertation, their total biomass may outstrip that of life in the oceans.

These and other new findings suggest that microbes deep in submarine rock may play a heretofore unrecognized role in the regulation of not just the oceans, but the global environment.

Wherever they live, bacteria can take most of the credit for bringing planetary geology into the service of life. They started working on these processes promptly upon their first emergence, perhaps as early as a mere billion years into Earth's 4.5-billion-year history. Both the energy-releasing chemical reactions and the assembly of complex organic molecules necessary for life are, Rutgers University professor Paul G. Falkowski and his co-authors wrote in *Science*, "an emergent property of microbial life on a planetary scale." In fact, they wrote, the genes that enable these processes today "may have been distributed across a common

global gene pool, before cellular differentiation and vertical genetic transmission evolved as we know it today."

In other words, bacteria are supreme code monkeys that probably perfected the packages of genes and the regulation necessary to produce just about every form of life, trading genetic information among themselves long before there was anything resembling a eukaryotic cell, let alone the masters of the universe that humans believe humans to be.

Bacteria, says Giovannoni admiringly, are marvels of engineering. "When it comes to biochemistry, they are much better than eukaryotes," he says. "They don't waste things. They're very efficient, very clever. They keep it simple but very elegant and sophisticated."

But just how smart are they, really?

Giovannoni stops short of claiming that bacteria are actually thinking. But the litany of bacterial talents does nibble at conventional assumptions about thinking: Bacteria can distinguish "self" from "other," and between their relatives and strangers; they can sense how big a space they're in; they can move as a unit; they can produce a wide variety of signaling compounds, including at least one human neurotransmitter; they can also engage in numerous mutually beneficial relationships with their host's cells. Even more impressive, some bacteria, such as *Myxococcus xanthus*, practice predation in packs, swarming as a group over prey microbes such as *E. coli* and dissolving their cell walls.

At least one scientist was willing to allow for the possibility of bacterial thinking quite early in the development of microbiology: Alfred Binet, who invented the first reliable intelligence test and who published a book in 1888 called *The Psychic Life of Microorganisms*. And today the idea of thinking microbes is gaining ground. Marc van Duijn and colleagues at the University of Groningen in The Netherlands point out in the June 2006 issue of *Adaptive Behavior* that the presence of "the basic processes of cognition, such as perception, memory and action" in bacteria can now be "plausibly defended." And bacteria that have antibiotic-resistance genes advertise the fact, attracting other bacteria shopping for those genes; the latter then emit pheromones to signal their willingness to close the deal. These phenomena, Herbert Levine's group argues, reveal a capacity for language long considered unique to humans.

One way to get around the conclusion that bacteria think the way humans think is to say that all the complexity in the world emerges from the simple actions of many "dumb" actors — biological molecules and individual cells, whether they are elegantly differentiated parts of a multicellular organism or bacteria and archaea. In this view, neither some overriding sentience nor individual organisms have any influence over the process.

So maybe bacteria are just computers, which so far, despite humans' unending fantasies of conscious machines, aren't yet really thinking. But University of Chicago microbial geneticist James Shapiro believes they come extremely close. He sees bacteria as consummate practitioners of information management, plus a bit more. They "have ways of acquiring information both from the outside and the inside," he says, "and they can do appropriate things on the basis of that information. So they must have some way to compute the proper outcome." It is these "sophisticated information processing capacities," Shapiro wrote in the paper "Bacteria Are Small but not Stupid," that represent "another step away from the anthropocentric view of the universe. … Our status as the only sentient beings on the planet is dissolving as we learn more about how smart even the smallest living cells can be."

On the other hand, Tufts University philosopher of science Daniel Dennett, a prominent member of the emergent complexity camp, will only grant bacteria "semi-smart" status. Unlike bacteria, human neurons combine in ways that enable intention, Dennett wrote in his 1996 book *Kinds of Minds*. This intentionality is

what he thinks sets us apart from the single-celled among us. We possess "different software — the information that organizes the teamwork of all those semi-smart robots," he says.

But this raises the question: Is some nonhuman software organizing the teamwork of all those nonhuman semi-smart robots, aka bacteria? For this would be the truly radical argument: that bacteria — demonstrably integrated deeply and broadly into the entire planet, shaping its geochemistry, creating substrates and chemical processes that support the development of complex organic molecules, regulating the cycling of energy and nutrients both in "higher" organisms and their environments — constitute a kind of distributed awareness encompassing the whole planet. That not only are bacteria in a given local environment busy texting each other like mad, but the entire planet may consist of a giant Microbial World Wide Web.

An aerial view of Grand Prismatic Spring in Yellowstone National Park. This hot spring is about 250 by 300 feet. The photo shows steam rising from blue water, surrounded by huge mats of brilliant orange algae and bacteria. (wikimedia)

That bacteria-centric argument is, of course, a hazy, metaphysical Gaian fantasy worthy of *Avatar*. In a more down-to-earth assessment, it is clear that bacteria are not what the general run of humans thought they were, and neither are humans. Bacteria are the *sine qua non* for life, and the architects of the complexity humans claim for a throne. The grand story of human exceptionalism — the idea that humans are separate from and superior to everything else in the biosphere — has taken a terminal blow from the new knowledge about bacteria. Whether humanity decides to sanctify them in some way or merely admire them and learn what they're really doing, there's no going back. And if there's any hope of rebalancing the chemistry of a biosphere deranged in two short centuries by humans, it very likely lies in peaceful coexistence with the seemingly brilliant, deceptively simple life-forms comprising the domain Bacteria.

http://www.miller-mccune.com/science-environment/bacteria-r-us-23628/

**To Reach Consensus, Let's Talk Less**

*Talking out our differences on controversial scientific and technological issues may be just the wrong way to reach agreement, new research suggests.*

By Emily Badger

*On controversial issues, trying to reach consensus with more — and louder — voices may not necessary improve the dialogue. (Trista Weibell/istockphoto)*

When it comes to controversial political issues, we often seek out sources of information that confirm what we already believe — conservatives, in other words, watch Fox News, and liberals lean forward with MSNBC. Along the way, our opinions grow more entrenched — and sometimes more extreme — whether they're reinforced by like-minded groups or challenged by people with whom we disagree.

This concept may also apply to how we process opinions about controversial science and technology issues, according to new research. And groups bracing for some tense national debate on this front — about the environment, stem cell research, climate change — would be wise to take note.

Sometimes the *more* we discuss the risks and benefits of controversial science, the harder it is to achieve consensus. This idea challenges the belief that we can talk through disagreement if we just keep at it.

"There's a consensus among many of my colleagues that we have to get away from this idea where if we just provide more information, or if you just discuss the issue more, then everybody will come to the same viewpoint," said North Carolina State assistant professor of communication Andrew Binder, the lead author of the new study. "It's almost this deterministic notion that if you build it, they will come; if you give them the information, their eyes will be open and they'll see it for all its glory, which doesn't seem to be the case."

Binder and colleagues Dietram Scheufele, Dominique Brossard and Albert Gunther, at the University of Wisconsin, studied the public reaction in six communities across the country that were being considered to host a new federal research facility under the Department of Homeland Security. Some community members welcomed the jobs the facility would bring, while others feared potential danger from the National Bio- and Agro-Defense Facility, which will conduct research on "foreign animal, emerging and zoonotic (transmitted from animals to humans) diseases."

The more people discussed the topic, the researchers found, the more wedded they became to their initial positions, either in support of or in opposition to the facility. The finding mirrors earlier research by Binder and some of the same co-authors around the topic of stem cell research. The more like-minded people in a homogenous group discussed the controversial science, the researchers found, the more extreme their positions became.

All of this means that we may not be able to find an acceptable public consensus on dealing with climate change, for one, simply by continuing to talk it out. In fact, more public discussion could push us farther apart.

In the wake of last week's U.S. elections, which will usher a new class of politicians skeptical of climate science into Congress, some scientists are strategizing a new outreach campaign to publicize the issue and counter political attacks.

They'd be wise to recognize, though, that more — and louder — voices may not necessary improve the dialogue.

"A lot of this research can inform how we might expect those debates to play out," Binder said. "The global warming issue is an interesting example. Because it's been around for so long, people seem very much entrenched in their viewpoint, and it's hard to see how exactly we can continue having the same conversation but have the two sides come to a consensus."

If it won't help us to keep having the same conversation, Binder suggests, perhaps we should reframe the discussion, creating a clean slate. He points as an example to geoengineering, the controversial concept of jiggering with the climate to reverse warming (as opposed to jiggering with our behavior to prevent climate change from occurring in the first place).

Some people oppose geoengineering on moral or ethical grounds. But if we reframe the discussion — around, for example, economics — it might be easier to find consensus. Geoengineering, theoretically, could be more cost-effective than alternative solutions.

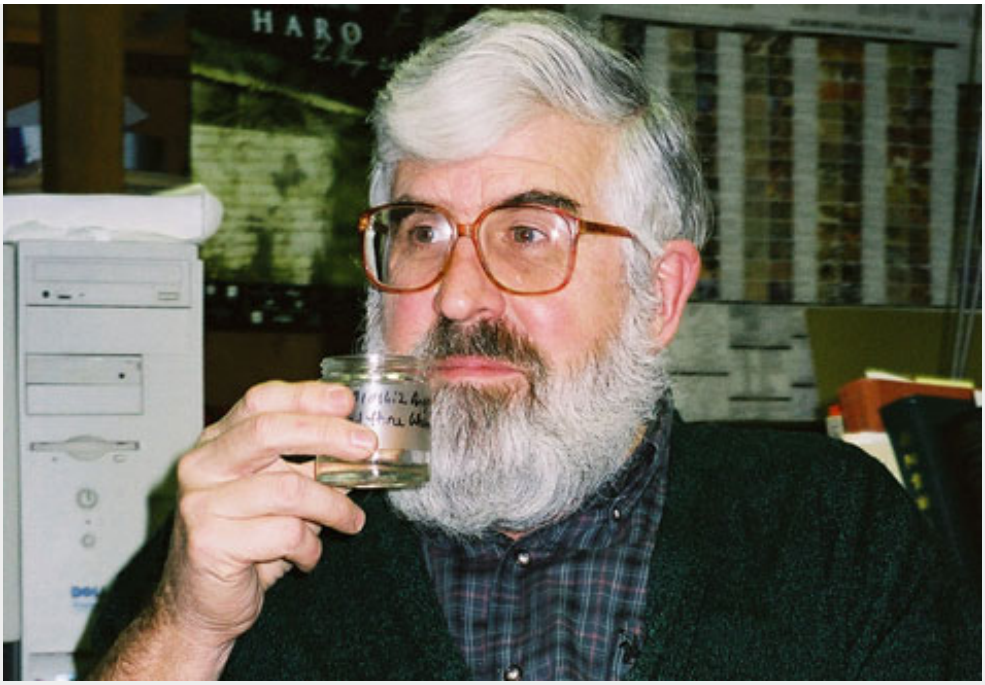
The lesson for anyone with a stake in the coming science debates is that more talk won't necessarily help. Whatever they're planning, scientists and politicians may want to figure out how to discuss these issues in a completely different way.

http://www.miller-mccune.com/politics/to-reach-consensus-lets-talk-less-25256/

**Uncovering Ancient Brews, and Cures**

*Patrick McGovern's alcohol-infused archaeology informs some of the best local alehouses, but the real benefit of his work may lie in the cancer ward.*

By Cathie Gandel




*Patrick McGovern and his colleagues have identified the earliest alcoholic beverage in the world, dating back to about 7000 B.C.*

When Patrick McGovern dons his Royal Purple latex gloves, the "Doctor Is In." But this doctor isn't working with live bodies; his "patients" are pottery sherds from ancient China, Egypt, Lebanon and even Honduras.

Unlike traditional archaeologists who study the sherds themselves for what they can tell us of past civilizations, McGovern, scientific director of the Biomolecular Archaeology Laboratory at the University of Pennsylvania Museum in Philadelphia, is looking for evidence of organic material in these remnants of jars, goblets and bowls.

"Most of what we are as humans is organic," McGovern says. "Our bodies, our clothing, dyes, wood houses, furniture. So the more information we can get from the organic side, the more we find out about how our ancestors developed and why we are the way we are today."

Biomolecular archaeology is the scientific analysis of ancient organic remains, and McGovern is one of its busiest investigators. Applying increasingly sophisticated techniques like mass spectrometry and liquid gas chromatography to sticky yellow and red residues on these ancient sherds, McGovern and his colleagues have established the earliest evidence of Royal Purple dye — hence the color of the latex gloves — going back to the early Bronze Age, 1300-1200 B.C.

They have also identified the earliest alcoholic beverage in the world, dating back to about 7000 B.C. from a site in China's Yellow River valley called Jiahu. It was what would today be called an "extreme beverage."

"When we first discovered it was a combination of barley beer, hawthorn fruit, grape wine and honey mead, we were kind of shocked," McGovern says. "Now everybody sort of takes it for granted that you mix all these things together." (For those who might want a taste of this ancient beverage, Sam Calagione, owner of Dogfish Head Craft Brewery in Milton, Del., actually produced Chateau Jiahu made from the original ingredients. A bottle sits in McGovern's office draped with a Gold Medal from the 2009 Great American Beer Festival.)

McGovern, who's been dubbed an Indiana Jones of ancient potables and is the author of *Uncorking the Past: The Quest for Wine, Beer and Other Alcoholic Beverages*, thinks alcoholic beverages have gotten a bad rap over the centuries. "There's a lot of negative press about alcohol," McGovern says. "In the Bible, there are verses that say don't over drink, but there are others that say a little wine for the stomach's sake is fine."

Meanwhile, other archaeologists of the potable attribute the rise of farming to the pursuit of suds. Most recently, Brian Hayden of Canada's Simon Fraser University suggests that the desire to have something potable at ancient feasts was a prime driver of cereal cultivation, in itself a keystone to modern societies. "It's not that drinking and brewing by itself helped start cultivation," Hayden told LiveScience's Charles Q. Choi, "it's this context of feasts that links beer and the emergence of complex societies."

Biomolecular archaeology can perhaps help redress the balance. "By doing these studies we are actually uncovering a part of human history that maybe hasn't been well explained in the past and has a lot to do with the way we've developed biologically and culturally," he says.

His current focus is on what he calls "archaeological oncology" or "digging for drug discovery." It's a natural segue for McGovern. "Well, alcohol dissolves these different compounds of plants. As a fermented beverage, the botanicals can then be ingested easily or applied to the skin."

Working with the University of Pennsylvania's Abramson Cancer Center, McGovern and his colleagues have uncovered the earliest chemical evidence of wine with organic medicinal additives.

Testing carried out on residues inside a jar from the tomb of one of the first pharaohs, Scorpion I, around 3150 B.C. revealed that the wine had been laced with herbs such as coriander, mint, sage, as well as pine resin and figs. "This showed us that ancient people were looking around in their environments for different herbal and other botanical substances that could be dissolved into alcoholic beverages and administered that way," McGovern says.

Other tests on a jar with residues from an ancient Chinese rice wine turned out to have artemisinin. "Artemisinin is very powerful. It's from a wormwood, Artemisia annua," McGovern says. "It has a very long history going back in traditional Chinese medicine right to the first recipe for a medicinal prescription that's known — maybe in 170 B.C. or so. And our sample comes from 1,000 years before that. It suggests then that people already knew about these plants that are in the wormwood or mugwort family and were using it for different purposes."

Do these particular compounds have potential in modern therapies?

McGovern answers a definite "yes," as he and his co-authors wrote in the July 2010 issue of the *International Journal of Oncology*. (A PDF of their paper is here. ) An extensive series of *in vitro* tests on artemisinin showed some success in inhibiting lung and colon cancers.

The next step is *in vivo* studies with mice and then finally clinical studies. McGovern and his lab are working with the Abramson Cancer Center and University of Pennsylvania Medical Center on a grant from the National Institutes of Health to pursue this whole line of research.

McGovern and his co-authors point to quinine and salicylic acid as notable examples of a traditional, natural remedy becoming an effective modern drug. Quinine, from the bark of a South American tree, was known as an anti-malarial medication by native Peruvians before Western science harnessed it, while the pain-relieving benefits of the bark of the willow tree were known to ancient Egyptians, Greeks and Mesopotamians before its active ingredient became the wonder drug aspirin.

"There are still a lot of unanswered questions," McGovern says. "But that's part of the process. That's what makes archaeology important, really. If you went to Mars and you had remnants of some ancient civilization there, you'd try to figure out who these creatures were. We're talking about actually uncovering what makes us human."

http://www.miller-mccune.com/health/uncovering-ancient-brews-and-cures-25238/

**Settling a Beef With American Cattle Productions**

*Taking a page out of cattle-raising's past, an old breed from Britain is invigorating American herds with healthier meat that's more sustainably produced.*

By Judith D. Schwartz

*The Devon, an old cattle breed from Britain, is helping invigorate cattle production in the U.S. Northeast. (North American Devon Association)*

Why did Chuck Lacy and Ridge Shinn charter two 747s to fly 87 bovines from New Zealand to New England?

For healthier beef.

Lacy and Shinn are founders and principles of Hardwick Beef, a leading distributor of 100 percent grass-fed beef in the Northeast. In building their business, they faced a challenge: most beef cattle in the U.S. are bred to fatten up quickly under industrial farm conditions, which means standing around in feedlots and eating corn and other grains for concentrated periods of time.

But after decades of selection for these traits, few cattle fattened up nicely and profitably solely through grazing, which produces healthier meat that can, in turn, sell for a premium.

Grass-fed beef is healthier not because it's lower in fat— it isn't, Shinn says, though cattle put on weight more slowly on grass — but because of the near 1-to-1 ratio of the essential fatty acids omega 3 (the "good fat" that's often hailed as a reason to eat more fish) and omega 6. By comparison, in grain-fed beef, the ratio can be as low as 1 to 10.

But because of the dominance of feed lot bovine, anyone who wanted to graze cattle, whether for environmental, moral or commercial purposes, saw their choices severely constrained.

So Shinn and associate Gearld Fry armed themselves with ultrasound and linear measurement tools (better to gauge intramuscular fat and tenderness) and traveled throughout North America and the globe looking for a breed that could prosper as a grazer. They zeroed in on the Devon, an English breed. (Fry is now the president of the North American Devon Association.)

Devons had become quite rare, with only 200 head in the U.S. in 2002. The animals are too "easily fleshing" — which means that they get so bulked up in industrial feeding operations that excess fat needed to be cut off. But put the Devon on a grass diet, and it produces superb meat. Not for nothing was the Devon called the "Butcher's Breed."

Shinn and Fry found some good females, but the quality of the bulls did not meet their standard. At that point they began importing bull semen from New Zealand and Australia. (Restrictions on genetic products from other nations, such as the Devons' home in the United Kingdom, required this look Down Under.).

In this quest for bovine perfection, they encountered the Rotokawa Stud, named for a lake that abuts the stud's ranch in New Zealand. "The breeder, Ken McDowell, had never heard of ultrasound," Shinn recalls, but had nonetheless produced an extraordinary herd. When McDowell decided to retire, and no one in his family wanted to maintain the stud, he contacted Shinn and asked, "Do you want the herd?"

To this point, Shinn and Lacy had focused their genetics operation on the Rotokawa females. They had brought in 12 Rotokawa heifers in 2003 and, through harvesting embryos, had created five U.S. herds, but they wished for more genetic purity. (One quality of Rotokawa Devons, Shinn says, is their "pre-potency": the ability of the sire to put its genetic stamp on its offspring — hence the emphasis on individual bulls.)

And so, in July 2008, the 87 animals came to the U.S. While they didn't need the full body scans of their human fellow travelers, the process was rigorous. First came 60 days of quarantine in New Zealand. Then they had to be fitted for custom-built wooden crates that fit in the jumbo jets' fuselage. Once in the States, they spent 45 days in a privately owned center in California, behind 8-foot-high fencing so they wouldn't interact with the local cattle — or wild elk.

Prized bull No. 93, whose large (i.e., meaty) front end has been passed onto some 5,000 progeny, weathered the trip fine. The herd is now happily grazing at Shinn's farm in Hardwick, Mass.

One goal of the Hardwick Beef Company and its new sister company, Rotokawa Cattle Company, is a different kind of cattle propagation: to create opportunities for rural farmers in the Northeast, many of whose businesses have been devastated by low dairy prices. The grass-fed beef industry, Shinn says, "will be almost impossible to industrialize. Since it's dependent on grass [rather than feed], you'll need smart people to manage it."

In June, Rotokawa Chairman Chuck Lacy, former president and COO of Ben & Jerry's, presented to the Slow Money Alliance for a loan to help keep the firm in bulls. They're looking to build their asset — mother cows — from about 60 to 100 before selling them to the general public, and there are maintenance costs of hay for the winter, fences, equipment and labor. "It's collateral you could visit — you can even eat one," he said.

Lacy referred to the fact that conventional beef has depended on cheap petroleum, with far more energy going into producing it than is in the meat itself. Shifting to grass-fed beef is smart, he said, adding, "We've been substituting oil for intelligence in this country for a long time."

http://www.miller-mccune.com/business-economics/settling-a-beef-with-american-cattle-productions-25679/

**Grasslands Preserve the Lonely Prairie**

*North America's grasslands filled an ecological role that goes mostly unfilled in their hugely reduced state.*

By Bruce Dorminey

*The Buffalo Gap National Grassland in South Dakota. (U.S. Forest Service)*

West from Sioux Falls, hundreds of miles of rolling South Dakota corn eventually morph into one of this country's largest remaining national grasslands, a portion of what is now the North American continent's largest endangered ecosystem.

Miles beyond the wide Missouri River, a small sign announces the beginning of the Buffalo Gap National Grassland's 600,000 acres; part of nearly 4 million acres of national grasslands administered by the U.S. Forest Service. The Buffalo Gap grassland is just one integral part of a tenuous sea of grass that stretches from southern Canada to Mexico; ranging from the eastern slope of the Rockies to the 100th meridian.

To the north, the Buffalo Gap grassland's panoramic carpet of dirty brown is set against a mostly clear sky. To the south and west, South Dakota's infamous Badlands lie in the distance.

"For most people, the grasslands are something you fly over or drive through," said Pete Bauman, director of community-based conservation at the Nature Conservancy's Clear Lake, S.D., office. "In the middle of summer or heart of winter, the prairie is miserable; a damned inhospitable place. They don't hold real strong appeal for people that weren't raised here. The prairie only offers up its treasures in spring and fall; at sunset and sunrise."

But the grasslands serve a larger eco-purpose — as natural buffers between forest and desert. Over millions of years, the grasslands evolved as the Rocky Mountains continually squeezed out moisture over what is now the Great Plains. Today, nearly all of this semi-arid region receives less than 24 inches of rainfall per year.

With its deep roots, tall grass like bluestem, switch- and Indian grass, can be shoulder-high in summer. In contrast, even in a good year, short grasses, like blue grama or buffalo, rarely grow above a few inches.

When Lewis and Clark first passed through the Northern Plains in 1805 and 1806, the prairies were thriving and pristine, although so open and so vast it's hard to imagine crossing them by wagon, much less by foot.

With the Homestead Act in the 1860s, however, 160 acres of federally administered land were given over to any qualifying individual (over age 21, not a Confederate soldier) who would "improve the land." In large part, this improvement — i.e. farming — saw the loss of as much as half of the northern grasslands.

Today, 98 percent of the tall grass historically present in the Northern Plains is gone. The loss is more than meets the eye — because 90 percent of the prairie's biomass important root system lies underground, its contribution to the ecosystem largely goes unnoticed.

"The grasslands act as a natural water filtration system," said W. Carter Johnson, an ecologist at South Dakota State University in Brookings. "Without our having to pay for it, grasslands ecosystems provide hay for cattle, clean surface and ground water, organisms used for medicines, and plants for pharmaceuticals. If we just allowed nature to function, it would provide these for us without cost."

The first priority is simply stopping virgin sod prairies from being converted, Bauman says. But as he points out, its future largely depends on the few farmers and ranchers who value range land and grassland enough to protect it.

About 98 percent of the Buffalo Gap grassland acreage is grazed via permit; mainly by cattle and a small number of bison. But the Forest Service is also willing to acquire land adjoining grasslands directly from owners who are willing to sell. John Kinney, district Forest Service ranger for the Buffalo Gap National Grassland, notes that his district has picked up about 10,000 acres in the last decade.

However, convincing the farmer to switch from cultivation to grasslands for grazing or biofuel production (switchgrass is a favorite topic) comes down to economics. Less intensive uses are a tough sell, especially in tough times and especially when corn prices are setting records.

"If biofuels [from grasslands] present an opportunity, the Farmers' Union would like our members to take advantage of it," said Chris Studer, communications director for the 10,000-member South Dakota Farmers Union. "But at this point, I don't see that happening on a large commercial scale. Acre per acre, corn and soybeans are going to make more money."

However, in this age of climate change, grasslands also serve as important natural carbon sinks.

"Prairie soils are pretty rich in organic matter," Johnson said. "Once you cultivate it, you oxygenate it, turning it black. That organic matter decomposes to carbon dioxide and water. Land use change is always one of the factors that contribute to higher carbon dioxide levels and climate change."

Without the grasslands, Johnson says, there would be darker soils, more carbon dioxide in the atmosphere and slightly warmer temperatures.

"Ten years ago," Bauman said, "we'd say a parcel of land was unfarmable due to rocks or topography. But with large equipment that can roll across just about any landscape and drought- and pest-resistant seeds, the technology has advanced so that you can plant crops just about anywhere. Money talks, so [cultivation] is something that the conservation community has a very difficult time combating. Are we making progress? Yeah. Is it adequate? Probably not."

http://www.miller-mccune.com/science-environment/grasslands-preserve-the-lonely-prairie-25537/

**Putting Sustainability to Music**

*Artists and industry insiders discuss how to make music green, both for fans and businesses.*

By Michael Todd

*Musicians and businesspeople unite at the New Noise Santa Barbara conference in California to discuss the greening of music to benefit everyone in the industry and fans alike. (N_Design / istockphoto.com*

The tradition of celebrities flitting from cause to cause is a well-engrained meme in the Western pop psyche. But a body of environmentally minded musicians and music industry types, while not abandoning the public face of action, are working to create institutional change behind the scenes.

Speaking Friday during the second annual New Noise Santa Barbara conference in California, a collection of businesspeople, artists and a conservation scientist outlined some of the structural improvements, current and speculative, washing over the music biz. The conference is a sort of "South by Southwest by the Sea," meant to appeal to music fans and industry insiders.

On one panel, the focus was as much on pushing vendors, venues and promoters to do the right thing while still benefiting their bottom lines as it was on influencing fans. And while music or even entertainment may be but a portion of any region's gross domestic product, actions taken there are amplified by what Jonathan Gelbard, the scientist founder and executive director of ConservationValue.org, called the "influential power of music to drive change."

And it has, he said, starting with the halls where musicians play. While it's been difficult at times for artists to get venues to change their wasteful practices, he noted that the U.S. Department of Energy now offers Energy Star ratings for hospitality and entertainment, allowing artists and fans to vote for the better venues with their participation.

Such friendly persuasion remains a priority, said Chris Baumgartner, who works on sustainable marketing and touring with so-called "artists of power" like U2, the Black Eyed Peas and Jack Johnson. While admitting "on-the-ground impact, we've come a long way," he said there's still "definitely a range" of sustainability at shows. His green spectrum ranges from the New Orleans Jazz Festival ("by Day 4, it ain't pretty") to green champions such as the High Sierra Music Festival or Michigan's Rothbury Festival.

Although no one on the panel opposed anyone making green decisions purely out of principal, most argued that sustainable actions were good for business. "You can be values driven and have an effective business framework," as Gelbard put it, adding later that data points like the "triple bottom line" and corporate sustainability officers aren't outliers any more.

"It's a decision to do better," Baumgartner said, "but it's also an investment to do better."

"Green is generally cheaper," said Steve Casper, the owner and chief fabricator of eco-friendly Zero Impact Guitars. "Green and frugal tends to go together."

As an example, Baumgartner noted that on its last tour the Dave Matthews Band saved approximately $8,750 just by using fewer (or no) plastic water bottles for the band and crew.

Big acts, he said, have the power to say, "This is what I want," and get it. One such artist is Jack Johnson, the grand young man of green musicianship. According to Jacob Tell, whose Oniracom manages Johnson, the singer-songwriter insists on fundamental changes at his venues, ranging from what toiletries are used and concessions handled to what light bulbs are installed and the sustainability of his merchandise.

But Johnson also leverages his influence with the fans to change their actions and hopefully their attitudes. Tell explained Johnson's social action "passports" call on fans at his shows to make concrete commitments to benefit nonprofits or the environment. Prefacing that 17 percent of fans took at least three actions and logged them, Tell said, "Again, he's preaching to the choir, but … an activated choir can make waves."

Nonetheless, Baumgartner said, while educating and activating fans is important, artists don't have to let the bully pulpit overpower their shows. "People don't come to events to learn," he said. "They come to party."

But what if fans didn't come at all and loved the show?

That's the secret to the most revolutionary speaker on the panel, musician and virtual artist Craig Lyons, who currently gigs in the online world of Second Life.

Lyons was doing his apprenticeship in Los Angeles' music circuit when one day he asked himself, "How much gas did I burn to get here? How much did the fans use to get here? And if I'm doing this much, what are others doing?"

So he now does up to three shows a day on Second life, streaming live video available at virtual halls online. "And I'm supporting myself!" he announced, explaining that he makes up to $200 a show. Plus, since fans don't feel they've been fleeced the way they might at a live show after paying for tickets, convenience fees, parking, overpriced T-shirts and $8 beer, "they have enough money left over to support artists better."

Lyons stressed that his carbon footprint-less gigs are not a replacement for live shows, and that, so far, no major artists are appearing alongside him, he's still enthusiastic about the future of his career.

And that kind of excitement still animates self-described "eco-troubadour" John Lefebvre, a former lawyer and benefactor of the DeSmog blog who sings about environmentalism. Blasting corporate-sponsored entities that reject the existence of climate change, he laid down the law for green musicians.

"As loud as they speak and as huge as they preach, that's how loud we have to sing."

http://www.miller-mccune.com/business-economics/putting-sustainability-to-music-25148/

**Sustainable Living in Very Small Homes**

*The Tiny House movement aims to shrink environmental footprints of the places where we live.*

By Deborah Zabarenko

*Built with construction-grade materials and well-insulated, the Mobile Hermitage can withstand the elements year-round.*

Jan Kenney has always been drawn to little spaces: the lesser of two bedrooms in a shared two-bedroom place, the economy of carrying everything she needed on cross-country bike trips. So when she heard about a house so small she could tow it to a new location with an SUV, she was ready to jump. Soon she expects to be the proud owner of the Mobile Hermitage, a stately domicile with a peaked roof, a front porch, a sleeping loft and most of the other comforts of home — all in 140 square feet.

"I'm very much into sustainability, the idea of being able to have the smallest footprint possible on the planet," Kenney said by telephone from her home in West Grove, Pa. "I used to have to rent a large space and have an extra room just for the *stuff* that I'd collected. And I got obsessed with, why do I have this stuff, why am I carrying this around, what is the purpose of this, why am I heating and cooling an extra room for these things I don't use?"

There was also a financial incentive. The Mobile Hermitage was offered at $20,000, a price its seller says is less than its appraised value. For Kenney, a lifelong renter, that low price meant she could take money from her 401(k) retirement account — she's over 59, so she paid no penalty to do so — and own this home outright. It lacks some basics, such as a shower and running water, and is meant to be part of a community of

small houses with shared facilities, or parked in a friend's backyard with some services provided by the main house.

Like many tiny houses, the Mobile Hermitage is on wheels, but it's no travel trailer. Built with construction-grade materials and well-insulated, it can withstand the elements year-round. The advantage to making it movable goes beyond transport: some building codes stipulate a minimum size for a single-family dwelling; with wheels, these homes get around that requirement.

Kenney figures the best way to use less energy is to live in a smaller space, and she's not alone. While truly tiny houses are the exception rather than the rule, U.S. single-family homes have started shrinking for the first time in decades, according to the National Association of Home Builders. Average house size peaked in 2007 at 2,521 square feet; by 2009, it was 2,438 square feet. One reason is a desire to cut energy costs.

Baby boomers and 20-somethings are two demographic groups drawn to tiny houses, says Kent Griswold, who publishes http://tinyhouseblog.com. The site says it's an affordable way to get a first home or a place to live during college, and can be a means to stay independent even when retirement savings have been eroded.

How will Kenney get the Mobile Hermitage from Iowa City, where owner Gregory Paul Johnson lives, to Pennsylvania without enlarging her carbon footprint? She'll tow it with her SUV, which runs on waste cooking grease.

http://www.miller-mccune.com/science-environment/sustainable-living-in-very-small-homes-25332/

**Affirming Science's Place**

December 14, 2010

Seeking to put to rest a controversy that has flared for the past two weeks in the news and blogosphere, the American Anthropological Association issued a statement Monday reaffirming the importance of science to the discipline.

"Anthropology is a holistic and expansive discipline that covers the full breadth of human history and culture," the statement reads. "As such, it draws on the theories and methods of both the humanities and sciences. The AAA sees this pluralism as one of anthropology's great strengths."

"It was never the board's intention to signal a break with the scientific foundations of anthropology."

The statement follows several news accounts here and elsewhere on the subject, which peaked with a piece last week in *The New York Times*. Those stories focused on changes to the mission statement included in a long-range plan for the association. The plan cut the word "science" in many places and replaced it with references to "public understanding."

Anthropologists from the four traditional subfields -- sociocultural anthropology, biological/physical anthropology, archaeology and linguistics -- who were grounded in scientific practice raised alarms about what this change signified. The Society for Anthropological Sciences condemned the altered language, arguing that it would undermine anthropological practice.

The new statement, which blames media coverage for blowing the issue out of proportion, may go a long way toward allaying those fears, judging by reaction from some of the most vocal critics of the change to the long-range plan. "This is a very positive move, obviously," said Peter Peregrine, professor of anthropology at Lawrence University and president of the Society for Anthropological Sciences. "I think it's what everybody hoped would happen."

Daniel Lende, an associate professor of anthropology at the University of South Florida who has chronicled response to the controversy amongst practitioners through his blog, Neuroanthropology, called Monday's public statement "an important step forward" for the association. "We finally have a statement from the executive board that reaffirms the place of science in anthropology," he said. "My initial concerns have been largely addressed."

Peregrine and Lende also lauded a statement, titled "What is Anthropology?" that was approved during last month's annual meeting on the same day as the changes to the long-range plan. The statement, referred to in a link in the press release that was issued Monday, describes anthropology as the study of humans, past and present. It goes on to say that the discipline "draws and builds upon knowledge from the social and biological sciences as well as the humanities and physical sciences." Peregrine called the statement "very good" and "very clear," while wondering why the statement defining anthropology was not released sooner.

The reason it did not come out sooner, said Virginia R. Dominguez, professor of anthropology at the University of Illinois at Urbana-Champaign and president of the association, was that the two documents -- the long-range plan and the statement defining anthropology -- were intended to serve two different purposes. This difference in purpose also struck a critic of the association, Alice Dreger, professor of clinical medical humanities and bioethics at Northwestern University -- and served, in her view, to undermine the effectiveness of Monday's public statement. A long-range plan, which is akin to a strategic plan, stakes out the future direction of the organization. It differs in function from a statement on the nature of anthropology, she said.

But Mary L. Gray, associate professor of communication and culture at Indiana University and a member of the executive board, posted on a blog that the long-range plan was intended as a guiding document for the board, and not as a new mission statement. She described a public and inclusive process of revising the plan, which included anthropologists from across the subfields. "The responses on the [listserv] did not suggest that there was any storm brewing or that people felt like they needed more time to block the adoption of this internal document," she wrote.

Dreger also pointed out that the press release issued Monday still does not explain why the long-range plan's language was changed in the first place. "Instead of that explanation, what we've seen are rather patronizing comments about scientists feeling marginalized," Dreger said in an e-mail.

The lingering effects of the controversy are also being debated. Peregrine and Dreger said the controversy made clear to all in the field -- in a much-needed way -- that there is a deeper split over the role of science in the discipline. "There is a division between scientists and humanists in anthropology right now," said Peregrine. "We need to find out how to bridge that gap." Dreger added that the speed with which scientists raised their concerns in this case testified to the depth of anger they felt. "The (still) unexplained purging of 'science' from the long-range plan clearly opened a surface wound that is gushing a fair bit of pus and blood due to previous injuries," she said in an e-mail.

Others pointed out that the way the debate was framed, as a fissure between science and the humanities -- or between an embrace of the scientific method as a means to get to the truth versus a postmodern critique of science as just one more means of knowing -- is an artifact of the 1990s. It has largely resolved itself in anthropological circles as devotees of Michel Foucault and Jacques Derrida have aged and mellowed, some have said. Dominguez said anthropologists are typically very passionate about their discipline. "Every so often something leads us to focus on our intellectual similarities and differences, and we usually end up reminding ourselves and each other why we all chose to become anthropologists," she wrote in an e-mail. "To say that there is a rift is to miss the wonderful plurality of topics, approaches, concerns, and practices in the discipline."

But still, some anthropologists worried that the very public fracas over an internal document will prove harmful, and that it is the last thing the discipline needs as departments nationwide face cuts or merging with other departments. They also fret that a popular perception that anthropology is anti-science will complicate future grants from the National Science Foundation, and that students will be turned off from entering the field.

"The audience at large (including students) might have the impression that most anthropologists are embroiled in a vicious debate about defining our field, and also that there are rampant turf battles in every anthropology department or program in North America," Katherine C. MacKinnon, associate professor of anthropology at Saint Louis University, wrote in an e-mail. "In my experience this is not true, and this depiction is hardly fair to those broadly trained anthropologists who are doing cutting edge, cross-subfield work that is pushing boundaries and furthering the discipline in a positive way."

— Dan Berrett

**http://www.insidehighered.com/news/2010/12/14/anthropology_science**

**Native Environmentalism and the Alberta Oil Boom**

*Is Canada's use of "traditional ecological knowledge" in resource planning an environmental advance or just a political sop to native tribes?*

By Chris Wood

*A Syncrude oil sands mine in Alberta, Canada. (The Pembina Institute)*

In May, with a runaway well belching thousands of barrels of oil a day into the Gulf of Mexico, congressional leaders received a delegation from the opposite side of the country eager to exploit the contrast between the BP disaster and fossil fuels sourced from Canada. Crude extracted from Canada's oil sands, Canadian Environment Minister Jim Prentice assured U.S. consumers, is "a safe, stable, secure supply of energy." And, he noted, it was being developed "to the highest possible environmental standards."

That's not how it looks to many Cree, Chipewyan and Metis people living downstream from oil production in northeastern Alberta. Where the Athabasca River — tapped for millions of gallons of water daily to steam-clean the oil out of sand — flows into a vast freshwater delta at Lake Athabasca, the 1,000 residents of Fort Chipewyan have seen populations of muskrat, lake fish and migratory ducks plummet — and their own cancer rates soar — in a quarter-century of oil extraction. "Years ago, nobody died from cancer," 68-year-old Metis elder Ray Ladouceur observed over tea in his kitchen. "If they died, it was TB, accidental drowning, a gun accident or old age." Out on the once lush delta, he said, "many things that used to be there are gone. Bugs on the water. The birds that used to sing. It's silent out there now. Even the quality of the fish has changed, from hard meat to mushy. When you boil it, it falls apart."

The starkly different takes on how much damage oil extraction in Canada is doing to the environment have cast into sharp relief a policy in which the country and its top oil-producing province claim to be eco-friendly world leaders. Enshrined in Canada's federal Environmental Assessment Act and splashed across Alberta government websites are repeated commitments to give the experience of people like Ladouceur more weight in resource development. Alberta, the Canadian federal government and resource companies have paid intermediaries and interpreters millions of dollars to engage native-Canadian communities — called First Nations — and record their "traditional ecological knowledge," or TEK, so it can be used in projecting and mitigating environmental impacts.

Metis elder Ray Ladouceur. (Jiri Rezac)

But as the stakes rise — Alberta is now the United States' top foreign source for oil — some critics question the very premise of that "progressive" policy.

"A lot of so-called 'traditional knowledge' is bunk," says Tom Flanagan, a political scientist at the University of Calgary and occasional adviser to Canada's conservative government. "It's what anthropologists used to call 'folklore.'" Others question the sincerity of Canada's commitment to let traditional knowledge — even when factual and relevant — stand in big oil's way.

Although enshrined in Canadian law and part of official policy, traditional ecological knowledge is having only a minor impact so far on a massive rush for Alberta's oil sands that is making the sparsely populated province wealthy but also denuding hundreds of square miles of its forest wilderness. This reality raises two questions about the development of Alberta: 1) Will native environmental knowledge ever be more than a political sideshow to the oil rush? 2) Given the nonscientific nature of much traditional knowledge, should it be?

Claims that traditional ecological knowledge should have a place in environmental policy start with an assertion that is hard to dispute: Indigenous peoples living in what is now Canada have survived in close relationship with their landscape and its plants and wildlife for thousands of years. "How can you doubt that they have huge reserves of applicable knowledge?" wonders Anne Gunn, a wildlife biologist who has worked closely with First Nations while studying northern caribou.

Canada's lead federal agency for environmental oversight echoes Gunn's sentiment. "Aboriginal peoples have a unique knowledge about the local environment, how it functions and its characteristic ecological relationships," the Canadian Environmental Assessment Agency asserts on its website. "This aboriginal traditional knowledge (ATK) is increasingly recognized as an important part of project planning, resource management, and environmental assessment."

That official view is in step with a field of study endorsed internationally by UNESCO and the International Union for Conservation of Nature and increasingly influential in the decisions of Canadian courts. Tellingly though, the same federal Canadian agency that underscores the value of indigenous knowledge makes a point of sidestepping what exactly it is. "Although there are many different definitions in the literature," the Environmental Assessment Agency's Web page notes, "there is no one universally accepted definition."

Clearly, the traditional beliefs of Canada's First Nations differ from the mechanistic, human-centered and strongly individualistic ethos that dominates North American society — and that difference is especially clear in the oil patch. By traditional First Nations' wisdom, *Homo sapiens* are neither the creator's pet nor evolution's alpha species — humans are merely one thread in a richly woven nature.

"TEK is about sustaining a creative reciprocal relationship with all of creation," writes Deborah McGregor, a geography professor at the University of Toronto who studies traditional knowledge, "and about fulfilling our lives as human beings in relation to creation." More than that, she adds, "traditional knowledge is an authority system. To be sustainable means to take responsibility and be spiritually connected to all of creation, all of the time. Everyone and everything carries this responsibility and has duties to perform."

In the Athabasca oil region, those traditional duties to creation stand in stark contrast to the giant machinery stripping away huge tracts of boreal forest for the oily bitumen beneath it. Mine operators have felled an area of virgin pine and spruce forest as large as Chicago, draining beaver ponds and evicting bear and endangered wood caribou along with smaller wildlife, and then bulldozed the underlying peat to expose the tarry grit below. Sprawling complexes of pipes and boilers, as gargantuan as everything else about the $13.8 billion industry, wash out the usable oil and pump the grit and dirty wash-water into miles-wide "tailing" ponds. With America as thirsty as ever for fuel and a new, deep-pocketed bidder in China, development is under way to triple the scale of output from the area.

The industry's expanding footprint and growing international pressure from environmentalists have spurred Alberta to establish a process to make decisions on further resource development. The province has promised any eventual plan will protect "aboriginal traditional use activities." Its government publicizes a desire to include traditional knowledge in other resource decisions as well, ranging from the allocation of water in its arid south to signing off on industry's effort to restore mined landscapes to a near-natural state. The province has subsidized 42 First Nations to collect and record their "traditional use" observations.

The Cumulative Environmental Management Association — an agency jointly funded by government and the oil industry to research environmentally acceptable limits to oil sand development — has also sought out traditional knowledge. But as Alberta's assistant deputy environment minister, Bev Yee, notes, the province faces a central question: "How do we bridge Western science to traditional knowledge?" It's a hard question to answer. Although advocates of traditional knowledge like to posit an alternative "way of knowing" that stands as a peer to Western science, specifics often prove elusive.

"The problem from a scientific perspective is that [TEK] allows answers that are not necessarily based on data, at least insofar as you can see data," says Alan Emery, a wildlife biologist who has worked with native elders. "To compound it, science in general feels that it is a superior way of finding out about the universe, so it tests all other knowledge bases against itself.

"And if the other knowledge base doesn't agree with the science, then it has to be wrong."

In substance, what's meant by traditional knowledge or its derivatives typically comes as a combination of stories — oral accounts passed down through generations — and judgments rendered by a tribal community's eldest members on the basis of lifelong observation, augmented by younger members of the community who are still active "out on the land."

Contrary to connotations of the term, traditional knowledge isn't stagnant, asserts Joanne Barnaby, a Cree consultant who was Emery's research partner in efforts to interpret between TEK and science. "To be a responsible Dene," she says, citing one example of a tribe, "you must share your observations with the community as a whole, and give elders in particular an opportunity to analyze your observation and determine whether it's important to retain."

Though government and industry give every sign of bending over backward in pursuit of traditional ecological knowledge, there are critics of TEK, some quite harsh. The most outspoken may be two political theorists and avowed Marxists who have denounced traditional knowledge in academic essays and presentations as "junk science." In one paper for the Canadian Political Science Association pointedly titled, "Aboriginal 'Traditional Knowledge' and Canadian Public Policy: Ten Years of Listening to the Silence," Frances Widdowson, a professor at Calgary's Mount Royal College, and co-author Albert Howard accused TEK of being a collection of "simplistic hypotheses, vague and unsubstantiated opinions and unsystematic data, [as well as] other unacceptable, unscientific premises … based on unverifiable beliefs in the supernatural." Giving it weight in resource management, the pair charged, posed "a threat to environmental assessment wherever it was applied."

The Athabasca River near Fort McMurray, Alberta. (The Pembina Institute / David Dodge)

Their critique provoked scholarly outrage from advocates for indigenous knowledge. "A dog's breakfast of outmoded communist ideology and rotten anthropological theories washed down with strong racial prejudices inherited from their own unexamined colonial upbringings," thundered Taiaiake Alfred, a professor of aboriginal governance at the University of Victoria, British Columbia.

But other Canadian academics say that fear of being labeled racist deters many from agreeing with at least some of Widdowson's criticism of the use of traditional ecological knowledge alongside science. "I think she is largely right," says Rod Clifton, an education professor at the University of Manitoba who has had experience in First Nations communities and is married to a Blackfoot woman. "What's myth and what's true [in traditional knowledge] is hard to sort out. There are many in the white community and in the aboriginal community that, below the surface, think this way, and they're afraid to say so."

The University of Calgary's Flanagan criticizes native leaders who invoke TEK as a hard-to-challenge cudgel in legal and policy debates. "It's a wonderful weapon for aboriginal spokesmen," he says, "if they claim to be in possession of special knowledge that by definition you're not able to share."

I relayed the criticism that some, and possibly a great deal, of what is presented as TEK might be hokum to Barnaby, the Cree consultant. She sighed before conceding, "That's probably true."

Canada's governments, Barnaby complains, have failed to match rhetorical enthusiasm for the use of traditional native knowledge with support for rigorous tests of its factuality. As a result, she says "there's no way to address quality. There should be verification standards in place and standards to determine that the traditional-knowledge holder is in full support of the analysis, based on his knowledge."

Other factors add to TEK's credibility problem. Much of what is often considered the purest traditional knowledge — insights based on years of integrating personal observation with oral history — resides in the memory of elders in remote communities. Many are reluctant to share their knowledge with outsiders. Those who are willing to speak face the disadvantage of deep linguistic differences between native tongues and English. "Indigenous language tends not to be object-based, like ours," Emery observes. "It tends to be relationship-based. If you ask for a direct translation of 'a rock' in some Athabascan languages, they'll say, 'Well, in our language, we say "pressing down."'

A Syncrude oil sands extraction plant in Alberta. (The Pembina Institute / David Dodge)

More dispiriting still to those who believe in the underlying value of traditional knowledge, many of the languages in which it is encoded are disappearing. More than 100 native North American languages have been lost over the last five centuries. Many that remain are becoming hybridized with English or face extinction as speakers dwindle in number. With the passing of elders and erosion of indigenous languages, says Don Harron, a Manitoba biologist who has worked with industry and First Nations to assess development impacts, "the knowledge itself is disappearing; it's degrading."

Syncrude, the oldest and largest oil sand producer in Canada, meets with one or another of the dozen First Nation communities in its operating area almost daily, spokeswoman Cheryl Robb says. The company sent its environmental affairs manager camping with elders and sought their advice on how to restore mined landscapes. In one lesson learned from traditional ecological knowledge, Robb says, Syncrude changed its practice of indiscriminately clearing away everything above the target layer of bitumen. On the advice of local elders, equipment operators now separate the top layer of forest "duff," which is full of seeds, roots and organic matter, and use it to top-coat the bare sand and clay of areas being reclaimed.

Oklahoma-based Devon Energy uses a less intrusive in-situ process to extract Alberta oil, forcing high-pressure steam into deep deposits of bitumen to liquify its hydrocarbons, then pumping the liquid oil up to an adjoining well. Devon has hired archaeological and other consultants to acquire local traditional knowledge before deciding where to locate well pad sites. "We'll try to avoid certain areas depending on what they're telling us," says Pete Millman, an environmental adviser in Devon's Calgary office. "If there's an area that's identified as a blueberry-picking area, we'll put a pad off to the side."

On larger questions — like when to call "when" on the large-scale transformation of the boreal wilderness into a maze of well pads, pipelines and unearthly strip mines — the influence of traditional ecological knowledge is more doubtful. One measure of the uncertainty: Observers on both sides of the debate question how deep their governments' embrace of traditional knowledge goes.

In many cases, TEK consultant Harron alleges, indigenous knowledge is included as lip service in development plans, but functionally ignored. Putting it only a little differently, Flanagan says governments find it expedient to accommodate TEK in advisory arenas, "where it won't gum up the works."

Those descriptions seem about right to Jumbo Fraser. A neighbor of Ray Ladouceur's in Fort Chipewyan, Fraser has participated in traditional-knowledge studies conducted by Alberta's Cumulative Effects Management Association, and, he says, he's brought dramatic changes in wildlife populations on the Athabasca delta to the agency's attention. "Government does what it was going to do anyway," he says. "I guess they figure if they're talking about [traditional knowledge], they're using it. They're not."

http://www.miller-mccune.com/politics/native-environmentalism-and-the-alberta-oil-boom-24740/

**Enamored with Enamel**

*Researchers at the UCSF School of Dentistry work to create synthetic tooth enamel.*

By Jessica Hilo

*UCSF School of Dentistry researchers are working on creating synthetic tooth enamel that helps to repair rather than patch damaged teeth. (Shironosov / istockphoto.com)*

Having navigated Halloween and now facing Thanksgiving in the United States, and with the December holidays around the corner worldwide, the annual battle of tooth versus sugary treat has begun. Diligently toiling to repair the inevitable cavities is Stefan Habelitz, a researcher at the University of California, San Francisco's School of Dentistry.

Habelitz has been studying the wondrous and often complicated production of tooth enamel, our first line of defense against tooth decay. Tooth enamel is as thick as a dime, highly-mineralized, and can withstand an immense amount of pressure (up to 250 kg/mm2). It consists of hair-thin, fibrous and densely packed crystalline rods gathered to shape a tooth's crown. Despite its strength, increased consumption of sugary and acidic foods, and social behavior, has a corrosive effect on the structure of tooth enamel.

Habiltz's research focuses on the formation of enamel's crystalline rods — a process that, if replicated successfully in vitro, could revolutionize restorative dentistry.

The formation of tooth enamel essentially creates minerals in your mouth.

The process starts as recombinant protein, called amelogenin, which forms in the mouth and self-assembles into peptide bracelets that initiate and control, molecule by molecule, the growth of calcium phosphate crystals. Amelogenin determines crystal size and direction of growth, forming nanospheres that gather into ribbon-like nanofibers.

These nanofibers in turn form into hair-thin rods that are packed together over the shape of the tooth. Protein is extracted from the mineralized tissue in the final stages of tooth enamel production, leaving behind a

substance that is 98 percent mineral and 2 percent protein and lipid. Formation of enamel over a tooth's crown takes roughly four years, and is the only material in the body that undergoes an organic to inorganic conversion.

But teeth aren't solid enamel; just beneath a tooth's enamel lies something called dentin. It is less mineralized and less brittle than enamel and consists of 70 percent calcium phosphate, 20 percent protein and lipids, and 10 percent water. Another part of Habelitz's research is focused on finding mechanisms to deliver calcium phosphate to tooth dentin after a cavity.

Replicating these processes in a test tube is an arduous task that requires vigilance over lab-simulated growth conditions. Habelitz and his team have only progressed through the nanoribbon phase in enamel production, but he remains optimistic.

"If you have a protein structure that directs the crystal growth, now you can use the protein as a template to create mineralized structures," he said. "[You can] control and manipulate the growth of the organic phase … you can control the growth of the inorganic. That can grow into micro and macro structures. [It will] eventually allow us to make very unique structures that we haven't been able to make."

One obvious benefit of his work would lie in creating a novel replacement for the gold and amalgam used in dental fillings, essentially repairing teeth instead of patching them.

"We still have to figure out how to attach the [remineralized dentin and synthetic enamel]," Habelitz said. "They grow away from each other in vitro. [Adhesives] are pretty good, but they don't last forever. So, that's the challenging part."

Meanwhile, his research may have applications beyond teeth

Synthetic enamel's unique structure, durability and scale offer interesting prospects in the world of biomaterials and bioengineering. Joanna Aizenberg, a researcher at the Bell Laboratories, has already used the process of self-assembly in research for microelectromechanical switches. Enamel's future in electric circuitry may yield results at dimensions we have yet to see.

Despite being on the bicuspid of dental innovation, Habelitz is leery of the commercial market. Dentists and dental researchers are tied to the demands of a culture that favors healthy-looking teeth over healthy teeth. (Americans spent $2.75 billion dollars on cosmetic dental procedures in 2007 and spend nearly $2 billion every year whitening their teeth.) "Overall, that idea of beauty is so important in dentistry that it really affects the treatment of people," said Habelitz. "Dentists kind of have that conflict. You don't always provide the best medical care because you have all these aesthetic requirements."

Still, with commercial and bioengineered application of synthetic enamel and remineralized dentin still years out, there is no downplaying the importance of a strict regimen of proper dental hygiene this holiday season, and year-round.

http://www.miller-mccune.com/health/enamored-with-enamel-25545/

**Teaming with Technology to Fight TB and HIV**

*Tuberculosis and HIV are both high-profile global health scourges, but surprisingly little focus has been paid on treating them when they team up.*

By David Richardson

*The presence of Tuberculosis accelerates the progression of HIV into AIDS, while HIV increases the chances of getting Tuberculosis. (JoeBiafore/istockphoto)*

Tuberculosis — already infecting the global population about one new case a second — is considered one of the most dangerous opportunistic infections attacking people with HIV.

The STOP TB Partnership reports that TB is the leading cause of death among persons infected with HIV in Africa. Worldwide, 1 in 4 TB deaths is HIV-related.

While the calculus seems straightforward — get HIV, see your immune system falter, then get TB — the tangled tango between the two deadly diseases is more complex.

According to the U.S. National Institutes of Health Division of Acquired Immunodeficiency Syndrome, the presence of TB accelerates the progression of HIV into AIDS, while HIV increases the chances of getting TB.

And treatment? While the World Health Organization estimates that one-third of the global population may currently have the bacterium that causes tuberculosis, the treatment — a yearlong regimen of drugs developed more than four decades ago — can, in the absence of HIV, usually restore health. But those who have both diseases face a much more difficult situation.

Despite the way they seem to gravitate toward one another, the pathways to treating the two diseases are very different. For example, says Dr. Gene Morse, associate dean of clinical pharmacology at the University of Buffalo, "TB can be targeted with an acute treatment period to get the bacteria to stop growing," which is

followed by less intensive therapy during a slower growth phase, and "if treatment is successful, we can stop the drugs."

"HIV on the other hand, requires lifelong treatment that includes dealing with chronic inflammatory states and other conditions."

Complicating matters, "the HIV treatment can have a direct effect on how well the TB treatment will work," Morse says, citing research that shows Rifampin, a first-line TB therapy, can reduce effectiveness of antiretroviral drugs that suppress HIV's advance.

Some experts have recommended patients delay antiretroviral treatments until they have been treated for TB — a trade-off that means patients increase the risk of their HIV progressing to AIDS during this uncontrolled interim. And, according to a source at the Health Division of Acquired Immunodeficiency Syndrome, the possibility of inadequate treatment of the persistent and adaptive pathogens of both diseases can become "the perfect setup for developing resistant TB that can spread to the rest of the community."

So researchers are examining the means to treat the two diseases together, rather than separately.

"You can't bring a lot of people who have TB into a clinic where you have people in the waiting room who have HIV and don't have TB," he explains. This is especially true when doing research in low-resource settings that lack sophisticated medical facilities.

With decades of experience in HIV drug development, Morse says now is the time to "synergize our energies and knowledge with HIV and TB" through better collaboration between the HIV and TB research communities. He recommends leveraging advanced information technology to coordinate TB and HIV clinical research programs worldwide, maximizing program efficacy and minimizing adverse drug interactions.

Today's electronic data collection technology makes it possible to track lots of health parameters for individual patients, and Morse says with the addition of links between health systems and academia to provide real-time feedback into the research process, "the idea of fast-track development can be accelerated through health information technology."

But technology is not the last word. He envisions a patient centered "Global HIV-TB Wellness and Research Initiative," so named to inspire patients to "feel positive" about the approach.

Such a system will require harmonization of institutional review board procedures to assure ethical patient protections regardless of where participants are treated. Morse says it is important also to involve ministries of health and local leadership and stakeholders from the affected countries throughout the research process. And success will further require broad-based technology transfer and training, to assure the highest quality care for the patients and data for the research.

Addressing a TB/HIV dual disease research initiative, "The major barrier is money," says George Atkinson, the CEO of Institute on Science for Global Policy and former science adviser to former U.S. State Department officials Colin Powell and Condoleezza Rice. He says that in donor countries, such as the United States, TB/HIV co-infection is not widely considered a major public health crisis.

"It's a question of convincing people that these are opportunities that will protect their families much better than they are today," Atkinson says. The bottom line, he adds, is this is a case that scientists will have to make directly with policymakers.

But Morse says that in addition to protecting lives, the prospect of examining TB and HIV in a coordinated fashion offers an additional opportunity.

"The nature of these two diseases is such that we can gain a lot of knowledge from looking at how these diseases are treated long term." And that aggregate knowledge, he says, can be applied to treating other "complex long term medical conditions and these may include vexing public health concerns such as cancer and cardiovascular illnesses."

http://www.miller-mccune.com/health/teaming-with-technology-to-fight-tb-and-hiv-25626/

**For Dying Cancer Patients, Geography is Destiny**

*It's not what you want; it's where you go. Dartmouth study finds cancer patients' end-of-life care is determined by their hospital, not their hopes.*

By Joanne Kenen

*A Dartmouth study finds that a cancer patient's end-of-life care is determined by their hospital. (1Joe / istockphoto.com)*

For many older Americans with advanced and incurable cancer, where and how they die — at home with their family or sedated in an ICU with a tube down their throat — may not be based on their final preferences and wishes, but on customs, care patterns, and even the financial incentives and number of beds in the hospital they and their loved ones entrusted with their care.

That's the conclusion of a new addition to the *Dartmouth Atlas*, a compendium of 20 years of research on how health care usage and practices vary tremendously from one place to another.

"The bottom line is the care patients receive has less to do with what they want and more with the hospital they happen to seek care from," said Dr. David Goodman, lead author of the Dartmouth Atlas Project and director of Dartmouth's Center for Health Policy Research. The study found "no consistent pattern of care or evidence that treatment patterns follow patient preferences, even among the nation's leading academic medical centers."

Overall 1 in 3 of these patients died in the hospital, sometimes in the ICU and sometimes on life support, but there was significant variation from one region or even one hospital to another. Six percent of the patients received chemotherapy in the last two weeks of life, but in some regions and academic medical centers the rate went above 10 percent. Half got hospice but often for just a few days, too little for them and their families to fully benefit from the medical and psychosocial assistance and comfort hospice can offer.

In addition to that wide variation, the overall message was that these very sick patients — elderly patients with advanced cancers nearing the end of their lives — are getting lots of aggressive care. Given the risk of infections and complications when frail people undergo invasive inpatient procedures, this aggressive care often does not help them and may even harm them, noted Rosemary Gibson, a health care consultant who has worked extensively on end-of-life and health care quality.

"We still don't know when to stop," said Gibson, who read the Dartmouth report but is not part of that research team.

Goodman said the Dartmouth data was adjusted to take socioeconomic aspects of a hospital population and location into account (although some health researchers have, in the past, faulted the Dartmouth methodology). The researchers also focused on patients who have a fairly predictable poor prognosis — patients with such diseases as advanced lung or pancreatic cancer. They looked at records of more than 235,000 Medicare patients who died from 2003 to 2007.

Some of the wide variation occurred in places that have cropped up in previous reports documenting treatment disparities. Nearly 7 out of 10 of these patients were hospitalized in their last month of life in McAllen, Texas — the community depicted as a profligate health care spender in Atul Gawande's *New Yorker* article that influenced the national health reform.

But in La Crosse, Wis., which has achieved national renown as a community where the medical culture emphasizes advanced planning and thoughtful conversations with patients and families, fewer than half were admitted in that final month.

That may not be a surprise; similar patterns have been identified before. But what can be quite startling is the variation between hospitals so near each other. At Lenox Hill Hospital on New York's Upper East Side, half of the older advanced cancer patients died in the hospital. But within walking distance on the Upper East Side, at Memorial Sloan-Kettering, the rate was 1 in 3.

And Sloan-Kettering is one of those magnets that draw people from afar in hope of a miracle. The same is true of Johns Hopkins — another center known for leading-edge cancer care that still has a fairly low rate of hospital use for the dying. And Hopkins is in Baltimore, socioeconomically a far cry from the Upper East Side.

People don't seek care at Hopkins or Sloan-Kettering to die. They go in hopes of a cure. But when a cure isn't possible, Goodman noted, "part of the very best care in cancer is also care for comfort." And that includes open conversations about the likely course of the disease, a patient's options, choices and wishes.

"We understand those conversations are difficult for physicians," said Jon Radulovic, a vice president at the National Hospice and Palliative Care Organization. But patients and families may already know in their heart what the doctors are reluctant to say; they know when their chemo is failing, when options are running out. "[Patients] might not be as surprised as many physicians think they may be." And they may be grateful for a chance to talk about their wishes, fears and concerns.

The reasons for the wide variation in hospitalization and hospice patterns aren't always clear. It can be the local business model and bed supply of a hospital with a pricy cancer center. It can derive from the way Medicare pays hospitals; they get a lot more for chemo and CPR than they do for palliative care and conversations.

And it can be local practice patterns. One group of doctors learns to practice in a certain way, and they pass that on to their colleagues, institutionalizing it over the years. There's not necessarily any solid evidence to

prove that one group of physicians' approach is better than another — one reason the federal government has increased its investment in comparative effectiveness research both through the 2008 economic stimulus law and health reform.

In addition, some communities have more hospice and palliative care available than others. And to make it even more confounding, a couple of hospitals with nationally recognized palliative care teams still had a lot of patients in the hospital shortly before or at the time of death.

According to Dr. Sean Morrison, director of the National Palliative Care Research Center based at Mt Sinai Hospital in New York, subtle differences in community norms also play a role. Hasidic Jews in Brooklyn, Morrison noted, make different end-of-life decisions than Latinos in the Bronx, a few miles away physically, but a chasm culturally. Midwesterners, one hospice administrator once told me, tend to respond to a bad prognosis with a plan for how to live out their life. Manhattanites getting the same upsetting news, she told me, want to schedule a meeting to strategize against death.

"It's great that we know about this variation," Morrison said. "But what are the true drivers?" Morrison's major worry isn't precisely what is the "right" amount of care for the dying. He wants to make sure that they are getting the care that they want, that appropriately trained health care providers talked to them — and listened to them.

"Is the care consistent with patient preferences?" he asked. "Are physicians really understanding what the values and goals are? Until we really understand that, we aren't going to change the observed variation."

One aspect of palliative care — which unlike hospice does not require people to give up chemotherapy, radiation or similar treatments — is to have those conversations and identify the goals of care. Palliative care services at hospitals and cancer centers have expanded greatly since 2003, the start year for the study. But the Dartmouth data doesn't tease out which of the hospitalized patients may have had those services or whether the patients who died in the hospital were also being treated and helped by a palliative team.

"What patients really want is for their physicians to be honest with them, to share the full range of treatment choices. Patients want to live long, but they also need to live well," said Goodman.

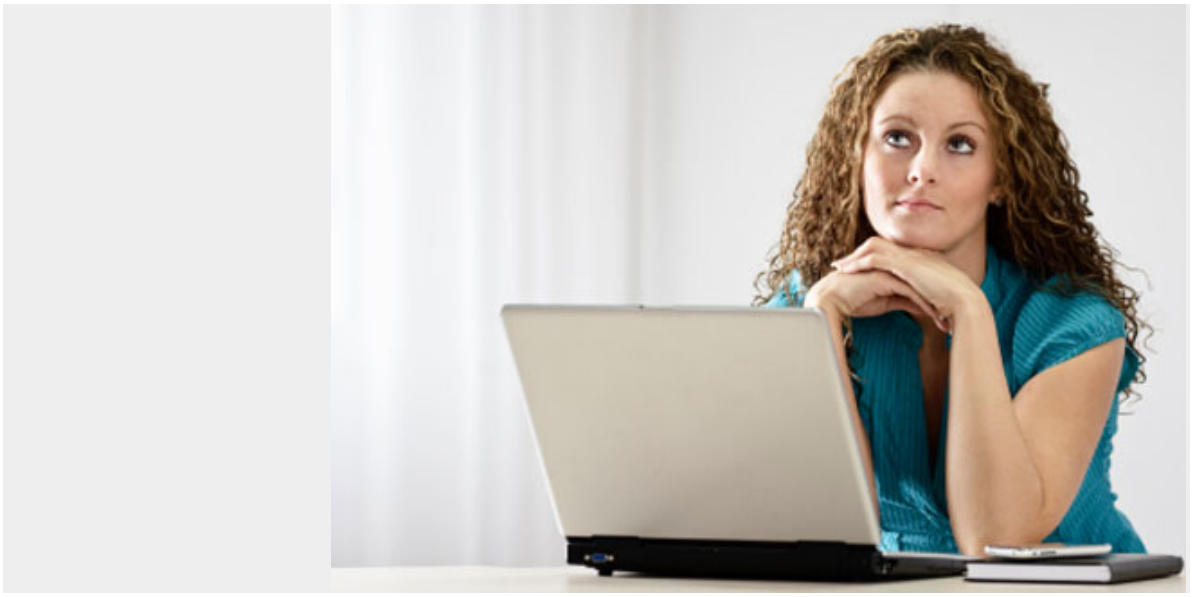
"Our preferences certainly can change. And they do change," Goodman added. "But opening up that conversation early allows for that conversation as well to evolve over time. The tragedy is when those conversations only start near the end. The longer you wait, like many things, the harder it is to do."

http://www.miller-mccune.com/health/for-dying-cancer-patients-geography-is-destiny-25370/

**Memo to the Mind: Don't Wander, Be Happy**

*New research finds our minds wander much more frequently than we realize, and our inability to stay focused in the present leads to unhappiness.*

By Tom Jacobs



Is your mind wandering right now? Will it begin doing so before you get to the end of this article? Newly published research by two Harvard University psychologists suggests the odds are close to 50-50.

Using data collected from a specially designed iPhone app, the researchers — stay with me now — report we spend nearly 47 percent of our waking hours thinking about something other than what's happening in front of us. Moreover, they write in the journal *Science,* this lack of focus tends to make us less happy.

"A human mind is a wandering mind, and a wandering mind is an unhappy mind," Matthew Killingsworth and Daniel Gilbert conclude. "The ability to think about what isn't happening is a significant cognitive achievement, but one that comes at an emotional cost."

Their conclusions are based on in-the-moment information elicited from a Web application they developed for the Apple iPhone. This high-tech data-gathering technique yielded a large sample: Nearly a quarter-million responses. In the end, the researchers analyzed data from 2,250 adults (58.8 percent male, 73.9 percent U.S. residents, mean age 34).

Volunteers who signed up at the website www.trackyourhappiness.org were contacted at least once a day and asked to respond to a variety of questions about their feelings, thoughts, behavior and environment. After 50 such responses were collected from an individual, sampling stopped for six months, or until the participant requested it be reinstated.

Each time they were contacted, participants were first asked "How are you feeling right now?" They responded by answering on a sliding scale from zero (very bad) to 100 (very good).

They were then asked, "What are you doing right now?" and "Are you thinking about something other than what you're currently doing?" If they answered yes, they were asked if the focus of their thoughts was something pleasant, unpleasant or neutral.

"People's minds wandered frequently, regardless of what they were doing," the researchers report. "Mind-wandering occurred in 46.9 percent of the samples, and in at least 30 percent of the samples taken during every activity except making love.

"The frequency of mind-wandering in our real-world sample was considerably higher than is typically seen in laboratory experiments," they note. "Surprisingly, the nature of people's activities had only a modest impact on whether their minds wandered."

So, where was I? Oh, yes: Happiness. "People were less happy when their minds were wandering than when they were not," Killingsworth and Gilbert write. "This was true during all activities, including the least enjoyable.

"Although people's minds were more likely to wander to pleasant topics … people were no happier when thinking about pleasant topics than about their current activity, and were considerably unhappier when thinking about neutral topics or unpleasant topics."

Now, if you're thinking about chickens and eggs (no, I don't mean looking ahead to tonight's dinner — focus!!), the researchers have a ready response.

"Time-lag analyses strongly suggests that mind-wandering in our sample was generally the cause — and not merely the consequence — of unhappiness," they write. "A person's happiness was strongly related to whether they had been mind-wandering in the previous sample, but was unrelated to whether they were mind-wandering in the next sample. This is precisely what one would expect if mind-wandering caused unhappiness."

Such findings support the insights of such spiritual teachers as Ram Dass and Eckhart Tolle, who argue contentment can be found by staying fully present in the current moment. The wisdom of "be here now" is backed up by hard data.

"Mind-wandering is an excellent predictor of people's happiness," Killingsworth told the Harvard public affairs and communications office. "In fact, how often our minds leave the present, and where they tend to go, is a better predictor of our happiness than the activities in which we are engaged."

http://www.miller-mccune.com/health/memo-to-the-mind-dont-wander-be-happy-25262/

**A Friends and Family Plan for the Flu**

*The Friendship Paradox may provide a handy predictor for whether a flu bug will result in a mass outbreak or a few cases of the sniffles.*

By Joan Melcher


*Predicting an outbreak might be as easy as signing up for a facebook account. The so-called Friendship Paradox, a barometer of social interaction, could be the key to monitoring the spread of a virus and more. (istockphoto.com)*

A fortune-teller looks into a crystal ball. She sees a network of people, and at the center are the trendsetters. They are contracting the flu. The seer predicts that in two weeks their friends will have the same bug.

Unlike the fortune-teller, predicting the onset of an epidemic is something the Centers for Disease Control cannot do at this time. In fact, the CDC is usually about two weeks behind the curve. But social network researchers may have found an effective predictive tool — a well-known, but to this point unused, barometer of social interaction — known as the friendship paradox.

Central to the paradox is the likelihood that at least a couple of your friends are more popular than you are. That may sound a bit harsh, but when asked to name friends, people generally name a person more connected and more social than they are. And just like their opinions of music or wines may infect others' thinking, so may their viruses infect other bodies.

The reason for this, says James Fowler of the University of California San Diego, is that "if you're at the center of a network, you're a shorter number of steps from everyone else in the network. If someone just randomly infects somebody in the network, it will start to spread from that person and it will spread to the center first because those people are best connected. They really are a crystal ball in this case."

**Making the Connection**

James Fowler and Nicholas Christakis aren't the only ones to connect social media and flu bugs. In spring 2009, when concerns about swine flu ebbed and flowed, Stanford University academics Marcel Salathé and James Holland Jones tracked public emotions about the threat using an Internet survey.

Fowler and Nicholas Christakis of Harvard University tested the friendship paradox to see if a social network would predict a flu outbreak.

In a study published last month in *PLoS ONE*, they studied 319 randomly chosen undergrads at Harvard who responded to e-mails and agreed to participate in the study. The researchers asked them to name up to three close friends, which yielded another 425 names and became what Christakis and Fowler referred to as the "friends" group.

They tracked the groups as flu season arrived and found that people in the friends group were diagnosed with the flu 13.9 days before those in the randomly chosen group (i.e., the general population).

The beauty of this tool, Fowler said, is that the friendship paradox is a simple, inexpensive method that allows researchers to zero in on those most likely to experience an epidemic early. It also has the potential to predict the spread of other phenomena in networks — for example the toy most likely to be popular at Christmas or the rise of a political issue.

"You need a planning component to go along with the implementation," he said, because random people have to agree to participate, name friends, and, in the case of his study, report flu symptoms and visits to the doctor.

Since the Harvard study was relatively small and contained, how would researchers go about predicting a flu outbreak across the country?

Fowler said it would be fairly easy to identify 1,000 who were then asked to name up to three friends. "A couple of dozen flu cases in this group would be enough for you to be sure that something was going on, and you'd know it by monitoring the friends group," he said.

He noted that the same methods used in the study he and Christakis undertook could be used to predict epidemics in cities, among different strata of society and early contractors of a disease and other trends.

Fowler mused about the potential for prediction of any number of things using online tools such as Google Trends — the number of searches for, say, symptoms of the flu would definitely tell you something — and online social networks such as Facebook as ways of predicting other public health problems and phenomena that spread in networks.

"Social networks are conduits through which many things flow," he said.

http://www.miller-mccune.com/health/a-friends-and-family-plan-for-the-flu-25210/

**Tempest in a Cement Mixer**

*The world of carbonate chemistry is rocking over claims that a new kind of cement can sequester carbon.*

By Frank Nelson

*A company says its process, unlike conventional cement manufacture, is a win/win for the environment, but skeptics are voicing their concerns.*

Calera Corporation sparked a lot of media attention (including at Miller-McCune.com) with its claims for carbon neutral, or even carbon-negative, cement produced primarily by bubbling industrial carbon dioxide ($CO_2$) emissions through seawater.

The Los Gatos, Calif.-based company says its process, unlike conventional cement manufacture, is a win/win for the environment: It doesn't create $CO_2$ and instead permanently traps huge volumes of the global-warming gas in the finished concrete.

That all sounded just too good to be true to a number of commentators who lit up online chat forums earlier this year; in a spirited debate that soon grew personal, with flaming messages "sent from my iPhone with radical intent."

Chief skeptic is Ken Caldeira, senior scientist in the Department of Global Ecology at Stanford's Carnegie Institution for Science, who doesn't buy what he likens to alchemist claims of being able to turn lead into gold.

Wally Broecker, Newberry Professor of Geology in the Department of Earth and Environmental Sciences at Columbia University — where he's been on the faculty for half a century — also has serious doubts about Calera's claims.

Just show me the chemistry, Caldeira says. "Every other proposed process to sequester carbon has been clear about the fundamental inputs to and outputs from the process, in ways that allow the fundamental chemistry, and energy and mass balances, to be assessed.

"They (Calera) can be secretive about what goes on in their black box, but they cannot be secretive about what goes in and what comes out, and they cannot be secretive about where they intend to source those inputs or dispose of those outputs."

But Calera CEO Brent Constantz, a consulting professor at Stanford University's Department of Geological and Environmental Sciences, questions Caldeira's motives and says his unfounded assertions illustrate a lack of understanding about even "basic carbonate chemistry."

Constantz says a wealth of information about Calera's processes is publicly available. For example, he says 10 times more detail than Caldeira has been requesting can be found by reading his company's patents filed in Australia. (If you want to look, click on "Specification/e-Register" link on the specific patents to see a PDF.)

He says the company's studies and research have been thoroughly and objectively evaluated by leading scientists and academics; the strength of the technology has also been endorsed by the company's scientific advisory board and is the reason top executives from other companies have joined Calera.

Constantz says he cannot understand why Caldeira is "trying to trash" Calera and wonders if he is being paid by the energy industry, which sees profit in injecting $CO_2$ into empty fossil fuel reservoirs.

He says companies like Calera could put a dent in that carbon capture and storage (CCS) revenue, making it worthwhile for oil and gas companies to use lobbyists and others to discredit alternative technologies.

An outraged Caldeira says he's never taken a penny from oil and gas interests and is willing to show tax returns and bank statements to prove it. He also brushes aside hints of a conflict of interest arising from his co-ownership of a patent for extracting and sequestering $CO_2$, saying if the patent ever yields any money, he'll give his share to charity.

Caldeira also bridles at comments questioning his grasp of the science behind Calera. Besides his body of published work dating back almost two decades, he points to a 2005 special report on climate change and reducing $CO_2$ emissions, published by the Intergovernmental Panel on Climate Change.

The 400-plus page report includes a chapter on carbon storage in the ocean for which Caldeira was coordinating lead author. "Would the IPCC choose me to lead this chapter if the community felt that I was ignorant of basic chemistry?" he asks.

http://www.miller-mccune.com/business-economics/tempest-in-a-cement-mixer-6587/

**Fetal genome mapped from mother's blood for first time**

- 19:00 08 December 2010 by **Peter Aldhous**

For the first time, a fetus has had its entire genome mapped from a sample of its mother's blood. This technical tour de force could open the door to new methods of prenatal genetic diagnosis.

In 1997, researchers led by Dennis Lo of the Chinese University of Hong Kong showed that "floating" fetal DNA can be detected in maternal blood plasma – it passes across the placenta from fetal cells that have broken down.

Lo's discovery sparked a lot of interest, because it raised the possibility of diagnosing genetic problems in a fetus without the need for invasive procedures such as chorionic villus sampling (CVS) or amniocentesis to extract fetal cells, both of which carry a small risk of inducing a miscarriage.

But it's hard to distinguish fetal sequences from the larger quantity of a woman's own DNA. This has so far largely limited practical applications of the technique to unambiguous situations in which particular fetal genes are not carried by the mother. For instance, fetal sex can be determined by detecting sequences from the male Y chromosome. It's also possible to identify fetuses at risk of rhesus disease, where the mother's immune system attacks a protein on her fetus's red blood cells, by looking for the gene for this rhesus protein in the blood of women who are rhesus negative.

Lo has previously worked on methods to detect fetuses with Down's syndrome from floating fetal DNA. Now, through a combination of brute-force DNA sequencing and sophisticated bioinformatics, his team has shown that it should be possible to detect any genetic disease from a sample of a pregnant woman's blood.

**Match and contrast**

Lo recruited a couple who were at risk of having a child with beta-thalassaemia, an inherited form of anaemia. By comparing the father's genome and fetal DNA extracted by CVS with billions of fragments of DNA from the woman's blood, Lo was able to construct maps of the entire fetal and maternal genomes. This revealed that the fetus was a carrier of beta-thalassaemia, but was not itself afflicted by the condition.

Of course, the whole point of sampling maternal blood is to avoid performing CVS or amniocentesis. But Lo says that this was just a proof of principle – in practice it should be possible to distinguish fetal and maternal sequences by comparing the fragments obtained from the woman's blood sample with DNA sequenced from her relatives.

Showing that the entire fetal genome is present in a pregnant woman's blood is an important development, says Diana Bianchi, a specialist in prenatal genetic diagnosis at Tufts University in Boston. "This paper is beautiful," she says.

However, at present the analysis is too cumbersome and expensive for clinical use. "At this moment, it would probably cost $200,000 per case," says Lo. "Cutting costs will be very important."

While sampling the entire fetal genome for genetic defects may remain prohibitively expensive for some while, Lo hopes within a year to develop a test focused on about five important genetic conditions, with the sequencing costing around $2000.

Still, Bianchi believes that the bioinformatics involved in reliably distinguishing fetal from maternal DNA sequences from a blood sample may prove impractical for many clinical labs. She also points out that the latest estimates put the risk of miscarriage associated with amniocentesis as low as 0.06 per cent. "At some point, someone's going to need to do an elegant cost-benefit analysis," she says.

Journal reference: *Science Translational Medicine*, DOI: 10.1126/scitranslmed.3001720

http://www.newscientist.com/article/dn19835-fetal-genome-mapped-from-mothers-blood-for-first-time.html

**Cosmic 'enlightenment' dawned slowly**

- 18:00 08 December 2010 by **Rachel Courtland**

The EDGES radio antenna in Western Australia (foreground) measured ancient cosmic radiation (Image: Judd Bowman)

The end of the universe's "dark age" was long and drawn out, according to the first direct measurement of the period when the first stars and galaxies heated up intergalactic gas.

Right after the big bang, the universe was a roiling soup of subatomic particles. These cooled and coalesced into neutral atoms within 400,000 years, beginning the cosmic dark age. This only ended when ultraviolet light from the first stars and giant black holes had once again ionised the fog of neutral atoms filling the universe. How long this process of "re-ionisation" took isn't clear.

To find out, Judd Bowman of Arizona State University in Tempe and Alan Rogers of the Massachusetts Institute of Technology deployed a small radio antenna called EDGES in Western Australia.

The telescope detects radio waves that have been emitted by neutral hydrogen atoms. These have a wavelength of 21 centimetres when they are emitted, but this gets stretched as they travel across space due to the universe's expansion.

**Slow and steady**

Based on the amount of stretch, the team knew that EDGES measured light released when the universe was a few hundred million to a billion years old. It did not find a sudden decrease in the brightness of the light emitted by neutral hydrogen atoms at any point in that period, suggesting that re-ionisation did not occur suddenly.

"I'm excited," says Avi Loeb of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts. "It's the first time we have a constraint on the duration of re-ionisation."

"It's also nice to see two people getting a result before the big teams that have much more money," Loeb adds. A range of large radio telescope arrays are under construction, such as the LOFAR telescope in the Netherlands and Germany. These projects, which consist of hundreds or thousands of antennas, will attempt to take high-resolution maps of the hydrogen.

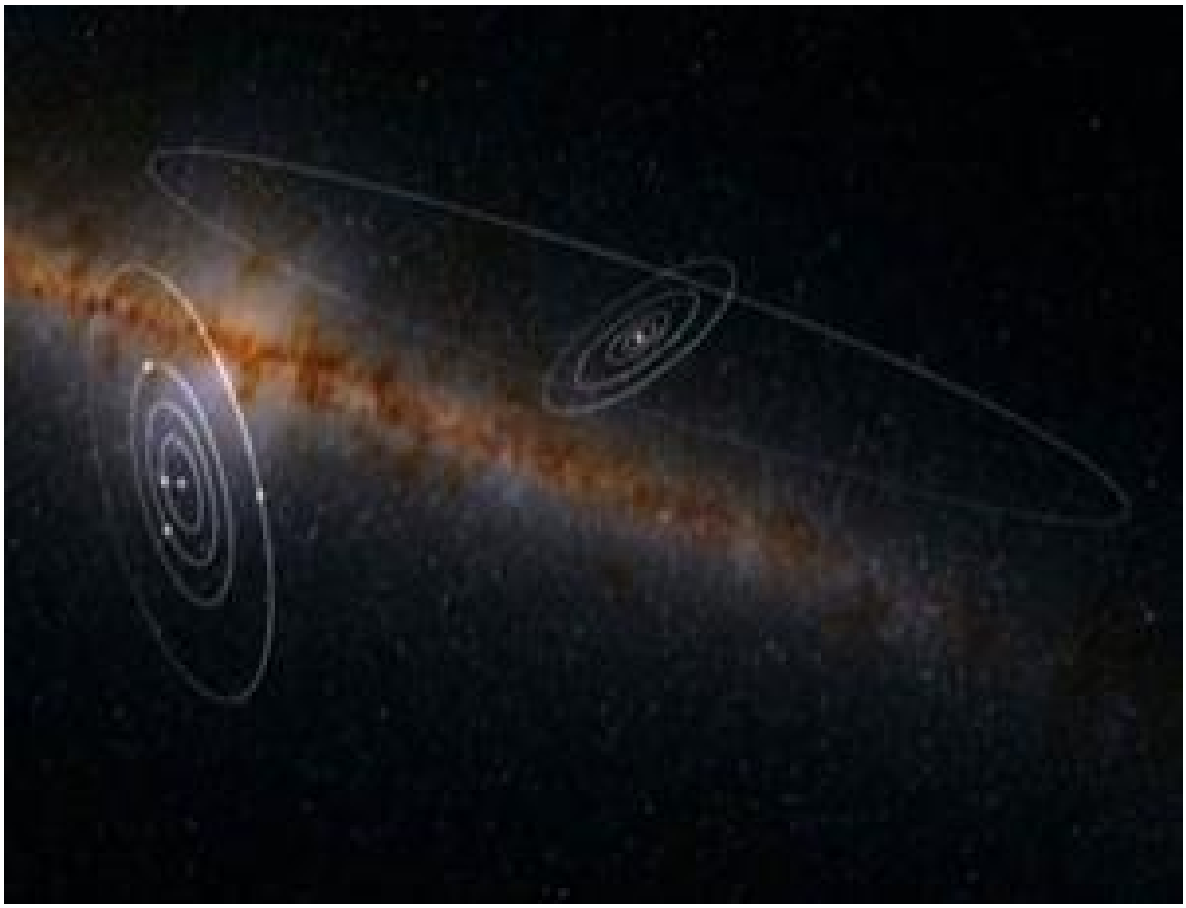
EDGES, which measures the total amount of radiation from hydrogen atoms over a large swathe of the sky, cannot image the gas in detail. But the small telescope may be better at looking even farther into the past than the larger arrays, allowing it to look at hydrogen atoms heated by the very first stars, Bowman says.

Journal reference: *Nature* (vol 468, p 796)

http://www.newscientist.com/article/dn19832-cosmic-enlightenment-dawned-slowly.html

**Quartet of giant planets puzzles astronomers**

- 18:00 08 December 2010 by **Stephen Battersby**



A 3D representation of the HR 8799 planetary system and the solar system in the Milky Way. (Image: 2MASS/UMass/IPAC-Caltech/NASA/NSF/NRC-HIA & C. Marois)

The discovery of a fourth giant world around the star HR 8799 is straining the two leading theories of how planets form.

Planets are thought to coalesce from a dusty disc around a young star. One model, called core accretion, says that giant planets form when the dust gathers into a rocky core, which then draws in gas to form a massive atmosphere. Another, called disc instability, says that these planets collapse suddenly from sections of the disc.

HR 8799's four planets, each five to 13 times Jupiter's mass, are too far apart to be explained easily by either model, say Christian Marois of the Herzberg Institute of Astrophysics in Victoria, British Columbia, Canada, and colleagues.

"This is the widest range of orbital radii of any planetary system known," Marois told *New Scientist*. His team imaged three planets around the star in 2008 and has now found the fourth.

The outermost planet is nearly 70 times as far from its star as the Earth is from the sun. At that distance, dust moves so slowly that by the time it had snowballed into a rocky core, the star would already have blown away most of the gas in the disc around it. That would have prevented a giant planet from forming in the core accretion model, the researchers say.

The newly discovered innermost planet challenges the rival disc instability model. It orbits at 15 times the Earth-sun distance – where the star's heat would prevent the disc from collapsing, the researchers argue.

It is unlikely that a mixture of the two processes would have produced planets with such similar masses, they say. Instead, the planets may have formed further in or out and then migrated through the gassy disc to their current positions.

Journal reference: *Nature*, DOI: 10.1038/nature09684

http://www.newscientist.com/article/dn19834-quartet-of-giant-planets-puzzles-astronomers.html

**The poison eaters: alternative life forms**

- 08 December 2010 by **David Shiga**

Magazine issue 2790.

Does Mono Lake hold a secret? (Image: Julian Calverley/Corbis)

*Two chemicals that swiftly kill most living things may sustain weird organisms in harsh environments on Earth, or even on alien planets*

THE outer limits of life just got stranger. Two chemicals that swiftly kill most living things may be harmless or even helpful to some unusual forms of life, suggesting that there are more ways of sustaining life than we realised.

"Life as we know it could be much more flexible than we generally assume or can imagine," says Felisa Wolfe-Simon of NASA's Astrobiology Institute and the US Geological Survey in Menlo Park, California. Her team grew bacteria that are apparently able to substitute the deadly poison arsenic for phosphorus, one of the six chemical elements thought to be essential for life, even replacing the phosphate backbone of DNA with one based on arsenic (*Science*, DOI: 10.1126/Science.1197258). The bugs could represent part of a "shadow biosphere" - a parallel form of life on Earth with a different biochemistry to all others.

The bugs could represent part of a 'shadow biosphere' - a parallel form of life on Earth

Whether or not the existence of an "arsenic bacteria" is confirmed - and some scientists are not convinced by the claim (see "Arsenic life") - the publication of the paper has reinvigorated interest in alternatives to our kind of life.

An equally outlandish life form has now been suggested by Johnson Haas at Western Michigan University in Kalamazoo. Haas calculated that if an alien microbe or plant used sunlight to knock electrons from chloride - producing chlorine gas as a waste product - it would be a more vigorous form of photosynthesis than the one we are used to, whereby light splits water molecules into oxygen, hydrogen ions and electrons.

Haas has proposed several alternative forms of photosynthesis, but in all of them the energy of sunlight is used to liberate electrons from chloride rather than water (see diagram). In both water-splitting and chloride-splitting photosynthesis, electrons are used to power the construction of sugars. Most life on Earth relies on photosynthesis either directly or indirectly for energy, but Haas says his reaction could provide more energy for sugar-making than the water-splitting one, potentially making chloride-based photosynthesis more profitable (*Astrobiology*, DOI: 10.1089/ast.2009.0364).

Dirk Schulze-Makuch, an astrobiologist at Washington State University in Pullman, says he finds the alternative photosynthesis idea fascinating and says it may well be realised on some life-hosting alien planets. "This is the type of research that really propels astrobiology," he says.

Robert Blankenship of Washington University in St Louis, Missouri, who studies the origin and evolution of photosynthesis on Earth, is more sceptical. Although he is not prepared to rule it out chlorine-based photosynthesis from an energy point of view, he says its waste products, which include chlorine gas, are "incredibly corrosive and toxic to all forms of life as we know it".

Chlorine gas was used as a weapon in the first world war, he points out. Because of the potentially deadly effects of the waste products of chlorine-based photosynthesis, he says he does not think it could sustain a biosphere. Haas counters that oxygen is a very aggressively reactive chemical too, and its rise in Earth's atmosphere billions of years ago forced some microbes to flee into mud and other low-oxygen environments to survive. Other organisms, including our own ancestors, developed antioxidant compounds to protect against the damage and evolved to use oxygen to burn food for energy. Aliens might even breathe chlorine as we breathe oxygen, he says.

William Bains, CEO of biotech company Delta G, based in Cambridge, UK, who has also published papers on astrobiology, agrees. "Chlorine is associated with bad outcomes, but that is because we are not adapted to such environments," he says. "For some terrestrial organisms today, oxygen is rapidly lethal, but humans survive OK in it."

Chlorine is linked to bad outcomes, such as rapid death, but that's because we are not adapted to it

Since chlorine is an efficient trapper of infrared radiation, it would act as a greenhouse gas. That could keep extrasolar planets warm enough for liquid water even if they were relatively far from their parent stars, where chlorine-deprived planets like ours would be frozen over, says Haas.

The absorption of infrared light by such an exoplanet's atmosphere could be detected in its light spectrum. Though astronomers usually talk about looking for oxygen as a sign of life, they should also keep chlorine in mind, Haas says.

There may well be other important ways that alien biology could differ from ours, "things that didn't happen to evolve here but are perfectly feasible", says Haas. "We only have one data point for a biosphere and what kinds of biochemistry it has. We don't really know how different it could be. We're not sure what we're going to find out there, and we need to be prepared for a great deal of variety."

**Arsenic life, taken with a pinch of salt**

Felisa Wolfe-Simon of NASA's Astrobiology Institute took arsenic-rich mud containing bacteria from Mono Lake in California (pictured) and grew them in ever-decreasing concentrations of phosphorus.

All known life is built around carbon, hydrogen, nitrogen, oxygen, phosphorus and sulphur - known as CHNOPS - which make up proteins, lipids and DNA. Wolfe-Simon's rationale was that since arsenic is just below phosphorus in the periodic table, and shares many of its chemical properties - and is even used as a source of energy for some bacteria - the bugs would be able to swap one for the other. That, they report, is what happened, with arsenic replacing phosphorus even in the backbone of the DNA double helix itself. Some scientists who spoke to *New Scientist*, however, were far from convinced.

"I doubt these results," says Steven Benner, a chemist at the Foundation for Applied Molecular Evolution in Gainesville, Florida. In order to measure the apparently modified DNA, it has to be put into a water-containing gel, which would rapidly dissolve any arsenic-containing chunks of DNA, but not those containing phosphorus. Since they found large chunks of DNA, it must contain phosphorus, not arsenic, Benner argues. "It remains to be established that this bacterium uses arsenic as a replacement for phosphorus in its DNA" or in any other biomolecule found in "standard" Earthly biology, he says.

Rosie Redfield at the University of British Columbia in Vancouver, Canada, says the paper does not present any convincing evidence that arsenic has been incorporated into bacterial DNA, calling the molecular biology methods used by Wolfe-Simon's team "crude".

"I'm not surprised by NASA's publicity juggernaut, but I'm very disappointed that these scientists did not bring higher standards to their work, and that Science thought it fit to publish," she says.

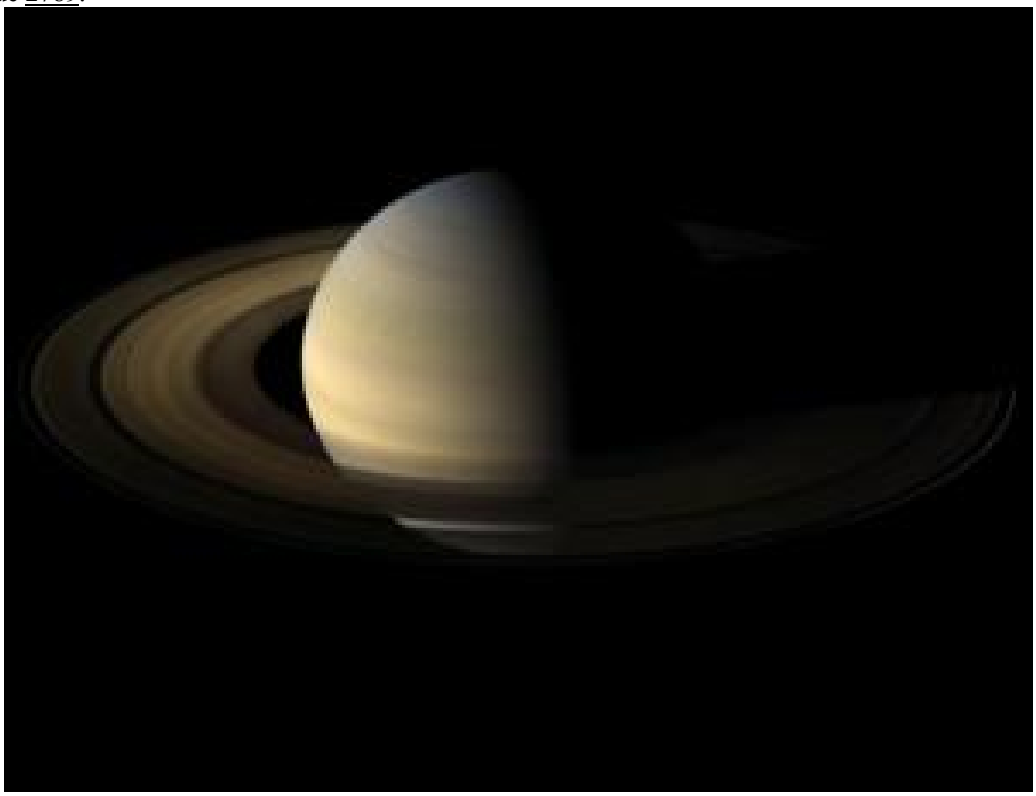
**Olivier Dessibourg**

http://www.newscientist.com/article/mg20827903.100-the-poison-eaters-alternative-life-forms.html?

**Saturn's strange propellers show how planets are born**

- 07 December 2010 by **Marcus Chown**

Magazine issue 2789.



Precious rings (Image: JPLl/NASA)

*The Cassini probe is revealing the fine details of Saturn's rings – details that open a window on the earliest days of the solar system*

FOR six years, the Cassini spacecraft has been touring Saturn and its magnificent rings. Unlike previous spacecraft, which have snatched a passing glimpse of the planet on their way to the edges of the solar system, Cassini has beamed back stunningly detailed images year after year.

Such images do much to unravel the mysteries of Saturn, its rings and moons. And that's not all. "These detailed observations have yielded insights into the formation of the solar system," says Carl Murray, a member of the Cassini imaging team at Queen Mary, University of London.

Saturn's ring system is the closest thing we have to the disc of dust and rubble that gave birth to Earth and the other planets 4.55 billion years ago. The protoplanetary disc took shape when a spherical cloud of ultra-cold gas and dust began to collapse under its own gravity. As the spinning cloud shrank, it took the form of a disc, swirling around the newborn sun. "Once the sun had blown away the gas, the disc of orbiting rubble would have resembled the disc of Saturn's ring system," says Murray.

From then on, larger bodies would begin to aggregate out of the debris. They would have gradually grown, vacuuming up material from their surroundings, their gravity reaching ever further. Competition between growing bodies would have seen some cannibalised by others.

It would probably have taken about 100,000 years and a complicated sequence of events for a planet to form, but we have very little observational evidence to tell us how it played out. "Planet formation theory is in a state not far from a shambles," says Renu Malhotra at the Lunar and Planetary Laboratory in Tucson, Arizona.

This is where Saturn's rings come in. "The incredible variety of complex structures we are seeing in the rings has much to teach us about planet formation," says Murray.

Among the most striking are structures shaped like aircraft propellers. They are the wakes created by unseen moons as they plough through the icy rubble orbiting around Saturn. Dozens of propellers have been spotted in the A-ring, a band 14,000 kilometres wide and only 10 metres deep.

The moons themselves are too small even for Cassini to see directly because they are only a few kilometres to a few hundred metres across. In contrast, their propeller-shaped wakes can be thousands of kilometres long, and some have now been observed orbiting Saturn for several years. They form as a result of a moon's gravity tugging on the surrounding material. The debris inside its orbit, being closer to Saturn, is moving faster, and the perturbation therefore quickly overtakes the moon, creating a long, thin wake ahead of it. This is the leading blade of the propeller. Meanwhile, the material outside the moon's orbit is moving more slowly, creating the trailing blade. "I have no doubt that propellers like these were the first structures to appear on the way to making the planets," says Murray.

Saturn's larger moons represent the next stage in planetary evolution. These growing moons have sufficient gravity to sweep up material and carve gaps between the rings, just as the growing planets would have done. As such bodies in the protoplanetary disc grew bigger, their influence would have grown, and we can watch exactly this process happening today. Saturn's moon Mimas is medium-sized at 400 kilometres across. It not only sweeps up debris along its orbit but also kicks it out from "resonant" orbits. For example, particles in a 2:1 resonant orbit make one circuit of Saturn for every two orbits of Mimas. They find themselves tugged regularly by the moon.

Saturn's moons sweep up material and carve gaps between the rings, just as young planets would have

While each extra gravitational tug doesn't amount to much, over many cycles they build up and knock the particles from their orbit to leave a gap. Gravitational tugs by Mimas have sculpted the inner edge of the most prominent gap in Saturn's rings, a 4700-kilometre-wide void called the Cassini Division.

Further out, in the F-ring, Cassini's eagle eye has shown that the moon Prometheus creates waves in the debris. That's because the moon pulls material inside its orbit towards it, but by the time the debris reaches Prometheus's location, the moon has scudded on past. So the material falls back, setting up oscillations in the ring. This has far-reaching consequences, because the wave compresses the debris and makes it behave more like a solid body. "What we are seeing is a passing moon triggering the formation of a body that has insufficient gravity to come together on its own," says Murray. If the same happened in the protoplanetary disc, growing bodies like the embryonic Jupiter could have triggered the formation of other planets that otherwise wouldn't exist.

That's not the only way the rocky disc could have affected planet formation. Linda Spilker is Cassini's project scientist at the Jet Propulsion Laboratory in Pasadena, California. What has surprised her about the propeller structures is that their orbits continually change. "We have tracked the larger propellers for about four years and noticed that they are sometimes moving inward and sometimes outward," she says.

**The early years**

Perhaps some of the embedded moons are being buffeted by the surrounding ring material and nudged outwards. With others, it may be that gravitational interplay with the rubble robs the moon of its energy, pulling it closer to Saturn. That would certainly help to explain the existence in other star systems of so-called hot Jupiters, gas giant planets that orbit extremely close to their star. Because gas near a star is too hot for gravity to hold onto, such gas giants are thought to have grown up much further from their stars and migrated inwards. "Perhaps this is what we are seeing in Saturn's rings," says Murray.

Malhotra is sure there is more to learn. "Saturn's rings and moonlets provide a very clean natural laboratory to hone our understanding of that detailed physics," she says.

They will never tell us the complete story, though. "Although we can see an analogue of the early stages of planet formation, we cannot see the later stages," says Murray. That's because the icy debris in Saturn's rings can never aggregate into moons in the same way that the protoplanetary disc turned into planets. Saturn's rings are more than 300 times closer to the planet than Mercury is to the sun, and their close proximity means that the planet's gravity will rip apart any budding large moons.

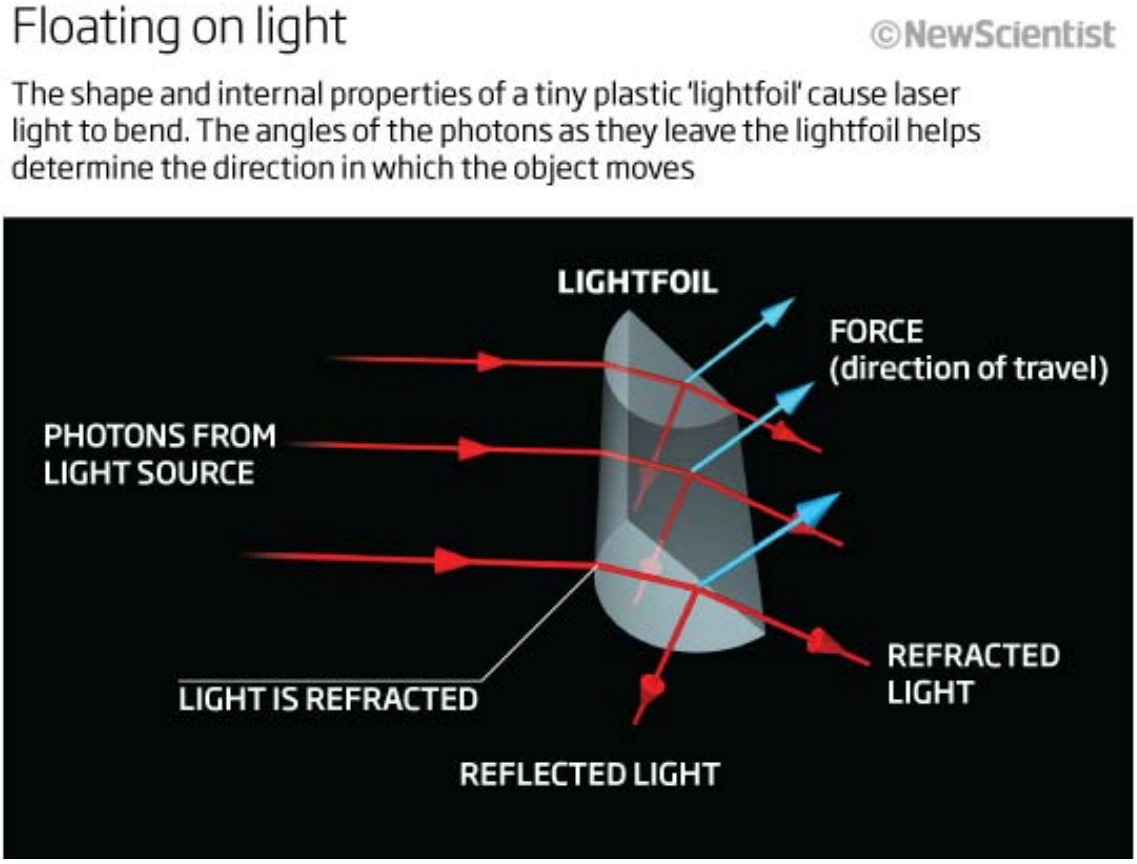
In Saturn's rings, the forces of destruction always have the upper hand. But that won't stop us marvelling at Cassini's beautiful images and all that they can tell us.

*Marcus Chown is author of We Need to talk About Kelvin (Faber & Faber, 2010)*

http://www.newscientist.com/article/mg20827891.200-saturns-strange-propellers-show-how-planets-are-born.html

**'Lightfoil' soars on a stream of photons**

- 19:14 06 December 2010 by **Kate McAlpine**




The shape and internal properties of a tiny plastic 'lightfoil' bend laser light. The angles of the incoming and outgoing light (red) determine the direction in which the object moves (blue) (Image copyright: New Scientist)

Light has been used to generate aerodynamic-like lift for the first time. The technique, which takes advantage of the fact that light bends, or refracts, when moving from one medium to another, could be used to create solar-sail spacecraft that could steer using light itself.

Photons create pressure when they bounce off objects. Solar sail prototypes are made highly reflective to maximise this push, but the effect does not allow the sails to be easily steered. "It's well known you can use a light source to push on something, but the steering mechanisms are still up for grabs," says Grover Swartzlander of the Rochester Institute of Technology in New York.

He says future sails could be manoeuvred if the photons did not just rebound off the material's surface but passed through it. As they entered and exited the sail, the photons would change direction by an amount dictated by the shape of the material's surface and its so-called refractive index. The angles of the incoming and outgoing light would control the direction of the sail's movement (see graphic).

Swartzlander and his colleagues demonstrated the effect in the lab with semi-circular plastic rods, each just a fraction of the size of a human hair.

**Asymmetrical shape**

They put the rods in a container of water, then shined laser light on them from below. The rods floated due to radiation pressure, as any object of similar mass would. But crucially, they also drifted sideways – a sign that they had been steered by refracted light.

The fact that the rods' asymmetrical shape affected their movement makes them the optical equivalent of aeroplane wings, or aerofoils, says the team. Wings, whether bird or Boeing, soar in part because air moves faster over their top sides, reducing the pressure above. The relatively high pressure below pushes upwards, providing lift.

Swartzlander says a future solar sail could be fully controlled in 3D with two perpendicular arrays of semi-circular rods.

But Dean Alhorn, lead engineer of NASA's recently launched NanoSail-D solar sail experiment, says sunlight may be too weak to do this in practice and is exploring ways to control the craft with reflected light alone.

Journal reference: *Nature Photonics* (DOI: 10.1038/NPHOTON.2010.266)

http://www.newscientist.com/article/dn19818-lightfoil-soars-on-a-stream-of-photons.html

**Criminals find the key to car immobilisers**

- 06 December 2010 by **Duncan Graham-Rowe**

Magazine issue 2789.

Not as secure as before (Image: Ashley Jouhar/Getty)

*For 16 years, car immobilisers have kept car thieves at bay – but that may now be changing*

AFTER a 16-year decline, car theft in Germany rose in 2009, according to figures released recently by the German Insurance Association. One "white hat" hacker, who probes security systems to flag up flaws that can then be patched, thinks he knows why. Karsten Nohl of Security Research Labs in Berlin, Germany, has identified vulnerabilities in the engine immobilisers used to protect modern cars from theft.

A device fitted within the key fob of a modern car broadcasts an encrypted radio signal to the car as the driver starts the vehicle. If the signal is recognised by the car's receiver, it responds by sending an encrypted signal to the engine control unit (ECU), which allows the car to start. If the driver tries using the incorrect car key fob, the ECU locks down the engine.

For over a decade, immobilisers have played a crucial role in reducing car theft, says Nohl. But the proprietary encryption keys used to transmit data between the key fob, receiver and engine are so poorly implemented on some cars (see "Castles built on sand") that they are readily cracked, Nohl told the Embedded Security in Cars conference, in Bremen, Germany, last month.

Last year he took just 6 hours to uncover the algorithm used to create the encryption key in a widely used immobiliser - the Hitag 2 made by Dutch firm NXP Semiconductors - making it easy to "de-immobilise" any car using that algorithm. And in 2005 Ari Juels of RSA Labs in Cambridge, Massachusetts, and researchers at Johns Hopkins University in Baltimore, Maryland, took under an hour to crack an encryption system sold by US technology firm Texas Instruments.

It took just 6 hours to reveal the algorithm used to create the encryption key in a popular immobiliser

Juels says that these cracks were possible because the proprietary algorithms that the firms use to encode the cryptographic keys shared between the immobiliser and receiver, and receiver and engine do not match the security offered by openly published versions such as the Advanced Encryption Standard (AES) adopted by

the US government to encrypt classified information. Furthermore, in both cases the encryption key was way too short, says Nohl. Most cars still use either a 40 or 48-bit key, but the 128-bit AES - which would take too long to crack for car thieves to bother trying - is now considered by security professionals to be a minimum standard. It is used by only a handful of car-makers.

"To our knowledge the direct causal link between the failure to adopt AES systems and the rise in car theft cannot be drawn," says Thomas Rudolph of NXP. And a Texas Instruments spokesperson argues that in some cases the firm's proprietary cryptographic systems have been shown to be stronger than AES.

Nevertheless, both NXP and Texas Instruments say they have been phasing out their shorter encryption key systems, and both now offer 128-bit AES.

Convincing car-makers to adopt the new systems remains a challenge, says Juels. He thinks they still believe hacking is a minor problem compared with more direct ways of stealing cars. "The reaction we got was that it would be cheaper to use a flatbed truck."

**Castles built on sand**

Karsten Nohl's assessment of dozens of car makes and models found weaknesses in the way immobilisers are integrated with the rest of the car's electronics.

The immobiliser unit should be connected securely to the vehicle's electronic engine control unit, using the car's internal data network. But these networks often use weaker encryption than the immobiliser itself, making them easier to crack.

What's more, one manufacturer was even found to use the vehicle ID number as the supposedly secret key for this internal network. The VIN, a unique serial number used to identify individual vehicles, is usually printed on the car. "It doesn't get any weaker than that," Nohl says.

http://www.newscientist.com/article/mg20827894.500-criminals-find-the-key-to-car-immobilisers.html

**Infrared add-on could let standard cameras see cancer**

- 11:57 09 December 2010 by **Kate McAlpine**

Mammograms take time (Image: Image Source/Getty)

Doctors could one day instantly detect cancers by photographing patients with a digital camera.

Jeppe Seidelin Dam and colleagues at the Technical University of Denmark in Roskilde are developing a device that can convert infrared radiation into visible light. Attached to a digital camera fitted with an infrared flash, it could detect tumours by recording the telltale pattern of infrared light they reflect.

"This would allow a surgeon to quickly determine if the entire tumour has been removed before finishing an operation," he says.

At the heart of the system is a multilayered crystal of potassium titanium oxide phosphate in which the infrared photons from the object to be imaged interfere with photons from an infrared laser, also fired into the crystal. The interaction shifts the wavelength into the visible spectrum while preserving the image information, allowing it to be captured by a normal camera.

**Mirror amplifiers**

The idea was first explored in the 1970s, but improvements to methods for growing crystals since then have improved the resolution of the device 300-fold. By placing a pair of mirrors on either side of the crystal so that the laser light reflects back and forth, the team increased the odds of its photons interfering with infrared photons from the object."We pass the same photons through the crystal up to 100 times," says Dam. The crystal was able to capture an infrared panorama with a resolution of 200 by 1000 pixels, the team says.

The device could be placed in front of a digital camera lens like a filter, and be used to take thermal photographs or video. Shrinking it down to a size suitable for everyday use should not be difficult, says Dam. "These are basically the same components that are in green laser pointers."

While current infrared colour imagers need to run at -200°C and cost around $100,000, Dam says that an upconversion imager would run at room temperature and cost about $10,000.Stefano Bonora of the University of Padua, Italy, calls the upconversion technique "really interesting" for its potential to generate infrared images at room temperature. Such detectors are lacking at the moment, he says.

Journal reference: *Optics Letters*, DOI: 10.1364/OL.35.003796

http://www.newscientist.com/article/dn19840-infrared-addon-could-let-standard-cameras-see-cancer.html

**Quantum links let computers understand language**

- 08 December 2010 by **Jacob Aron**

Magazine issue 2790.

Ask me anything you like (Image: Louie Psihoyos/Science Faction/Corbis)

AS YOU read this article, your brain not only takes in individual words, but also combines them to extract the meaning of each sentence. It is a feat any competent reader takes for granted, but it's beyond even the most sophisticated of today's computer programs. Now their abilities may be about to leap ahead, thanks to a form of graphical mathematics borrowed from quantum mechanics.

"It's important for people like Google," says physicist Bob Coecke at the University of Oxford, who is pioneering the new approach to linguistics. At the moment computers "only understand sentences as a bag of different words without any structure".

Coecke's approach, aired at a recent workshop in Oxford, is based on category theory, a branch of mathematics that allows different objects within a collection, or category, to be linked. This makes it easy to express a problem in one area of mathematics as a problem in another, but for many years was viewed even by its creators as "general abstract nonsense".

That changed when Coecke and his colleague Samson Abramsky used a graphical form of category to formulate some problems in quantum mechanics in a way that can be understood more intuitively. It provided a way to link quantum objects, written as vectors, to each other. That's useful for representing quantum teleportation, say, when information passes instantaneously between certain locations via a specific route.

Coecke likens traditional approaches to such problems to watching television at a pixel level. "Rather than seeing the image, you get it in terms of 0s and 1s," he says. "It wouldn't mean anything to you." By translating quantum mechanical processes into pictures, higher-level structures become apparent.

More recently, Coecke, together with Mehrnoosh Sadrzadeh, also at Oxford, and Stephen Clark, now at the University of Cambridge, realised this graphical mathematics might also be useful in computational linguistics. The field aims to create a universal "theory of meaning" in which language and grammar are encoded in a set of mathematical rules.

Computers could, in principle, use the rules to make sense of language. In practice, most existing models of human language focus either on the meaning of individual words, allowing search engines to work out the general context of a web page, or on the rules of grammar, but not both.

To produce a model that uses the rules of grammar to encode the meaning of sentences, Coecke and his colleagues had to combine the existing model types. To do this, they adopted the graphical approach Coecke had developed for use in quantum mechanics.

A graphical approach developed for quantum mechanics combines words and grammar

Existing models for word meanings define words as vectors in a high-dimensional space, in which each dimension represents some key attribute. So the vector for "dog" might include the vectors for "eat", "sleep" and "run". "Cat" might be generated by a combination of similar words to "dog", but "banker" would be built from quite different words, such as "money" and "work". Defining words in this way allows a dictionary to be represented as a "neighbourhood" of words, with the distances between residents in the high-dimensional space defined by their vectors. The vector representations of "dog" and "cat" would ensure that these words live much closer to each other than either does to "banker".

Now Coecke's team has created a similar neighbourhood for sentences. To create a vector for a sentence, Coecke has devised an algorithm to connect individual words, using the graphical links that were developed to model the flow of quantum information. In this case, the links embody basic grammatical rules, such as the way the word "likes" can be linked to "John" or "Mary", and the different way it can be linked to the word "not" (see diagram).

The team has already shown that the method allows the two sentences "John likes Mary" and "John does not like Mary" to be represented as vectors and placed at the appropriate location. That's no small feat: while anyone who can read English knows that these sentences are directly opposite, to a computer this isn't obvious. The work will be published in the journal *Linguistic Analysis*.

Most sentences have more nuanced relationships than these two examples. The next stage of Coecke's work allows more complex sentences to be represented as vectors, with the vectors that represent verbs taking into account the meaning of their subject and object nouns. This ensures that "dogs chase cats" gets assigned a vector placing it closer in sentence space to "dogs pursue kittens" than to "cats chase dogs". This work will be presented next month at the International Conference on Computational Semantics.

The team plans to train the new system on a billion pieces of text, starting with formal, carefully written legal or medical documents which should be relatively easy to parse. From there they will work their way up to more challenging extracts such as ambiguous sentences or sloppily written pages on the web.

It is not yet clear whether the insights gained so far can deal with all the nuances of language. Sebastian Pado, who studies computational linguistics at Heidelberg University in Germany, says that Coecke's team needs to show its method working on text from the real world, rather than specially prepared examples. Coecke agrees: "We have shown many proof-of-concept examples which have been crafted by hand, but to really convince the whole world this is the way to do things, you need a huge experiment."

http://www.newscientist.com/article/mg20827903.200-quantum-links-let-computers-understand-language.html

**New gadget promises 3D without the headaches**

- 21:11 07 December 2010 by **Frank Swain**

A perceptual trick could improve 3D vision (Image: Sean Gallup/Getty)

In 1907 a Polish optical scientist named Moritz von Rohr unveiled a strange device named the Synopter, which he claimed could make two-dimensional images appear 3D. By looking through the arrangement of lenses and mirrors, visitors to art galleries would be drawn into the paintings, as if the framed canvas had become a window to a world beyond. But the Synopter – heavy and prohibitively expensive – was a commercial failure, and the device vanished almost without trace.

A century later, Rob Black is hoping to rekindle interest in von Rohr's creation. A psychologist specialising in visual perception at the University of Liverpool, UK, Black has designed and built an improved version he calls "The I". Unlike some 3D glasses, the device uses no electronics, and works on normal 2D images or video.

**Playing tricks on your eyes**

The device works in the opposite way to the 3D systems employed in cinemas. There, images on the screen are filtered so that each eye sees a slightly different perspective – known as binocular disparity – fooling the brain into perceiving depth. "The I" ensures that both eyes see an image or computer screen from exactly the same perspective. With none of the depth cues associated with binocular disparity, the brain assumes it must be viewing a distant 3D object instead of looking at a 2D image. As a result, the image is perceived as if it were a window the viewer is looking through, and details in the image are interpreted as objects scattered across a landscape.

The perceptual trick, called synoptic vision, is apparent on any nearby two-dimensional image, but is especially marked where other depth cues exist. For instance, the brain will naturally assume an animal in the 2D image is in the foreground if it is large, and far away if it is small.

**No more headaches**

Black says that the device also avoids the headaches associated with other 3D technologies. In movie theatres, the eyes need to focus on the screen itself to see objects in focus, but the 3D effects can force the viewer to try to focus several metres in front of or behind the screen instead. "Even with if you use the world's best 3D kit, it can still present conflicting perceptual information," Black told *New Scientist*.

Because his device uses no binocular disparity the viewer isn't forced to attempt such impossible feats of focusing – instead, they can focus naturally on any object in the image, using other cues such as size to 'decide' what depth the object occupies. "By turning off that conflicting information, you can enjoy the scene in the way the artist depicted."

Currently the device is still a prototype, but Black hopes that his synoptic viewer will one day be incorporated into existing 3D systems. "I think 3D is impressive at the moment, but with this we can get significantly closer to reality simulation."

http://www.newscientist.com/article/dn19825-new-gadget-promises-3d-without-the-headaches.html

**Greenland's ice has secret weapon against melting**

- 14:00 09 December 2010 by **Michael Marshall**
- For similar stories, visit the **Climate Change** Topic Guide

Greenland's vast ice sheets are proving surprisingly resilient. That means the glaciers will melt only slowly as the climate warms, provided it does so steadily. However, wild changes in the weather could make them melt much faster.

Greenland's ice sheets are shrinking already as the climate warms, and some glaciologists fear that they could accelerate their own destruction. If they all melted, they would raise global sea levels by 6.5 metres – though even in a world 8 °C warmer than now this might take 1000 years.

The feared self-destruct device is water. As a glacier melts, water runs down to its base. In theory, this lubrication should accelerate the glacier's slide downhill and melt it sooner.

But this positive feedback is "limited", says Christian Schoof of the University of British Columbia in Vancouver, Canada, who has built a new model of glaciers that simulates how they respond to meltwater. He says glaciers can get rid of excess water because of the way their internal structure changes.

**Channels and cavities**

Glaciers have two drainage systems: meltwater carves out conduits called Röthlisberger channels in the base of the glacier, and cavities form whenever the ice passes over a bump in the ground. The cavities are the real threat because water stays in them, lubricating the glacier for longer.

However, Schoof's model shows that once the amount of meltwater exceeds a critical value, it burrows larger Röthlisberger channels for itself. As a result, extra water above that critical amount simply drains away and the glacier slows down. "It's a very efficient route for water to be evacuated," Schoof says.

Schoof's model could help explain what is happening to Greenland's glaciers, says glaciologist Roderik van de Wal of Utrecht University in the Netherlands, who has found no sign of the feared feedback effect. "The melt has been increasing but glacier velocities have not," he says. "This is a physical explanation."

**Ice and storms**

But there is one fly in this otherwise comforting ointment. Changeable weather can cause short-term spikes in water supply, adding more water than the glacier's drainage can cope with and temporarily speeding it up. "The variability of the weather is key," Schoof says.

That could be a problem, as Greenland is expecting more frequent rainstorms this century thanks to climate change. These storms might drive the glaciers to destruction.

Fortunately, this effect may also be quite small. Rainstorms have been observed accelerating glaciers, but each one's effect lasts only a few days, says Hilmar Gudmundsson of the British Antarctic Survey in Cambridge, UK. "You need a lot of storms to make a big difference," he says.

Journal reference: *Nature*, DOI: 10.1038/nature09618

http://www.newscientist.com/article/dn19842-greenlands-ice-has-secret-weapon-against-melting.html

**Brazilian farmers are unlikely climate heroes**

- 23:50 08 December 2010 by **Fred Pearce**, Cancún, Mexico
- For similar stories, visit the **Climate Change** Topic Guide

Here is the good news from Cancún. Brazil, so often demonised for its destruction of the Amazon rainforest, is turning over a new leaf. In the past year it has transformed a sketchy promise made in Copenhagen to cut emissions to 36 to 39 per cent below business-as-usual by 2020 into a detailed science-based plan. And much of the work will be done by the industry most responsible for trashing the Amazon – cattle ranching and commercial agriculture.

World-wide, agriculture is directly responsible for roughly 15 per cent of greenhouse gas emissions – a figure that does not include emissions from the deforestation is causes. Yet the climate talks in Cancún, Mexico, have so far failed to address this industry's contribution to global warming. Against all odds, Brazil is now bidding to go from the bad boy of forestry and agriculture to their poster child.

Researchers at the state-backed Brazilian agricultural research corporation, EMBRAPA, on Wednesday unveiled a detailed "low-carbon agriculture" plan that they said would cut direct farm carbon dioxide emissions by 170 million tonnes a year, and save as much again by curbing the invasion of rainforests by farmers.

Most remarkably, EMBRAPA researcher Gustavo Mozzer claimed cattle ranching, the number one destroyer of the Amazon rainforest, would become a national carbon sink, reabsorbing $CO_2$ from the air. Currently, most pastures lose carbon as soils degrade, he said. But "a well-managed pasture can accumulate carbon. In fact our research shows it can accumulate so much that it more than cancels out the warming effect of methane and other emissions from cattle production".

**Engineered nitrogen bugs**

Mozzer, an architect of Brazil's climate policies for almost two decades, says Brazil plans to rehabilitate 150,000 square kilometres of degraded pastures by 2020, restoring its carbon content. One method will be to plant trees and other crops among the cattle.

Another big project is to extend no-till farming, which Brazil has pioneered. Ploughing releases carbon from soils. But if farmers avoid the plough and instead plant seeds in holes drilled among the stubble of the previous year's crop, the typical carbon content of the soil rises from 1.6 to 2 per cent over a decade, Mozzer said. The technique, which is already used in 60,000 square kilometres of Brazilian farmland, is to be extend to another 80,000 square kilometres in the coming decade.

EMBRAPA has 32 research centres and 192 farm units working on the low-carbon plan. Other elements include capturing methane emissions from pig manure to make biogas, and reducing nitrogen fertiliser use by engineering new strains of nitrogen-fixing bacteria that can be given to farmers.

Assuero Doca Veronez from the Brazilian Federation of Agriculture and Livestock, representing more than a million farmers, said the new techniques would be supported by farmers because they improved soils and increased yields.

**Eliminating deforestation from the supply chain**

With the Brazilian government offering farmers loans to clean up their act, rich-world campaigners are

encouraging them to sign up to new green certification schemes covering products like palm oil, soya, timber, biofuels, beef, sugar and even leather.

Mark Moroge of the Rainforest Alliance, a prominent certifier, said in Cancún: "After eight years of not much success, we have suddenly seen a huge interest in signing up to certification by Brazilians in the past two years."

Barbara Bramble of the National Wildlife Federation, a US-based conservation group, said that the market opportunities created by selling certified products to western consumers had the potential to "eliminate deforestation from the supply chains of global brands. We can do this now, without waiting for – and perhaps instead of – a global deal on climate change."

http://www.newscientist.com/article/dn19838-brazilian-farmers-are-unlikely-climate-heroes.html

**Hedge-fund philanthropist: Physics can save the planet**

- 08 December 2010 by **Alison George**

Magazine issue 2789.

Helping sustainability (Image: Matthew Ford)

*I want to help spark new technologies, says **David Harding**, who is donating £20 million to "the physics of sustainability"*

**Your donation is going to the University of Cambridge's Cavendish Laboratory, to fund research into the "physics of sustainability". What exactly is this?**

It means developing materials to help a 9-billion-strong future human race live in harmony with the planet. You could call it the physics of materials, but sustainability sounds more catchy.

**How could these new materials help us live sustainably?**

One example is improving renewable power generation by making solar cells from commonly occurring elements: carbon, hydrogen, oxygen and nitrogen. Solar cells are currently made of cadmium telluride, but cadmium is terribly poisonous and tellurium is terribly rare, so in terms of solving humanity's energy problem, it might not be the final answer. If you could make a material from common elements, even if it was very inefficient, then you would be well on the way. You might express scepticism that this could be done - then I'd point you to chlorophyll.

**What other areas are important?**

Energy storage. If you could find a substance that could store energy efficiently, then you could do away with the need to have a fixed-line power grid in Africa and India, in the same way that we're never going to need a fixed-wire phone network in Africa due to the rise of the mobile phone.

**As an undergraduate, you specialised in theoretical physics. Do you now think practical physics is more important?**

It seems to me that cosmology and particle physics have been well funded. Look at the Large Hadron Collider. I love the LHC and don't begrudge it a penny. In fact, I think we should spend more money on it. But the success of something like that does tend to orphan other areas.

**It sounds like you favour a blue-skies approach to research**.

Definitely. Why? Because I can afford to take that risk. In a way it is almost irresponsible for governments to put money into things that are long shots in terms of discovery. I wanted to give researchers at the Cavendish Laboratory more freedom to take risks, to pursue wild ideas. I'm sure that was the spirit that won the Cavendish its 29 Nobel prizes.

**You're an advocate of applying the scientific approach to markets. What does this entail?**

It means the techniques we use are based on the scientific method. We analyse massive volumes of noisy data from the markets, trying to find patterns that we can "bet" on. I would say we have considerable humility compared with most participants in the financial markets, who create elaborate stories. We know that we know almost nothing, but the "almost nothing" we know isn't completely nothing, and we only bet on that. It's a bit like a scientific experiment, because quite often we fail. But overall we make more money than we lose, otherwise I wouldn't have £20 million to give away!

**Profile**

David Harding is founder, chairman and head of research at Winton Capital Management, a London hedge fund which uses statistical tools to analyse market behaviour. He studied natural sciences at the University of Cambridge

http://www.newscientist.com/article/mg20827895.000-hedgefund-philanthropist-physics-can-save-the-planet.html

**Organic pollutants tracked down to US parking lots**

- 14:17 08 December 2010 by **Jeff Hecht**
- For similar stories, visit the **US national issues** Topic Guide

Chemical detectives have tracked down the main source of a troublesome family of organic pollutants. Their "fingerprinting" of polycyclic aromatic hydrocarbons (PAHs) shows that surface sealers based on coal tar are responsible for most of the noxious substances by far.

PAHs have accumulated rapidly over the past 40 years in many US stream and lake beds, and many are toxic or carcinogenic. Suspected culprits had included used motor oil and the burning of wood, coal and oil.

Current US guidelines consider certain PAHs dangerous to organisms that live at the bottom of streams and lakes if there is more than 22.8 milligrams of the chemical per kilogram of sediment. Many urban and suburban lakes have higher levels; worse still, other kinds of PAH are air pollutants.

Yet controlling that pollution has been difficult. "There are so many small sources that people had thrown up their hands," says Peter Van Metre of the US Geological Survey (USGS) Texas Water Quality Center in Austin. Then Austin water-quality officials suggested that coal-tar roadway sealer might have caused local PAH problems.

**Foe underfoot**

The thick tarry sealers are widely used in the US to coat blacktop driveways, parking lots and paved portions of playground. Most sold outside of the western US are based on coal tar and contain about 50 grams of PAH per kilogram of dry weight, although some sealers are based on heavy petroleum compounds such as asphalt and contain only 50 milligrams of PAH per kilogram.

Van Metre and colleagues had earlier showed that dust from coal-tar-sealed parking lots was laden with PAHs. Now he and USGS colleague Barbara Mahler say they have nailed the case. They took sediment samples from 40 lakes across the US and compared the chemical fingerprints of the PAHs they contained – the ratios of different PAH compounds – with those of possible sources.

Dust grains from the break-up of coal-tar parking lot sealant were by far the biggest source. In eight of the nine lakes with PAH levels above the 22.8-milligrams-per-kilogram guideline, the concentration of the coal-tar component alone exceeds the guideline. In some, it approaches 60 milligrams per kilogram. In areas where coal-tar sealers are widely used, Van Metre says, "they were the primary drivers" in the increase of PAH levels over the past decade.

Even before the new results, Austin had banned coal-tar sealers after linking them to high PAH levels. Six Minnesota communities have banned or restricted coal-tar sealers because they have contaminated sediments in storm-water ponds so much that disposal cost up to hundreds of thousands of dollars per pond, says Judy Crane of the Minnesota Pollution Control Agency. In North Carolina there have been similar reports.

Journal reference: *Science of the Total Environment*, DOI: 10.1016/j.scitotenv.2010.08.014

**http://www.newscientist.com/article/dn19829-organic-pollutants-tracked-down-to-us-parking-lots.html**

**Blue whale feeding methods are ultra-efficient**

- 12:41 09 December 2010 by **Michael Marshall**

Efficient feeders (Image: David B Fleetham/OSF/Getty)

Blue whales are the biggest and perhaps most efficient animals alive. Their method of filter-feeding takes in 90 times more energy than it uses.

The enormous mammals dive up to 500 metres beneath the surface, then lunge into the swarms of tiny krill above them at several metres per second. As they strike, their massive mouths fill with huge volumes of water, including plenty of krill. The water is pushed out through the filters, or baleen, in each whale's mouth, trapping the krill.

This feeding technique takes a lot of effort due to the energy needed for the lunges. "We wondered how they coped," says Robert Shadwick of the University of British Columbia in Vancouver, Canada.

Shadwick's colleague Jeremy Goldbogen of the University of California, San Diego, led a team who set out to track blue whales as they fed. In small boats they zoomed up alongside surfacing whales and attached tracking devices to them using suction caps.

**Energy efficient**

In total the team tracked 265 blue whales as they carried out 200 foraging dives and 654 lunges. From the speeds the whales reached while lunging, they calculated that each lunge used about 3200 kilojoules of energy.

That may seem high, but it was dwarfed by the amount of energy the whales got from their food. Based on known krill densities in the whales' feeding grounds, each lunge netted between 34,000 and 1,912,000 kJ – up to 237 times the energy used. Even when the energy costs of diving are included, the whales still gained 90 times the energy they used.

Shadwick says the results could explain how blue whales survive their migratory lifestyles. They feed in Antarctic waters in the summer, then head north to their tropical breeding grounds where little food is available. Even so, the females must still produce enormous volumes of milk for their calves. "This explains how they can cope with seasonal starvation," Shadwick says.

Foraging whales must have high densities of krill for their feeding methods to be effective, says Alejandro Acevedo-Gutiérrez of Western Washington University in Bellingham. Lunge feeders "have to get more bang for the time underwater, so to speak", he says.

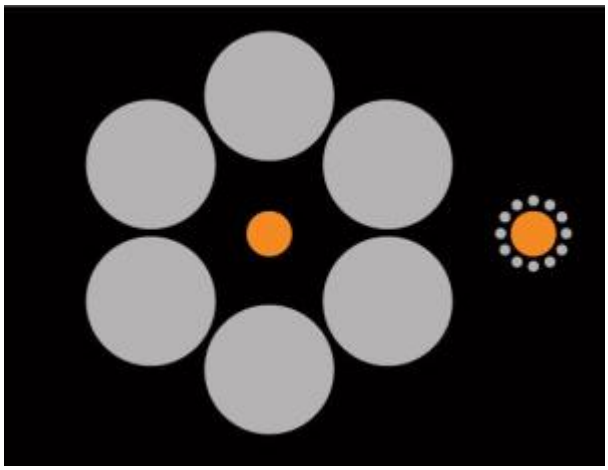
Journal reference: *Journal of Experimental Biology*, vol 214, p 131

http://www.newscientist.com/article/dn19841-blue-whale-feeding-methods-are-ultraefficient.html

**Bigger brains tricked by optical illusion**

- 17:37 07 December 2010 by **Jessica Hamzelou**

Magazine issue 2790.



Which orange circle looks bigger? (Image: Samuel Schwarzkopf)

Are the orange circles in this picture (right) different sizes? Your answer can reveal the size of your brain.

Most people perceive the central circle to be smaller, an effect known as the Ebbinghaus illusion. Samuel Schwarzkopf and colleagues at University College London created a series of images in which the relative sizes of the two circles varied, and asked 30 volunteers to estimate which of the two was larger.

The team then scanned each volunteer's brain using fMRI while they were shown a black dot in various points of their visual field. From the scans, they were able to assess the size of the visual cortex.

They found that people with a smaller visual cortex experienced the Ebbinghaus illusion more strongly.

Schwarzkopf suggests that this is because the circuits in the visual cortex responsible for the illusion are the same size in everyone, but cover a greater proportion of a smaller visual cortex, causing a stronger effect.

The team also found that people with a smaller visual cortex tended to have bigger brains overall, though it is not clear why.

Journal reference: *Nature Neuroscience*, DOI: 10.1038/nn.2706

http://www.newscientist.com/article/dn19823-bigger-brains-tricked-by-optical-illusion.html

**Genome pioneer: Make your genes public**

- 06 December 2010 by **Peter Aldhous**

Magazine issue 2789.

Genes on public display (Image: Beatrice de Gea)

***George Church*** *helped develop the technology that made sequencing human genomes affordable. Now he wants volunteers to open up their medical records. He tells* ***Peter Aldhous*** *why privacy is an outdated concept in medical research and how Ozzy Osbourne is a science educator*

**You head the Personal Genome Project. How will this lead towards personalised medicine?**

The goal is to collect genome, environment and trait data from as many people as possible, and provide that as an open resource for research. For example, someone who specialises in prosopagnosia - the inability to recognise faces - can find people with the condition in our project and study its causes.

**You were the first volunteer. How is recruitment coming along?**

So far we have 13,000 volunteers, of whom 1000 have their trait data online. Fifteen people have had their genomes completely sequenced or almost completely. We have a paper in review looking at these people and others with full genome sequences, analysing over 2000 genes that are highly predictive of future health.

**What will this achieve?**

When medical geneticists see patients, they have to do a deep dive into the scientific literature, spending hours figuring out what their genes mean for their health. Our paper is about making a system to turn personal genomic information into something you can act upon. It's like GPS. The first time I used a GPS device it told me where all the satellites were, and my coordinates. Now my GPS says, "Turn left", and I don't even need to know what street I'm on. Our genomic system will say, "Take this drug and not this one" or "Go get a mammogram".

I want a system that turns genome information into something you can act on

**Has it been hard to find volunteers willing to put their medical records and genome sequences online?**

No. To me it's inspiring that there are so many people willing to go ahead, because we make it very clear what the risks are. You have to pass an exam to show you understand this to get into the study. If you think that you are in danger of being discriminated against on the basis of your genome, then you shouldn't do this. Revealing names and faces is optional. Everything else is not.

It's very different from the promises of privacy in conventional research.

People who are concerned about their privacy probably shouldn't be volunteering for medical research. The idea that anonymity can be protected is from an era that is long gone, when people didn't have computers that allowed them to snoop around. False assurance of anonymity is really worse than no assurance.

**Even before this project, you put your own medical records and dietary information online. Are you an "information exhibitionist"?**

I'm actually fairly private. My impression is that people who volunteer to open their personal data for research are not exhibitionists so much as altruists. There is some privacy in numbers, though, because if there are enough of us sharing our medical records it becomes boring to look through them.

**Has any particular incident convinced you that providing open access to personal information brings more benefits than risks?**

I try not to make decisions based on anecdotes, but here's one that is interesting. In 2004, I was giving a lecture and a haematologist who had seen my web page told me I should get my cholesterol checked. He had seen I had a high reading and was taking a statin, and told me that statins sometimes cause tissue damage or may not work at the initial prescribed dose.

Sure enough, it turned out that the statin wasn't doing any good, and there was some tiny evidence of damage. So we doubled the dose, and I switched to a strict vegan diet. Then, to deal with the damage, I started supplementing my diet with co-enzyme Q10.

**Your records also reveal that you subsisted on a semi-synthetic diet based on corn starch for a number of years. Why was that?**

In the summer of 1974 I was taking a quantum physics course at the Massachusetts Institute of Technology and volunteered for a study into a diet low in the amino acid leucine. I learned a lot about nutrition, and I wanted to keep learning, so after the study was over I carried on with a similar diet but with normal leucine, trying to make sure I had everything that was necessary for life. Actually, I forgot something. One morning both of my calves cramped up simultaneously. I limped over to my desk and pulled out my diet sheet. I thought about muscle physiology, and oops, no potassium!

**Isn't going on a diet like that a bit extreme?**

I probably would admit that it's extreme today, but I was just curious. I was a teenager, and teenagers take risks. Instead of riding a motorcycle I participated in a study of leucine deficiency, and then, accidentally, in a study on potassium deficiency.

**Did conducting experiments in your personal life inform your approach to science?**

Somebody has to be a research subject and why shouldn't I, as a scientist? I felt it was a way of giving.

**Were there any setbacks in your early scientific career?**

It's easy to be dismissed as being unfocused, especially when you are young. I would occasionally get thrown out of class for asking questions that the lecturers didn't like. But more often I got into trouble for falling asleep, because I am narcoleptic. The combination of being distractable, inquisitive and sleepy is not ideal. I eventually flunked out of graduate school at Duke University. Fortunately, I had earlier turned down Harvard. I guess Harvard figured that they had accepted me once and I hadn't really changed. Actually, the only thing that had changed was that I had written five papers. They said, "You're in", and that was it.

**You are known for taking on a diverse range of projects. Where did that come from?**

I had this feeling that everything could be connected. When I hit college I found the killer example - crystallography - which combined physics, chemistry, computers, automation, biology and medicine. I decided that I was going to apply automation and computers to the rest of biology. Today I would describe my work as reading and writing genomes.

**There is an obvious comparison with Craig Venter. Do you see him as a rival?**

It's not a rivalry. It's mutual respect. I tend to make technology; he is more productive in using it. There are certain similarities, with us both making our genomes public. He did it first, partly because he could spend $500 million on his genome. I waited until we could publish it at $1500. I'm a cheapskate.

**Now the buzz is around synthetic life. Venter has transplanted a synthetic genome into a bacterial cell. What happened to your blueprint for building a completely artificial cell?**

We are looking at 150 genes that run the synthesis of DNA, RNA and proteins. They are probably sufficient to get evolution in an artificial cell. Where it stands now, although we haven't yet published, is that we have made synthetic ribosomes, which make proteins. We haven't yet made a self-replicating ribosome, but once we do, wrap that in a membrane and you have got something that is isolated and can presumably evolve. That's not a primary objective, though. We are more interested in using synthetic ribosomes to make new polymers.

**Recently, your company Knome sequenced Ozzy Osbourne's genome. Was this just a publicity stunt?**

Ozzy has an audience. I'm an educator and I believe in educating more than a few students in class. One finding was that I have three times as much Neanderthal DNA as him. It's silly, but in a good way. I think it is important for us to realise that we are not the only humans that have ever existed. One of Ozzy's quotes was that if Neanderthals could get laid then there's hope for us all!

**Profile**

George Church heads the Center for Computational Genetics at Harvard Medical School in Boston. He gained his PhD at Harvard University in the lab of Nobel prizewinner Walter Gilbert and made his name developing improved technologies for sequencing and synthesising DNA

http://www.newscientist.com/article/mg20827890.900-genome-pioneer-make-your-genes-public.html

**Royal Parks to feature Greenwich design**

09 December 2010 Greenwich, University of

Water fountain close up

A University of Greenwich lecturer has been named joint winner of an international design competition to find 'The Ultimate Drinking Fountain' for London's eight Royal Parks.

Mark Titman's design, *Watering Holes*, was chosen along with *Trumpet,* by Ben Addy, from over 150 entries from 26 countries, with the judges unable to split the two. The designs will be unveiled as prototypes next year before the final pieces are installed in London's eight royal parks; St James's, Regent's, Hyde, Green, Kensington Gardens, Greenwich, Richmond, and Bushy.

Mark, who is a part-time lecturer at the university's School of Architecture & Construction, says: "Having won, I feel encouraged that there remains civic pride in this marvellous city. So much effort and money is spent on the built environment lately with little care for the person on the pavement.

"My first response to the brief was to ask, what is a water fountain? I answered this by suggesting it was a civic monument and that it offered a delightful connection between the drinker and the natural elements. I came up with the design after meeting architect Robin Monotti in Hyde Park and looking at an ancient sundial which was a block of stone with an engraved hole carved into it. From there I developed the notion of two or more holes.

"The references to the monolith in *2001: A Space Odyssey*, standing stones, grottoes, sculpture and seaside photo panels in which you insert your head all showed our proposal to be one of both contemporary delight and timeless classicism.

"Water fountains save energy and prevent pollution by reducing the need for water bottles which consume energy in their production and are the cause of much litter in our parks. Therefore it is hoped the fountains will re-emerge as an engaging and sustainable addition to our cities and parks."

The competition, called *Tiffany - Across the Water,* has been organised by the Royal Parks Foundation, the charity for London's eight Royal Parks, in partnership with the Royal Institute of British Architects (RIBA) and is mainly funded by the Tiffany & Co. Foundation, the charitable arm of the famous jewelers.

Sara Lom, CEO of the Royal Parks Foundation says: "We are staggered by the response to the competition and grateful to the Tiffany & Co. Foundation for this unique opportunity to restore and renew historic water features across the 5,000 acres of The Royal Parks. The new drinking fountain will benefit millions of runners, walkers, riders, cyclists and other visitors to The Royal Parks and will, we hope, be adopted by other green spaces around the world."

http://www2.gre.ac.uk/about/news/articles/latest/royal-parks-to-feature-greenwich-design

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91823&CultureCode=en

**Souring on Business?**
December 13, 2010

Conventional wisdom has held that legions of college students have long opted to pursue business majors as a means to advance themselves economically -- and that wintry job markets motivate even more students to choose finance over philosophy.

But as the current economic downturn drags on and hiring continues to lag, interest in business among undergraduates appears to be static, even flagging in some circles, according to federal and college data and a nationwide survey of incoming freshmen.

The drop has been particularly stark at Pennsylvania State University, which, since 2008, has seen a 30 percent decline in undergraduates accepting offers from its Smeal College of Business, said Anne Rohrbach, executive director of undergraduate admissions. “Fewer students see that a business degree guarantees career and financial returns,” she said via e-mail. She attributed this decrease, in part, to Smeal limiting its enrollment and admitting students with a stronger record of academic achievement, which can depress yield rates. But the number of applications to Penn State's program during this period has dropped by nearly the same percentage as acceptances, she said.

Rohrbach also thinks the larger economic picture has played a role. “With the headline news of the recession, students are not as certain about a future in business," she said. The ranks of the undeclared, always well-populated, have grown, she said, as a result of the uncertain job market.

Penn State is not alone. The share of business majors in the University of Central Florida's undergraduate student body is down by nearly 15 percent this semester relative to 2008. At Purdue University, nearly 13 percent fewer students enrolled at the Krannert School of Management this semester compared to two years ago, and in 2009 the number of applicants dropped 26 percent from the year previous before edging back up this year. The tumult in the business world has made students and their parents more wary about job prospects after graduation, said Mitch Warren, senior associate director of admissions at Purdue. "There are cyclical trends in many areas; business is no different," said Warren, who added that these cycles of popularity need to be seen as part of a longer-term pattern of natural ups and downs. "Things that are doing quite well now in five or six years might not be."

Still, such shifts are by no means universal; elsewhere, enrollments have been stable or even climbed modestly, as at the University of Oregon and Indiana University.

But beneath such anecdotes lies a more notable and widespread change, according to researchers from the Higher Education Research Institute at the University of California at Los Angeles. Researchers gathered data from nearly 220,000 first-year students at almost 300 colleges, and asked what major and career path they planned to pursue. Results in 2009 revealed that 14.4 percent of first-year students planned to major in business -- a more than 3 percentage-point drop since 2006 -- and a low not seen since the Ford Administration. "They will likely be graduating with higher debts and have shifted majors and career aspirations away from business fields," researchers wrote in their summary of findings from the American Freshman survey.

**Percentage of Freshmen Interested in Business as a...**

| | 1974 | 1978 | 1981 | 1984 | 1987 | 1990 | 1993 | 1997 | 2000 | 2003 | 2006 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Major | 14.0% | 20.4% | 21.9% | 24.7% | 25.7% | 21.0% | 14.8% | 15.6% | 16.8% | 15.8% | 18.0% | 14.4% |
| Career | N/A | 18.3% | 19.6% | 22.3% | 24.2% | 19.2% | 13.9% | 14.6% | 15.2% | 13.6% | 15.6% | 12.1% |

John Pryor, director of the Cooperative Institutional Research Program at UCLA, which administers the survey, suggested that not just debt, but also the perceived lack of career stability in business may be fueling this shift. "Even though students have higher debt, some are seeing that business is not as likely to help them pay that debt back," Pryor wrote in an e-mail. "We also saw business employees losing jobs and having lower incomes, so perhaps students see business as not providing as sure a track towards economic freedom as in the past."

At the same time, it is unclear whether business degrees are any less desirable than they were before. "In terms of the job outlook, while our surveys show that overall demand has risen/fallen with the economy, business majors are consistently cited as among the majors employers expect to target," Mimi Collins, director of communications for the National Association of Colleges and Employers, wrote in an e-mail.

The Association to Advance Collegiate Schools of Business strongly cautioned against reading too much into the future plans of first-year students, and said that interest in the major remained strong. "We graduate far more students than indicated interest coming in," said Jerry Trapnell, executive vice president and chief accreditation officer of the AACSB. He added that he had seen no real dip among the 400 business schools in the U.S. that have been accredited by his association (he estimated that there are approximately 1,800 such programs, in total, operating nationwide).

"We haven't seen a decline in undergraduates. I've talked to a lot of deans," Trapnell said. "I can count on one hand the number saying that the number of students has dropped. Most say it's up, or level, or strong."

Nor has the shift in interest away from business at the front of the pipeline translated into a marked change at the other end. While students may not think they want to major in business when they start college, many still choose that path by the end of their undergraduate careers. About 21 percent of bachelor's degrees awarded in 2008 were in business, a rate that has remained essentially unchanged since 2001, according to the National Center for Education Statistics's higher education general information survey. It is worth noting, however, that graduates in 2008 would have declared their intent to major in business by 2006, if not sooner -- well before the financial sector's collapse. In addition, it will be several years before the rate of bachelor's degrees awarded in the field will register the impact -- if any -- of the drop in first-year interest.

Many disciplines experience ebbs and flows in popularity. The future health of the humanities lately has generated concern. Tightening budgets and the shaky economy add another layer of complexity, and business programs are not immune. "Yes, business schools are affected by the economy somewhat, but we have not seen a precipitous drop in enrollment at this stage -- that we can foresee or tell," said Trapnell. He also said that the share of business majors tends to run counter to the cycles of recession and booms.

The longer-term pattern described in federal statistics and in UCLA's survey suggests that interest in business peaked a long time ago -- in the late 1980s. It was in 1987 that the share of incoming freshmen who planned to major in business reached its highest point, at more than 25 percent -- a far cry from the 14.4 percent planning to do so in 2009. About 24 percent of freshmen in 1987 said they planned to launch a career in business, which was double the percentage of those expressing similar plans in 2009, according to UCLA's survey. In fact, 2009 marked the lowest share of freshmen to articulate that planned career path since 1976, when UCLA began asking first-year students about their career aspirations.

At the back end of the pipeline, the percentage of bachelor's degrees awarded also hit its high-water mark in the late 1980s, shooting from 15.5 percent in 1976 to 24 percent a decade later. In the early 1990s, the share of bachelor's degrees awarded in business crept down slightly, to about 21 percent, where it has remained ever since, through booms and busts -- albeit with another drop later that decade, since recovered.

It is unclear what made the late 1980s the heyday for interest in business. Some have suggested that this was the decade when the status of CEOs shifted in the popular imagination from corporate steward to rock star.

After all, 1987 was the year that Michael Douglas, portraying corporate raider Gordon Gekko in the first *Wall Street* film, declared that "greed, for lack of a better word, is good."

E.J. Reedy, manager of research and policy for the Ewing Marion Kauffman Foundation, has analyzed the UCLA data and said finds the upsurge of interest in the 1980s puzzling. He also suggested that recent shifts away from a formal business major may reflect a difference in emphasis and avenue more than anything else, because college-age students continue to express a strong desire to start their own ventures. A recent survey of 1,000 18-to-24-year-olds revealed that four out of 10 respondents wanted to start, or already have started, businesses of their own -- and that the most common reason for wanting to do so was to build something for the future. "I think today's youth have a lot of interest in making an impact on the world," said Reedy. "It can happen through business and through the nonprofit sector. There are a lot of different avenues."

Or perhaps Gordon Gekko has been replaced in the popular imagination by Bill Gates or Mark Zuckerberg -- information-age iconoclasts who studied computer science, not business (and dropped out of college, by the way), to become corporate titans. The trajectories mapped out by these CEOs are anomalies -- most entrepreneurs don't launch their businesses until 10 or 15 years after they graduate, and they tend to be more successful if they are more educated, said Reedy.

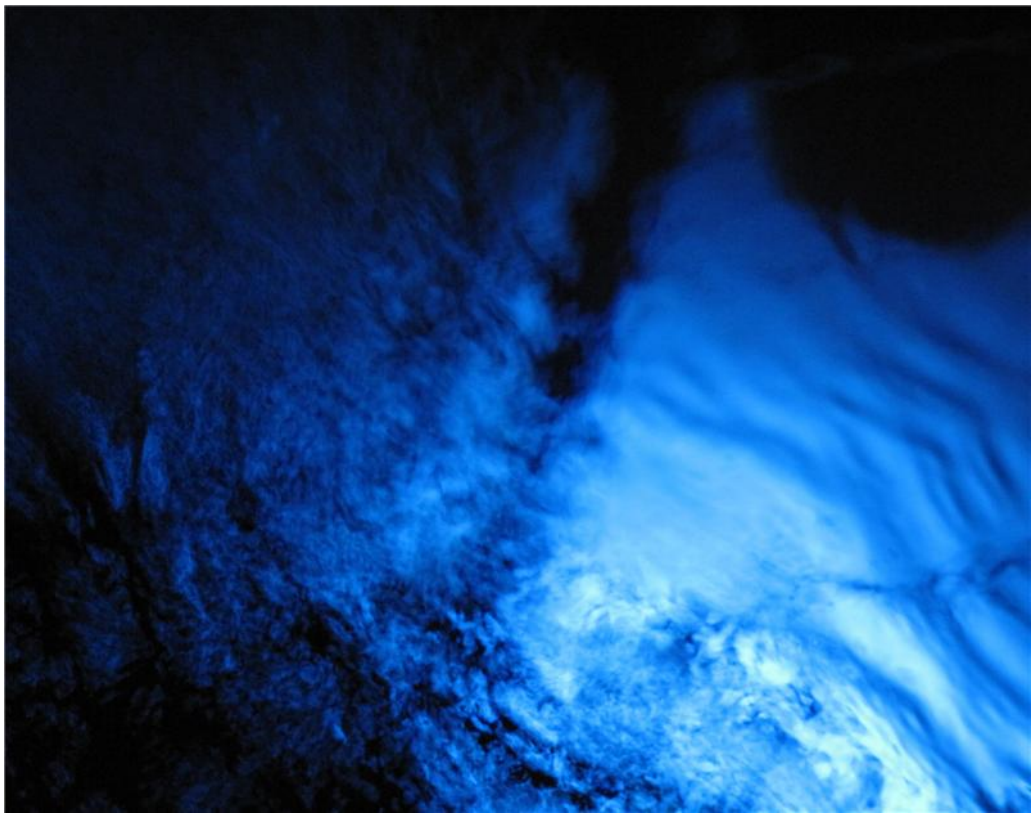
But the path to riches trodden by Gates and Zuckerberg has not gone unnoticed by students. According to the American Academy of Arts and Sciences, it is not business, but the sciences -- a broad category encompassing behavioral, health, life, medical, and physical sciences -- that now command the greatest share of bachelor's degrees.

— Dan Berrett

**http://www.insidehighered.com/layout/set/print/news/2010/12/13/business**

**Diamond detectors provide a glimpse into artificial suns**

09 December 2010 Soltan Institute for Nuclear Studies (IPJ)



The glow of Cherenkov radiation visible in water in a traditional nuclear reactor. In the picture: the pool in the MARIA research nuclear reactor – IEA Polatom in Świerk. (Source: Jan Anderman)

*Unique Cherenkov detectors for measurements of electron beams in thermonuclear installations of the tokamak type are being developed at the Institute for Nuclear Studies in Świerk. Tests conducted this year in the Tore Supra tokamak in Cadarache, France revealed that the device constructed by Polish physicists might be useful for investigating the extreme physical conditions inside the largest present-day installations, which will form the basis of future fusion energy reactors, commonly known as artificial suns.*

Cherenkov detectors for measurements of electron beams constructed at the Institute for Nuclear Studies (IPJ) in Świerk underwent tests in the French Tore Supra tokamak at the research centre in Cadarache, this year. Concluded several days ago, a recent series of experiments revealed that the scientists from IPJ are the only ones in the world who can built Cherenkov detectors that might be useful for investigating the extreme physical conditions in the immediate vicinity of plasma almost as hot as the one inside the Sun. Thermonuclear fusion is the energy source of the stars. The synthesis process consists in the merging of the nuclei of light elements, usually isotopes of hydrogen, to create heavier nuclei. The resulting products have a lower mass than the sum of the masses of the constituents. The excess mass is converted to large amounts of energy, as stated in the famous Einstein's formula. To conduct controlled thermonuclear fusion would be to ensure energy security for thousands of years to come. It is worthy of note that the energy would be both clean and safe. For atomic nuclei to fuse, the electrostatic repulsion between them must be overcome. To that

end, hydrogen fuel needs to attain the same temperature as the plasma inside the stars – that is the temperature of at least hundreds or so million degrees.

Attempts are currently being made to produce controlled thermonuclear fusion in tokamaks – devices with a toroidal (donut-shaped) vacuum chamber surrounded by strong magnetic fields. Plasma, which consists of free electrons and the nuclei of isotopes of hydrogen stripped of electrons, is compressed by the magnetic field. An electric current of intensity exceeding one million amperes is driven through the plasma. The magnetic field of the electric current along with the magnetic field generated by the coils of the tokamak form a magnetic trap to confine the plasma in the torus. The difficult technical issue of controlling such plasma has long exercised the minds of physicists. There are a great many problems to solve – one of the most pressing being the electron beams generated during discharge. The uncontrolled electron beams that escape the plasma region have already caused severe damage to chamber walls in experimental reactors in operation. Hence, physicists and constructors are seeking ways to gain direct insight into the reaction area, which would allow to gain a better understanding of the processes that occur during the reactions and provide solutions to the adverse phenomena.

Several years ago the scientists from the Institute for Nuclear Studies in Świerk put forward a proposal to construct detectors that would apply Cherenkov effect to investigate electron beams that escape the plasma region in tokamaks. “Cherenkov radiation is emitted when a charged particle passes through a medium at a speed greater than the phase velocity of light in that medium,” explains Jarosław Żebrowski, PhD, from IPJ. The particle – for example an electron losing energy – travels at such a high speed that the crests of the light waves it emits begin to overlap in the medium. The formed front is the electromagnetic equivalent of the shock wave that occurs when an aircraft exceeds the speed of sound in the air. In the case of an electromagnetic wave in a medium such as water or diamond, the front may be visible as a blue-green glow – Cherenkov radiation. It was first observed in 1934.
As the physical conditions inside a tokamak are extremely adverse to measuring devices, the materials used to construct Cherenkov detectors need to be characterized by high melting temperature and high thermal conductivity. At the same time, their high refractive index would ensure that Cherenkov radiation is emitted even by relatively low-energy electrons. Therefore, the physicists from IPJ opted for diamond crystals to construct a detector for the French Tore Supra tokamak.

The extreme working conditions of the detector posed plenty of difficulties for the constructors. It proved necessary to develop special methods for fixing the position of the crystals (in the present-day version of the detector there is a set of four diamonds operating), connecting the crystals to optical fibres leading to photomultipliers and screening the diamonds from other sources of radiation that could affect the precision of electron beam measurements. “Yet the problems do not end here. The signals need to leave the reactor chamber, which is characterized by high vacuum, and be transmitted at a distance of several dozens of meters to the control room. There they need to be registered by photomultipliers and electronic systems with a short reaction time,” stresses Lech Jakubowski from IPJ, PhD, the head of the project.

The Polish detector crystal has a size of millimetres, good spatial resolution and extremely short response time of approximately several billionths of a second. The aforementioned features allow to take precise measurements of electron beam parameters. The device is mounted on a 3 meters long movable probe. The probe is inserted through a diagnostic port into the vicinity of the plasma for a period as short as 0,1 s. Having been removed and cooled down, the probe may be reinserted. “One discharge in the Tore Supra tokamak may last six minutes. During this period, our detector can take up to over a dozen measurements,” reveals professor Marek Sadowski from IPJ.

Research into the application of Cherenkov radiation in investigating the conditions prevailing in tokamak chambers has been conducted at the Institute for Nuclear Studies in Świerk for over six years. The idea has been tested in increasingly larger tokamaks, initially in the CASTOR tokamak in Prague, at a later stage in the ISTTOK tokamak in Lisbon and presently in the Tore Supra in Cadarache. The results of the first

measurements in the French tokamak have already been published in the prestigious journal Review of Scientific Instruments. Data analysis of the most recent measurement session is currently under way.
"The tests conducted this year reveal that we are the only ones who can construct Cherenkov detectors that might be useful for investigations in the most powerful tokamaks in the world," concludes Marek Rabiński, PhD, the head of the Department of Plasma Physics and Material Engineering IPJ. The experience gained in the recent years in increasingly larger tokamaks allows Polish physicists to be optimistic about the prospects of constructing at the Institute for Nuclear Studies in Świerk detectors intended for the future thermonuclear reactor ITER developed in Cadarache at a cost over 10 billion euros.

Research into Cherenkov detectors for measurements in tokamaks conducted at IPJ is funded by EURATOM, an organisation, governed by the EU institutions, coordinating European research into controlled nuclear fusion.

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91805&CultureCode=en

**Platinum and Blue Light Combine to Combat Cancer**

09 December 2010 Warwick, University of

Professor Peter Sadler, University of Warwick

When it comes to health care blue lights, are usually most useful on the top of ambulances but now new research led by the University of Warwick has found a way to use blue light to activate what could be a highly potent platinum-based cancer treatment.

Research led by the University of Warwick, along with researchers from Ninewells Hospital Dundee, and the University of Edinburgh, have found a new light-activated platinum-based compound that is up to 80 times more powerful than other platinum-based anti-cancer drugs and which can use "light activation" to kill cancer cells in a much more targeted way than similar treatments.

The University of Warwick team had already found a platinum-based compound that they could activate with ultra-violet light but that narrow wave length of light would have limited its use. Their latest breakthrough has discovered a new platinum based compound known as *trans,trans,trans*-$[Pt(N_3)_2(OH)_2(py)_2]$ that can be activated by normal visible blue, or even green, light. It is also stable and easy to work with, and it is water soluble so it can simply dissolve and be flushed out of the body after use.

The University of Warwick researchers passed the new compound to colleagues at Ninewells Hospital Dundee, who tested it on oesophageal cancer cells cultivated within lab equipment. Those tests show that once activated by blue light the compound was highly effective requiring a concentration of just 8.4 micro moles per litre to kill 50% of the cancer cells. The researchers are also beginning to examine the compound's

effectiveness against ovarian and liver cancer cells. Early results there are also excellent but that testing work is not yet complete.

Professor Peter Sadler, from the Department of Chemistry from University of Warwick, who led the research project, said:

"This compound could have a significant impact on the effectiveness of future cancer treatments. Light activation provides this compound's massive toxic power and also allows treatment to be targeted much more accurately against cancer cells."

"The special thing about our complex is that it is not only activated by ultra-violet light, but also by low doses of blue or green light. Light activation generates a powerful cytotoxic compound that has proven to be significantly more effective than treatments such as cisplatin."

We believe that photoactivated platinum complexes will make it possible to treat cancers that have previously not reacted to chemotherapy with platinum complexes," says Sadler. "Tumors that have developed resistance to conventional platinum drugs could respond to these complexes and with less side-effects."

This research has been supported by the EPSRC, MRC, ERC and Science City (ERDF/AWM).

http://www2.warwick.ac.uk/newsandevents/pressreleases/platinum_and_blue

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91802&CultureCode=en

**Tracing the Spark of Creative Problem-Solving**

**By BENEDICT CAREY**

The puzzles look easy, and mostly they are. Given three words — "trip," "house" and "goal," for example — find a fourth that will complete a compound word with each. A minute or so of mental trolling (housekeeper, goalkeeper, trip?) is all it usually takes.

But who wants to troll?

Let lightning strike. Let the clues suddenly coalesce in the brain — "field!" — as they do so often for young children solving a riddle. As they must have done, for that matter, in the minds of those early humans who outfoxed nature well before the advent of deduction, abstraction or SAT prep courses. Puzzle-solving is such an ancient, universal practice, scholars say, precisely because it depends on creative insight, on the primitive spark that ignited the first campfires.

And now, modern neuroscientists are beginning to tap its source.

In a just completed study, researchers at Northwestern University found that people were more likely to solve word puzzles with sudden insight when they were amused, having just seen a short comedy routine.

"What we think is happening," said Mark Beeman, a neuroscientist who conducted the study with Karuna Subramaniam, a graduate student, "is that the humor, this positive mood, is lowering the brain's threshold for detecting weaker or more remote connections" to solve puzzles.

This and other recent research suggest that the appeal of puzzles goes far deeper than the dopamine-reward rush of finding a solution. The very idea of doing a crossword or a Sudoku puzzle typically shifts the brain into an open, playful state that is itself a pleasing escape, captivating to people as different as Bill Clinton, a puzzle addict, and the famous amnesiac Henry Molaison, or H.M., whose damaged brain craved crosswords.

And that escape is all the more tantalizing for being incomplete. Unlike the cryptic social and professional mazes of real life, puzzles are reassuringly soluble; but like any serious problem, they require more than mere intellect to crack.

"It's imagination, it's inference, it's guessing; and much of it is happening subconsciously," said Marcel Danesi, a professor of anthropology at the University of Toronto and the author of "The Puzzle Instinct: The Meaning of Puzzles in Human Life."

"It's all about you, using your own mind, without any method or schema, to restore order from chaos," Dr. Danesi said. "And once you have, you can sit back and say, 'Hey, the rest of my life may be a disaster, but at least I have a solution.' "

For almost a century scientists have used puzzles to study what they call insight thinking, the leaps of understanding that seem to come out of the blue, without the incremental drudgery of analysis.

In one classic experiment, the German psychologist Karl Duncker presented people with a candle, a box of thumbtacks and the assignment of attaching the candle to a wall. About a quarter of the subjects in some studies thought to tack the box to the wall as a support — some immediately, and others after a few failed efforts to tack wax to drywall.

The creative leap may well be informed by subconscious cues. In another well-known experiment, psychologists challenged people to tie together two cords; the cords hung from the ceiling of a large room, too far apart to be grabbed at the same time.

A small percentage of people solved it without any help, by tying something like a pair of pliers to one cord and swinging it like a pendulum so that it could be caught while they held the other cord. In some experiments researchers gave hints to those who were stumped — for instance, by bumping into one of the strings so that it swung. Many of those who then solved the problem said they had no recollection of the hint, though it very likely registered subconsciously.

All along, researchers debated the definitions of insight and analysis, and some have doubted that the two are any more than sides of the same coin. Yet in an authoritative review of the research, the psychologists Jonathan W. Schooler and Joseph Melcher concluded that the abilities most strongly correlated with insight problem-solving "were not significantly correlated" with solving analytical problems.

Either way, creative problem-solving usually requires both analysis and sudden out-of-the-box insight.

"You really end up toggling between the two, but I think that they are truly different brain states," said Adam Anderson, a psychologist at the University of Toronto.

At least, that is what brain-imaging studies are beginning to show. At first, such studies did little more than confirm that the process was happening as expected: brain areas that register reward spiked in activity when people came up with a solution, for instance..

Yet the "Aha!" moment of seeing a solution is only one step along a pathway. In a series of recent studies, Dr. Beeman at Northwestern and John Kounios, a psychologist at Drexel University, have imaged people's brains as they prepare to tackle a puzzle but before they've seen it. Those whose brains show a particular signature of preparatory activity, one that is strongly correlated with positive moods, turn out to be more likely to solve the puzzles with sudden insight than with trial and error (the clues can be solved either way).

This signature includes strong activation in a brain area called the anterior cingulate cortex. Previous research has found that cells in this area are active when people widen or narrow their attention — say, when they filter out distractions to concentrate on a difficult task, like listening for a voice in a noisy room. In this case of insight puzzle-solving, the brain seems to widen its attention, in effect making itself more open to distraction, to weaker connections..

"At this point we have strong circumstantial evidence that this resting state predicts how you solve problems later on," Dr. Kounios said, "and that it may in fact vary by individual."

The punch line is that a good joke can move the brain toward just this kind of state. In their humor study, Dr. Beeman and Dr. Subramaniam had college students solve word-association puzzles after watching a short video of a stand-up routine by Robin Williams. The students solved more of the puzzles over all, and significantly more by sudden insight, compared with when they'd seen a scary or boring video beforehand.

This diffuse brain state is not only an intellectual one, open to looser connections between words and concepts. In a study published last year, researchers at the University of Toronto found that the visual areas in people in positive moods picked up more background detail, even when they were instructed to block out distracting information during a computer task.

The findings fit with dozens of experiments linking positive moods to better creative problem-solving. "The implication is that positive mood engages this broad, diffuse attentional state that is both perceptual and visual," said Dr. Anderson. "You're not only thinking more broadly, you're literally seeing more. The two systems are working in parallel."

The idea that a distracted brain can be a more insightful one is still a work in progress. So, for that matter, is the notion that puzzle-solving helps the brain in any way to navigate the labyrinth of soured relationships, uncertain career options or hard choices that so often define the world outside.

But at the very least, acing the Saturday crossword or some mind-bending Sudoku suggests that some of the tools for the job are intact. And as any puzzle-head can attest, that buoyant, open state of mind isn't a bad one to try on for size once in a while. Whether you're working a puzzle or not.

http://www.nytimes.com/2010/12/07/science/07brain.html?_r=1&nl=health&emc=healthupdateema2

**On a Hunt for What Makes Gamers Keep Gaming**

**By JOHN TIERNEY**

By the age of 21, the typical American has spent 10,000 hours playing computer games, and endured a smaller but much drearier chunk of time listening to sermons about this sinful habit. Why, the experts wail, are so many people wasting their lives solving meaningless puzzles in virtual worlds?

Now some other experts — ones who have actually played these games — are asking more interesting questions. Why are these virtual worlds so much more absorbing than school and work? How could these gamers' labors be used to solve real-world puzzles? Why can't life be more like a video game?

"Gamers are engaged, focused, and happy," says Edward Castronova, a professor of telecommunications at Indiana University who has studied and designed online games. "How many employers wish they could say that about even a tenth of their work force?

"Many activities in games are not very different from work activities. Look at information on a screen, discern immediate objectives, choose what to click and drag."

Jane McGonigal, a game designer and researcher at the Institute for the Future, sums up the new argument in her coming book, "Reality Is Broken: Why Games Make Us Better and How They Can Change the World." It's a manifesto urging designers to aim high — why not a Nobel Prize? — with games that solve scientific problems and promote happiness in daily life.

In the past, puzzles and games were sometimes considered useful instructional tools. The emperor Charlemagne hired a scholar to compile "Problems to Sharpen the Young," a collection of puzzles like the old one about ferrying animals across a river (without leaving the hungry fox on the same bank as the defenseless goat). The British credited their victory over Napoleon to the games played on the fields of Eton.

But once puzzles and gaming went digital, once the industry's revenues rivaled Hollywood's, once children and adults became so absorbed that they forsook even television, then the activity was routinely denounced as "escapism" and an "addiction." Meanwhile, a few researchers were more interested in understanding why players were becoming so absorbed and focused. They seemed to be achieving the state of "flow" that psychologists had used to describe master musicians and champion athletes, but the gamers were getting there right away instead of having to train for years.

One game-design consultant, Nicole Lazzaro, the president of XEODesign, recorded the facial expressions of players and interviewed them along with their friends and relatives to identify the crucial ingredients of a good game. One ingredient is "hard fun," which Ms. Lazzaro defines as overcoming obstacles in pursuit of a goal. That's the same appeal of old-fashioned puzzles, but the video games provide something new: instantaneous feedback and continual encouragement, both from the computer and from the other players.

Players get steady rewards for little achievements as they amass points and progress to higher levels, with the challenges becoming harder as their skill increases.

Even though they fail over and over, they remain motivated to keep going until they succeed and experience what game researchers call "fiero." The term (Italian for "proud") describes the feeling that makes a gamer lift both arms above the head in triumph.

It's not a gesture you see often in classrooms or offices or on the street, but game designers like Dr. McGonigal are working on that. She has designed Cruel 2 B Kind, a game in which players advance by being nice to strangers in public places, and which has been played in more than 50 cities on four continents.

She and her husband are among the avid players of Chorewars, an online game in which they earn real rewards (like the privilege of choosing the music for their next car ride) by doing chores at their apartment in San Francisco. Cleaning the bathroom is worth so many points that she has sometimes hid the toilet brush to prevent him from getting too far ahead.

Other people, working through a "microvolunteering" Web site called Sparked, are using a smartphone app undertake quests for nonprofit groups like First Aid Corps, which is compiling a worldwide map of the locations of defibrillators available for cardiac emergencies. Instead of looking for magical healing potions in virtual worlds, these players scour buildings for defibrillators that haven't been cataloged yet. If that defibrillator later helps save someone's life, the player's online glory increases (along with the sense of fiero).

To properly apply gaming techniques to school and work and other institutions, there are certain core principles to keep in mind, says Tom Chatfield, a British journalist and the author of "Fun Inc.: Why Gaming Will Dominate the Twenty-First Century." These include using an "experience system" (like an avatar or a profile that levels up), creating a variety of short-term and long-term goals, and rewarding effort continually while also providing occasional unexpected rewards.

"One of the most profound transformations we can learn from games," he says, "is how to turn the sense that someone has 'failed' into the sense that they 'haven't succeeded yet.'"

Some schools are starting to borrow gamers' system of quests and rewards, and the principles could be applied to lots of enterprises, especially colossal collaborations online. By one estimate, Dr. McGonigal notes, creating Wikipedia took eight years and 100 million hours of work, but that's only half the number of hours spent in a single week by people playing World of Warcraft.

"Whoever figures out how to effectively engage them first for real work is going to reap enormous benefits," Dr. McGonigal predicts.

Researchers like Dr. Castronova have already benefited by tracking the economic transactions and social behavior in online games. Now that Facebook and smartphones have enabled virtual communities to be created fairly cheaply, Dr. Castronova is hoping to build a prototype that could be adapted by researchers studying a variety of real-world problems.

"Social media like video games are the only research tool we've ever had that lets us do controlled experiments on large-scale problems like global warming, terrorism and pandemics," Dr. Castronova says. "Not everything in virtual environments maps onto real behavior, but a heck of a lot does. Rules like 'buy low, sell high' and 'tall people are sexier' play out exactly the same way, whether the environment is virtual or real."

Dr. Castronova envisions creating financial games to study how bubbles and panics occur, or virtual cities to see how they respond to disasters.

"One reason that policy keeps screwing up — think Katrina — is because it never gets tested," he says. "In the real world, you can't create five versions of New Orleans and throw five hurricanes at them to test different logistics. But you can do that in virtual environments."

Well, you can do it as long as there enough players in that virtual New Orleans who are having enough fun to keep serving as unpaid lab rats. Researchers will need the skills exhibited by Tom Sawyer when he persuaded his friends it would be a joyous privilege to whitewash a fence.

Tom discovered, as Twain explained, "that Work consists of whatever a body is *obliged* to do, and that Play consists of whatever a body is not obliged to do." The ultimate challenge, when trying to extract work from the World of Warcraft questers and other players, will be persuading them that it's still just a game.

http://www.nytimes.com/2010/12/07/science/07tierney.html?ref=science

**Eye for Art and Artistry Amid Jigsaw's Jumble**

**By JENNIFER A. KINGSON**

When I was in elementary school, holiday time meant visiting my grandparents and doing the Mushroom Puzzle. I would hide the last piece in my fist, and my grandmother would scour the floor for it. Then I would magically reveal it and snap it in place.

My mother would sometimes pitch in — a jigsaw ringer — but the men of the house steered clear. My father, who can calculate all kinds of math problems in his head, would claim that he was no good at spatial relations. My grandfather showed no interest.

Jigsaws have their frustrating side. They are often used in intelligence tests, and their origins are pedagogical: the earliest wooden puzzles, from the 18th century, were dissected maps meant to teach geography to the children of aristocrats.

Then a funny thing happened: jigsaws turned into adult playthings, so popular in the 1930s that there were lending libraries of them where the pieces were counted after each puzzle was returned. Anne D. Williams, a jigsaw historian, cites several reasons for the change, including the introduction in the 1870s of a foot-powered fret saw that turned well-off American women into wood-cutting hobbyists.

From there, puzzle makers started using grown-up images, including political cartoons, on their creations, and glamorous people would hold dinner parties where guests competed to put puzzles together.

For some people, jigsaws easily inspire obsession. Ms. Williams — who is arguably the queen of the jigsaw world — owns 10,000 puzzles and has a room in her Lewiston, Me., home for them.

"I like the wooden ones that are manufactured with saws, because to me there's a reflection of the puzzle creator in the puzzle itself," said Ms. Williams, a retired professor of economics at Bates College. "There's sort of a little long-distance dance going on between the person who made the puzzle and the person who is trying to solve it."

John S. Stokes III, of San Diego, who cuts dazzlingly intricate puzzles by hand, would agree. Sometimes he deliberately leaves wavy or irregular borders to thwart people who like to put the edge pieces together first.

“By far the hardest-to-assemble puzzle I ever made was a transparent plastic puzzle with nearly identically shaped pieces,” said Mr. Stokes, 60, who turned to puzzle cutting after a career in computer programming. “Also, you can’t tell which side is up.”

At age 4, Mr. Stokes said, he was putting together 500-piece puzzles. He turned professional about 10 years ago, spending long days guiding pieces of wood into the stationary blade of a scroll saw. “It’s very much like a sewing machine,” he observed.

Among the more spectacular puzzles he has created — all of which are pictured on custompuzzlecraft.com — was a map of the world that had 1,384 pieces and measured nearly three feet long; it took three weeks to cut, he said. His largest puzzle was a four-and-a-half-foot triptych of Hieronymus Bosch’s “Garden of Earthly Delights,” with 4,271 pieces. It sold on eBay for $25,100.

Each panel of the Bosch puzzle was cut in a different style: one in what Mr. Stokes refers to as “swirl curl,” a second in “long round” and a third in “creative.” These idiosyncratic styles — a far cry from the simple grid patterns used by commercial puzzle manufacturers — take varying amounts of time and energy. Mr. Stokes charges $1.10 per piece for his long round style and $3 a piece for the creative style.

Another puzzle cutter, Mark G. Cappitella of East Haddam, Conn., sometimes uses a style so infuriatingly difficult that he calls it “nightmare.” His largest puzzle measured eight feet long and sold for more than $10,000, he said.

A video on Mr. Cappitella’s Web site shows him rapidly twisting flat pieces of birch around a vertical saw blade. As a child, he said, he drew elaborate mazes on the back of his school notebooks; later, he studied architectural drawing.

“I can typically cut between 120 and 150 pieces per hour, depending on what is involved,” Mr. Cappitella said. “The only thing I ever plan out in advance is the personalization of the puzzle.”

That stage involves designing the figural pieces that are cut to in recognizable shapes: a cat, the sun, a ballerina and so on. They tend to be favorite pieces among puzzle fans; they are certainly mine. The nicest puzzle in my collection comes in an unmarked box (no picture for guidance) and turns into a snow scene replete with figurals: a sword, a musical note, a heart.

No jig saws are involved in the cutting of jigsaw puzzles. Cutters who work by hand use scroll saws for a more delicate cut. Other artisans create a design on a computer and send the image to a laser cutter, which carves it into a slab of wood — sort of like printing a document. A few puzzle makers use a high-pressure water jet to cut their wood.

Mass-market puzzle makers — who use metal dies to press a design into a piece of paperboard — say their sales have risen during the recession. Springbok has seen sales grow nearly 20 percent in each of the last two years, said Steven Pack, president of Allied Products of Kansas City, Mo., which owns Springbok. That is up from the 12 to 13 percent growth that Allied had been seeing since 2002, when it bought Springbok from Hallmark.

“One of the possible reasons for a jigsaw puzzle resurgence is it gets people sitting and talking,” said Christopher W. Wirth, 43, the founder of Liberty Puzzles in Boulder, Colo. “There’s really something about a wooden puzzle — the heft of the pieces. It’s really sort of satisfying to plunk them into place.”

A few younger people are getting into the business. Maya R. Gupta, 34, an electrical engineering professor at the University of Washington, set up a laser-cutting puzzle business, Artifact Puzzles, last year. “I was hoping to find an audience that would be a lot like me — people who are technology professionals and want to get away from the computer,” Ms. Gupta said.

She likes jigsaws because they can be assembled neatly in a finite amount of time. By contrast, in her engineering work, “the problems are not solvable, and things don’t finish,” Ms. Gupta said.

Although there has been a lot of talk about whether jigsaw puzzles can retard the advance of Alzheimer’s disease, Ms. Gupta does not buy it.

“We would love as a company to claim that these are good for the brain,” she said. “We refrain from doing so because we respect the scientific process, and we are waiting to see the evidence.”

It is not clear what makes some people jigsaw fans or why there seems to be a strong overlap between jigsaw lovers and crossword solvers. Ms. Williams, the jigsaw expert in Maine, said she wondered about those questions, too. “I learn new words when I do crosswords, and I am amused by the wittiness of them,” she said by e-mail. “I find that with jigsaws, I am entertained by different things, such as the color line cutting, the figure pieces and craftsmanship.”

Jigsaws also tend to be a more social activity. Sydney Jones, a member of the Association of Game and Puzzle Collectors, recalled childhood summers when she and her stepmother bonded over jigsaws. “I remember when we were looking for a piece, my stepmother would turn it over to look at which way the grain was going, and I would accuse her of cheating,” said Ms. Jones, 55.

Although my own grandmother is no longer with us, I still have her Mushroom Puzzle, which is now legitimately missing several pieces. My children, alas, show little interest.

http://www.nytimes.com/2010/12/07/science/07jigsaw.html?ref=science

**Math Puzzles' Oldest Ancestors Took Form on Egyptian Papyrus**

**By PAM BELLUCK**

"As I was going to St. Ives

I met a man with seven wives. ..."

You may know this singsong quiz,

But what you might not know is this:

That it began with ancient Egypt's

Early math-filled manuscripts.

British Museum

**CALCULATIONS** The scribe of the Rhind Mathematical Papyrus, an Egyptian document more than 3,600 years old, introduces the roughly 85 problems by saying that he is presenting the "correct method of reckoning, for grasping the meaning of things and knowing everything that is, obscurities and all secrets.

It's true. That very British-sounding St. Ives conundrum (the one where the seven wives each have seven sacks containing seven cats who each have seven kits, and you have to figure out how many are going to St. Ives) has a decidedly archaic antecedent.

An Egyptian document more than 3,600 years old, the Rhind Mathematical Papyrus, contains a puzzle of sevens that bears an uncanny likeness to the St. Ives riddle. It has mice and barley, not wives and sacks, but the gist is similar. Seven houses have seven cats that each eat seven mice that each eat seven grains of barley. Each barley grain would have produced seven hekat of grain. (A hekat was a unit of volume, roughly 1.3 gallons.)

The goal: to determine how many things are described. The answer: 19,607. (The method: $7 + 7^2 + 7^3 + 7^4 + 7^5$.)

The Rhind papyrus, which dates to 1650 B.C., is one of several precocious papyri and other artifacts displaying Egyptian mathematical ingenuity. There is the Moscow Mathematical Papyrus (held at the Pushkin State Museum of Fine Arts in Moscow), the Egyptian Mathematical Leather Roll (which along with the Rhind papyrus is housed at the British Museum) and the Akhmim Wooden Tablets (at the Museum of Egyptian Antiquities in Cairo).

They include methods of measuring a ship's mast and rudder, calculating the volume of cylinders and truncated pyramids, dividing grain quantities into fractions and verifying how much bread to exchange for beer. They even compute a circle's area using an early approximation of pi. (They use 256/81, about 3.16, instead of pi's value of 3.14159....)

It all goes to show that making puzzles is "the most ancient of all instincts," said Marcel Danesi, a puzzle expert and anthropology professor at the University of Toronto, who calls documents like the Rhind papyrus "the first puzzle books in history."

Dr. Danesi says people of all eras and cultures gravitate toward puzzles because puzzles have solutions.

"Other philosophical puzzles of life do not," he continued. "When you do get it you go, 'Aha, there it is, damn it,' and it gives you some relief."

But the Egyptian puzzles were not just recreational diversions seeking the comforting illusion of competence. They were serious about their mission. In the Rhind papyrus, its scribe, known as Ahmes, introduces the roughly 85 problems by saying that he is presenting the "correct method of reckoning, for grasping the meaning of things and knowing everything that is, obscurities and all secrets."

And the documents were practical guides to navigating a maturing civilization and an expanding economy.

"Egypt was going from a centralized, structured world to partially being decentralized," said Milo Gardner, an amateur decoder of Egyptian mathematical texts who has written extensively about them. "They had an economic system that was run by absentee landowners and paid people in units of grain, and in order to make it fair had to have exact weights and measures. They were trying to figure out a way to evenly divide the hekat so they could use it as a unit of currency."

So the Akhmim tablets, nearly 4,000 years old, contain lists of servants' names, along with a series of computations concerning how a hekat of grain can be divided by 3, 7, 10, 11 and 13.

The Egyptian Mathematical Leather Roll, also from about 1650 B.C., is generally considered a kind of practice test for students to learn how to convert fractions into sums of other fractions.

The Rhind papyrus contains geometry problems that compute the slopes of pyramids and the volume of various-shaped granaries. And the Moscow papyrus, from about 1850 B.C., has about 25 problems, including ways to measure ships' parts and find the surface area of a hemisphere and the area of triangles. Especially

interesting are problems that calculate how efficient a laborer was by how many logs he carried or how many sandals he could make and decorate. Or the problems that involve a pefsu, a unit measuring the strength or weakness of beer or bread based on how much grain is used to make it.

One problem calculates whether it's right to exchange 100 loaves of 20-pefsu bread for 10 jugs of 4-pefsu malt-date beer. After a series of steps, the papyrus proclaims, according to one translation: "Behold! The beer quantity is found to be correct."

The problems in these ancient texts are not difficult by modern mathematical standards. The challenge for scholars has come in deciphering what the problems are saying and checking their accuracy. Some of the numerical equivalents are written in a symbolic system called the Eye of Horus, based on a drawing representing the eye of the sky god Horus, depicted as a falcon. Sections of the falcon's eye are used to represent fractions: one-half, one-quarter and so on, up to one sixty-fourth.

Scholars have found a few errors in the problems, and Ahmes even wrote an incorrect number in his St. Ives problem. But over all, the equations are considered remarkably accurate.

"The practical answers are solved," Mr. Gardner said. "What is unsolved about them is the actual thinking in the scribe's head. We don't know exactly how he thought of it."

http://www.nytimes.com/2010/12/07/science/07first.html?ref=science

**The Look of Letters**

**By ALICE RAWSTHORN**

LONDON — Cyrus Highsmith set himself a challenge: to avoid the typeface Helvetica for a day. He banned himself from buying anything branded in that font and from traveling on any form of transport with Helvetica signage. As he's a New Yorker, that included the local subway system. If he happened to come across anything in the typeface, he would look away.

Easy-peasy, you might think, but you'd be wrong. Helvetica cropped up much more often than Mr. Highsmith had expected.

He had known to avoid the Internet, and had taken the precautionary measure of erasing Helvetica from the font menu on his computer. But he hadn't reckoned on spotting it on the washing instruction labels of his clothes, his television remote control, a bus timetable or the stock market tables in The New York Times.

Another problem was finding a Helvetica-free way of paying for whatever he needed to buy during the day, as the forbidden typeface not only appeared on his credit cards but on the newest U.S. dollar bills.

Why, you might wonder, would anyone take on such a weird challenge?

Mr. Highsmith is a type designer. He embarked upon his Helvetica boycott in the hope of addressing the philosophical question: "Do you need type to live?" But the author Simon Garfield, who included the story in his "Just My Type: A Book About Fonts," suggests that a more pertinent question would have been: "Do you need Helvetica to conduct contemporary urban activity?" Judging by Mr. Highsmith's experience, the answer is yes, unless you're willing to go to a great deal of trouble to avoid it, especially if you live in New York.

The Helvetica boycott is just one of the engaging tales of typographic obsession in "Just My Type." Many of them involve designers who, like Mr. Highsmith, have devoted their working lives to creating fonts. Others

explain how powerfully their work affects the rest of us, the 99.99 percent of the population whom they describe, part-derisively, part-pityingly, as “civilians.”

Like many of his fellow “civilians,” Mr. Garfield discovered typography after becoming curious about the contents of his computer font menu, developing a particular fondness for Mrs Eaves and HT Gelateria. He has published more than a dozen nonfiction books, mostly on science and social history. “Just My Type” is his first foray into typography, making him a very brave man, because the world of type is an intensely geeky one with its own language, rules and rituals, including the popular pastime of denouncing hapless “civilians” for making typographic gaffes.

Take Matthew Weiner, the creator of “Mad Men.” He is regularly roasted by type bloggers who can’t understand how a television series that is lauded for historical accuracy when it comes to props, costumes, sets, slang and just about everything else, could be so sloppy in choosing fonts. Likewise, among the “Just My Type” cast of characters is Mark Simonson, an American graphic designer who scores movies for typographic (in)accuracy on his Web site. Both “LA Confidential” and “The Hudsucker Proxy” have been cited for committing the “Mad Men” crime of featuring fonts designed long after the periods in which they were set.

Mr. Garfield makes some factual gaffes of his own. It’s neither correct, nor fair, for instance, to describe the gloriously eclectic graphic designer Alan Fletcher as a “book designer.” “Just My Type” also suffers from his apparent inability to decide whether to write a history of typography or an anecdotal account of its impact on daily life. The result is occasionally confusing, not least because neither the history nor anecdotes are in chronological or any other discernible order. But its strengths far outweigh its weaknesses, so much so that it feels mean to moan about as impassioned, warm-hearted and open-minded a book as this.

The historic passages begin with Johannes Gutenberg, the German printer who made books affordable for millions of people by casting the first reusable letters in the 1440s. Gutenberg died poor, having forfeited his printing machinery in a legal battle, leaving the British printer William Caxton to commercialize his innovations in the late 1400s. In this, he was helped by his protégé, the propitiously named Wynkyn de Worde, whose fonts were imitated throughout Europe.

Mr. Garfield then introduces the designers of beautiful fonts that are still used today, such as Claude Garamond in 16th-century France, William Caslon and John Baskerville in 18th-century Britain, and 20th-century Modernists like Paul Renner in Germany and Adrian Frutiger in Switzerland. Having described the painstaking process of casting the letters, numbers and symbols of traditional typefaces in metal, he explores the shift from printed to digital fonts, which are made on computers, and the efforts of Matthew Carter, Erik Spiekermann and other digital pioneers to create a new genre of typefaces to be read on screen, rather than in print.

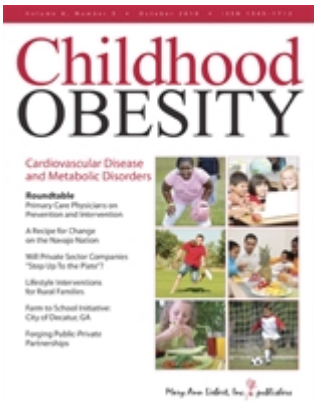
Along the way, “Just My Type” reflects on everything from the uproar over Ikea’s decision to ditch Mr. Frutiger’s Modernist classic Futura for its logo in favor of Mr. Carter’s digital font Verdana; to Gotham’s role as a secret vote-winning weapon in Barack Obama’s 2008 presidential campaign; to how Cooper Black can convey one meaning on the cover of the Beach Boys’ 1966 album “Pet Sounds,” and another on the title sequence of the turn-of-the-1970s British television series “Dad’s Army,” and a third in the corporate identity of the budget airline Easy Jet.

The book also dwells on the importance of the distinction between legibility and readability when it comes to choosing typefaces; the psychology of favorite fonts; and why type nuts love the ampersand symbol, loathe Comic Sans and are suspicious of Arial — but how, despite their doubts, Arial Black has become one of the most popular fonts, along with Frutiger, for European soccer shirts. Answer: Because it’s both legible even from the opposite end of the stadium.

http://www.nytimes.com/2010/12/06/arts/06iht-design6.html?ref=design

**Expert Panel Explores How to Engage Pediatricians and Primary Care Physicians in Childhood Obesity Prevention and Intervention**

Mary Ann Liebert, Inc., Publishers




Childhood Obesity is a bimonthly journal, published in print and online, and the journal of record for all aspects of communication on the broad spectrum of issues and strategies related to weight management and obesity prevention in children and adolescents

As the prevalence of childhood obesity approaches epidemic levels, physicians on the "front line" need to become more involved in obesity prevention and weight management to reverse this dangerous trend among their young patients. But several obstacles discourage pediatricians and other primary care physicians from taking a more active role in managing childhood obesity. An expert panel identified these barriers and explored strategies for overcoming them in a Roundtable Discussion on "New Ways to Overcome Old Barriers: Engaging Pediatricians and Primary Care Physicians in Obesity Prevention and Intervention" presented in the current issue of *Childhood Obesity*, a journal published by Mary Ann Liebert, Inc. The article is available free online.

Melinda Sothern, PhD, Professor and Director, Section of Health Promotion, Behavioral, and Community Health Sciences Department in the School of Public Health at Louisiana State University Health Sciences Center (New Orleans, LA) and Pennington Biomedical Research Center (Baton Rouge, LA) moderated the Roundtable Discussion. Participants included Sonia Caprio, MD, Yale University School of Medicine (New Haven, CT); Stephen Daniels, MD, PhD, University of Colorado School of Medicine (Aurora); Stewart Gordon, MD, Louisiana State University School of Medicine (New Orleans, LA); and David Ludwig, MD, PhD, Harvard Medical School and Children's Hospital Boston (Massachusetts). The panelists identified several key barriers, including inadequate reimbursement for childhood obesity management and prevention; lack of office time to interact with and educate patients; lack of financial resources to support patient/family education and counseling; and a "toxic" culture that encourages poor nutrition, overeating, and a sedentary lifestyle.

"Unless government and insurance reimburses for primary care prevention and treatment of childhood obesity, it is not going to happen in a comprehensive way," said David Ludwig.

Moderator Melinda Sothern proposed the creation of "community hubs" in which primary care offices and clinics form alliances with schools, recreation departments, or community centers in the area and work together "to support efforts to identify, organize, and implement" group programs for children who are overweight or obese.

The panelists also discussed the need to include more information about childhood obesity and proper nutrition in the educational experiences of medical students and residents. To help overcome time limitations, primary care physicians can encourage their nursing staff to talk to parents about the significance of the measurements they are taking, such as weight and height, laying the groundwork for the physician to reinforce those messages.

Too often, pediatricians "do not plot the BMI (body mass index) over time and do not focus on the development of obesity," says Stephen Daniels, emphasizing the importance of identifying trends such as increasing BMI as a key step in prevention and management of childhood obesity.

http://www.liebertonline.com/doi/abs/10.1089/chi.2010.0502

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**University to develop unique X-ray imaging and coherence facility**

Aerial view of Diamond Light Source. I13 can be seen in the foreground stretching away from the main synchrotron building.

Manchester, The University of

The University of Manchester has joined forces with Diamond Light Source, the UK's national synchrotron science facility, to produce a world-class imaging facility.

This will allow researchers in a wide range of fields to create high-quality 3D images of samples including engineering components, biomaterials, fossils, organic materials and energy devices such as fuel cells.

Due for completion in 2012, the X-ray Imaging and Coherence beamline at Diamond, I13, is designed for a broad range of scientific users from biomedicine, materials science, geophysics, astrophysics and archaeology.

Its two branch lines – called the 'imaging' and 'coherence' branches – will provide tools for non-destructive examination of internal features ranging from the micro (a few thousandths of a millimetre) to the nano (a few millionths of a millimetre) length scale.

Diamond has entered into a seven-year collaboration with The University of Manchester to develop the imaging branch line, working together to discover, explore and exploit new science using synchrotron light.

Professor Phil Withers is leading the X-ray Imaging at the University and is a longstanding synchrotron user. He said: "The late Professor Alan Gilbert [the inaugural President and Vice-Chancellor of the University of

Manchester] visited Diamond and was struck by the world-class standard of the facility, and he was keen for Manchester to be directly involved.
"With our own dedicated imaging suite at Manchester, the Henry Moseley X-ray Imaging Facility, which was officially opened in June last year, Manchester was looking to expand its imaging capabilities and the partnership with Diamond provided the perfect opportunity."

The 3D X-ray tomography that will be performed on I13 has many applications. It can be used to characterise the internal structure of porous materials such as trabecular bone or metal foams, or to determine the size and shape of cracks and other defects inside components such as aircraft parts, where unexpected failures could have catastrophic results.
The funding from Manchester includes capital, staff and operational costs towards the I13 imaging branch beamline in return for substantial dedicated access.

The staff financed through this collaboration will accelerate the completion of the I13 imaging branch and ensure its operation for the next seven years. The effort is further supported by a team from The University of Manchester, situated on site to drive forward the research.

The experimental hutches for I13 are currently under construction but the optics hutches are already receiving X-rays from the synchrotron ready for testing. Following the inaugural board meeting Prof. Colin Bailey, Vice-President and Dean of the Faculty of Engineering and Physical Sciences at The University of Manchester, ran the first test sample on the beamline with great success.
He said: "The partnership with Diamond will allow the leading academics at The University of Manchester to push the boundaries of science using synchrotron light.
"The facilities at Diamond complement our current imaging facilities at Manchester, including our new Henry Moseley X-ray Imaging Facility. I look forward to the exciting, world-leading scientific discoveries that will result from this partnership with Diamond."

Chief Executive of Diamond, Prof. Gerd Materlik, says, "This is great news for Diamond and the I13 beamline. In the current economic climate, creating a new model of interaction with one of our university partners, and financial support such as this, is extremely important in terms of fully exploiting our facilities. I13 is part of the second phase of construction at Diamond which is due to be complete in 2012. Funding for Phase III, the design and construction of a further ten beamlines, was announced by the government in October this year and will bring the total number of experimen

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**Soaring is better than flapping**

Max-Planck-Gesellschaft

Small migrating birds also save energy as they fly. Large birds, such as storks, save energy on the flight to their wintering grounds by soaring through the air on thermal currents. Until now, however, we knew nothing about the flight patterns of small migrating songbirds, such as whether they flap their wings or soar and whether these styles of flight allow them to save energy. Now, a team of scientists at the Max Planck Institute for Ornithology in Radolfzell, Ben-Gurion-University of the Negev, and Hebrew University of Jerusalem have tracked the movement of European bee-eaters (Merops apiaster) along the Africa-Eurasia migration flyway with the help of tiny radio transmitters. Analysing measurements of heart rate, flight speed and flying style, they found out that these small birds also soars. Further, they found that the birds fly just as quickly when soaring as when flapping their wings, while using as little energy as it takes to sit in its nest. (Published in PloSOne 11, November 2010)

European bee-eater during flight.

When we think of birds gliding majestically through the sky without beating their wings, we imagine large species like storks or hawks searching silently for prey. The flight patterns of large birds have been well studied. Ornithologists know how quickly and how far they fly, and how often they flap or soar while in flight. However, much less is known about these patterns in smaller birds. Until recently, it was thought that small birds were not able to glide and save energy in the same way, due to their smaller musculature and wings. Gliding would reduce the flight speed, so it was assumed.

In a recently published study, scientists at the Ben-Gurion University of the Negev and the Hebrew University of Jerusalem, along with Martin Wikelski, director of the Max Planck Institute for Ornithology in Radolfzell, determined for the first time the energy use of small songbirds in the wild. The researchers attached tiny radio transmitters onto the backs of European bee-eaters (*Merops apiaster*) caught in Israel to record their wing

beat frequency, heart rate and flight speed. In order to estimate the birds' energy use, they determined in the laboratory that the birds' heart rate increased with oxygen consumption, and therefore the heart rate measurements indicate the birds' energy use while flying.

"Analysing the data, we were surprised to see that bee-eaters often switch between soaring and flapping, and also that the frequency of heart beats while gliding was only as half what it was while flapping," says Martin Wikelski. "The birds needed the same amount of energy while soaring or gliding as they did when they were resting on a branch or in a nest." In contrast, previous studies with larger birds showed that energy use was at least 30 percent higher when the birds were gliding than when they were resting. Thus, soaring and gliding flight means a considerably higher savings of energy for small migrating birds than for larger species. In addition, the scientists did not find any loss of flight speed when birds were gliding.

The results of this study not only provide an answer to the question of whether small migrating birds can soar during their long journey, but also show that they travel just as fast while doing so and use less energy.

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**Restorative Justice Realities- Empirical Research in a European Context**

miércoles, 08 de diciembre de 2010 COST

- **Título de publicación:** Restorative Justice Realities- Empirical Research in a European Context
- **Autor:** I. Vanfraechem, I. Aertsen and J. Willemsens (Eds)
- **Clase de publicación:** Libro (en rústica)
- **Número ISBN:** 978-90-8974-361-9

The purpose of this book is to offer an analysis of empirical research carried out within European countries with regard to restorative justice. This is not another collection of theoretical essays on restorative justice. Neither is the book dealing with international research projects (apart from the work presented in Chapter 2 and references made in the chapter on Italy), which have been implemented in Europe during the last ten years mainly with financial support from the EU.

Furthermore,'restorative justice' is investigated through its operational models; in particular the focus will be on VOM and conferencing since they are considered to be the most restorative practices (McCold and Wachtel, 2002). In the respective chapters, authors may briefly refer to other practices that are considered as restorative in their country.

The nine countries included in the book have developed research on the topic, to a varying extent. Reviewing this research and its results offers an insight on the state of affairs, not only of the research but also of the restorative practices and policies in those countries. The concluding chapter provides an overview of research results and furthermore reflects upon the difficulty of collecting comparable research materials in Europe.

Each country contributor was given a template delineating three common types of research: descriptive-inventory research, action-research and evaluative research. After a general introduction on the state of affairs with regard to the practices and legislation on VOM and FGC in their country, the authors present the different types of research conducted so far in that country in detail, including the setup, research methodology and main results. Not all authors could strictly adhere to the scheme because of differences in restorative justice and research developments between countries, various research cultures and modes of cooperation, and combinations of the abovementioned research types. Nevertheless, the template was used as a common framework to present the available research.

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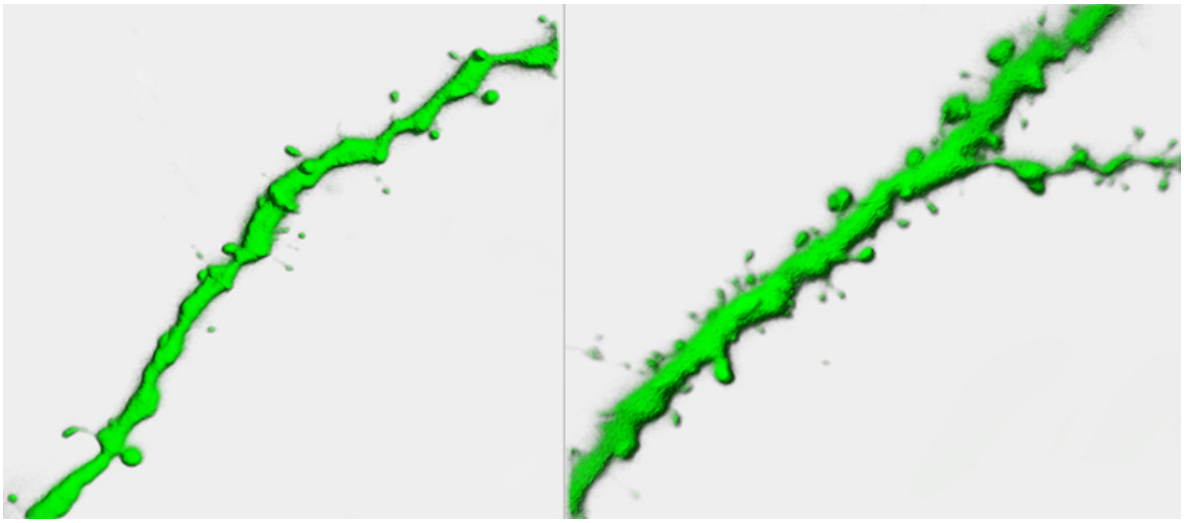
**Fewer synapses – more efficient learning**

Max-Planck-Gesellschaft



When the amount of SynCAM1 was increased in experiments, the neurons formed a much greater number of synapses (cf.: picture on the right with increased SynCAM1). However, in the learning test, these mice performed worse than animals that lacked the protein. (image: Valentin Stein)

Neurons exchange information via special connections, the synapses. New synapses are constantly being formed, existing synapses are reinforced and redundant synapses are eliminated. Scientists from the Max Planck Institute of Neurobiology and the Yale University studied the adhesion protein SynCAM1, which glues synapses together. When they increased the amount of SynCAM1 in neurons, the number of synapses grew. This would offer the neurons more routes for transmitting information. However, a behavioral experiment showed that mice without SynCAM1 learned better than animals with normal levels of the protein. These results suggest that both the formation and the elimination of synapses are essential for learning and memory - a finding that could be potentially interesting with regard to certain diseases. *(Neuron, online publication December 8, 2010)*

The brain resembles a large construction site. Tiny protrusions constantly form on the surface of neurons. If such a protrusion meets the corresponding structure of an adjacent cell, the ends of these processes mature into a synapse. A synapse, in turn, makes it possible to transmit information from one cell to another. If an existing synapse is inefficient or is no longer needed, it will be eliminated. Scientists agree that the capacity to learn, forget and remember depends on this constant “remodelling” of the brain.

The functions of a synaptic adhesive

Although synapses are tiny, their function is relatively well understood. However, synaptogenesis – the process of synapses formation – and the molecules involved in this process are far more difficult to study. Several proteins have been identified, which keep both sides of a synapse in position while the connection matures. Scientists from the Max Planck Institute of Neurobiology in Martinsried and the Yale University in New Haven have now been able to shed light on several functions of SynCAM1, one of these proteins.

Alexander Krupp from the Max Planck Institute of Neurobiology explains: “The protein SynCAM1 creates adhesion between the two sides of a synapse, much like glue. This raised the question of whether SynCAM1 affects the number and lifetime of synapses”. The scientists addressed these questions by studying genetically

modified mice either with increased levels of SynCAM1, or no SynCAM1 at all. The changes observed under the microscope and in behavioral tests surprised the neurobiologists.

The results showed that SynCAM1 is important both for the formation of synapses and their maintenance. When the amount of SynCAM1 was artificially increased, the neurobiologists found a significantly greater number of synapses. If the amount of SynCAM1 was then again reduced through a genetic trick, the additional synapses disappeared. Moreover: the effect was not limited to an early phase of postnatal brain development, the time when most synapses are formed; it could also be observed in the adult brain.

Easier learning without SynCAM1

“One would perhaps think that animals with an increased number of synapses would be able to process or store information better”, Valentin Stein, one of the two heads of the study, suggests. In reality, it was quite the opposite – these animals were poor learners. A behavioral test demonstrated that mice without SynCAM1 learned faster and remembered better.

At first glance this finding may seem counterintuitive. It's true that with SynCAM1 more synapses are formed. However, the synapses are also more stable, which makes it harder to eliminate redundant or ineffective connections. The neurobiologists therefore propose that the observed difference in learning capacity can be explained by the elimination of unused synapses. Without SynCAM1, it is easier to break up connections again. “Our results show how important the elimination of synapses is for learning and memory”, says Stein. This is a small breakthrough in its own right. In addition, SynCAM1 could play an important part in diseases that involve changes in synapse formation, such as autism. There is also a chance that SynCAM1 could be used in the future for treatment of, for instance, Alzheimer’s disease. These are aspects which the scientists will consider in their future research.

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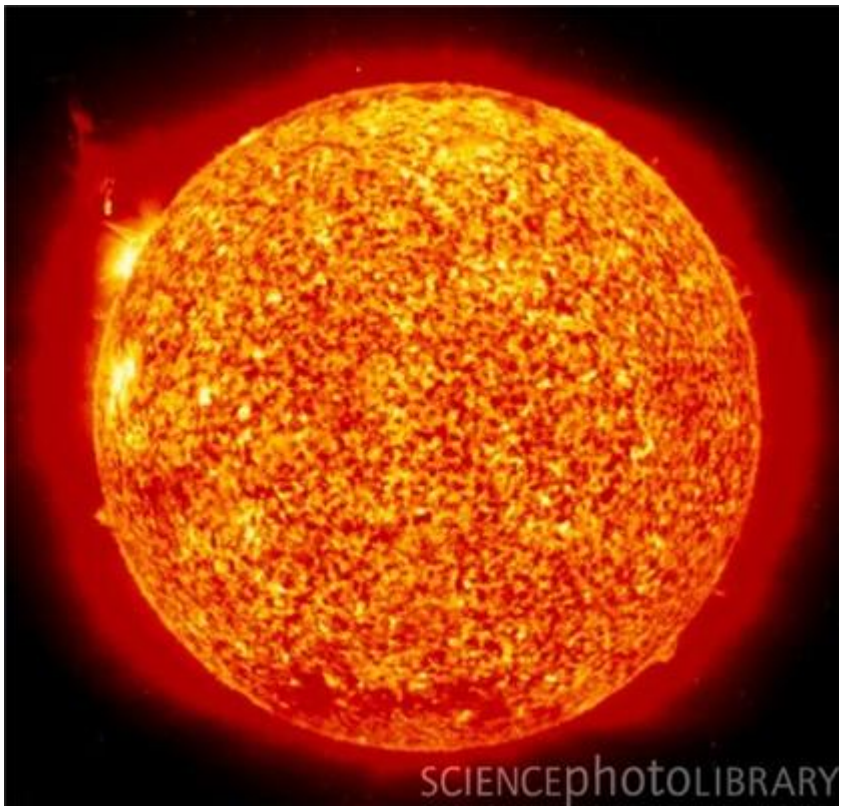
**Changes in solar activity affect local climate**

Lund University




Credit: EUROPEAN SPACE AGENCY / SCIENCE PHOTO LIBRARY Caption: *** THIS PICTURE MAY NOT BE USED TO STATE OR IMPLY ESA ENDORSEMENT OF ANY COMPANY OR PRODUCT *** Sun. Ultraviolet image of the part of the Sun's atmosphere (upper chromosphere & lower transition layer), taken by the SOHO (Solar Heliospheric Observatory) satellite. The Sun appears granulated due to turbulence in the gas. Around the Sun's edge are rising streams of particles. The light seen here has a wavelength of 30.4 nanometres and is being produced by doubly-charged helium ions at a temperature of 60,000 degrees celsius. Image taken by SOHO's Extreme Ultraviolet Imaging Telescope (EIT). - © Esta imagen aparece simplemente como ejemplo y está sujeta a derechos de autor. No debe usarse o copiarse en ningún caso sin el permiso expreso de Science Photo Library

Most of the current climate models suggest that the sun has only a small effect on the global climate, but there is insufficient knowledge of the processes behind this link. Variations in solar activity could have major significance for regional climate development, according to Lund researcher Raimund Muscheler and his colleagues in the USA and Mexico.

Raimund Muscheler is a researcher at the Department of Earth and Ecosystem Sciences at Lund University in Sweden. In the latest issue of the journal Science, he and his colleagues have described how the surface water temperature in the tropical parts of the eastern Pacific varied with the sun's activity between 7 000 and 11 000 years ago (early Holocene). Contrary to what one might intuitively believe, high solar activity had a cooling effect in this region.

"It is perhaps a similar phenomenon that we are seeing here today", says Raimund Muscheler. "Last year's

cold winter in Sweden could intuitively be seen to refute global warming. But the winter in Greenland was exceptionally mild. Both phenomena coincide with low solar activity and the sun's activity probably influences the local climate variations."

Today there is a lot of debate about whether the sun's activity could have influenced the earth's climate over thousands or millions of years.

"The key processes in this influence are still mostly unclear. This is why the present climate models probably do not include the full effect of solar activity", says Raimund Muscheler.

By reconstructing surface water temperatures from plankton stored in a sediment core taken from the seabed off the west coast of Baja California Sur, Mexico, researchers have now made new findings. The results suggest that solar activity has influenced the sea's surface water temperature by changing local circulation processes in the sea. Previous studies have shown that the surface water temperature in the tropical Pacific Ocean is linked to atmospheric and seawater circulation through the regional weather phenomena El Niño and El Niña.

"We know that El Niño brings a warmer climate, while El Niña brings a cooler climate in the eastern part of the Pacific Ocean", says Raimund Muscheler. "If we presume that this connection existed during the early Holocene, this means that there could be a link between solar activity and El Niño/El Niña on long time scales."

In his research, Raimund Muscheler works to reconstruct previous changes in solar activity by studying how cosmogenic isotopes, for example of beryllium-10 and carbon-14, have been stored in both ice cores and annual rings in trees. Cosmogenic isotopes are formed in the atmosphere as a result of cosmic radiation from space. When solar activity is high, a small amount of the cosmic radiation reaches the atmosphere and thus a small number of cosmogenic isotopes are formed and stored.

"This is the best and most reliable method we have to reconstruct solar activity", says Raimund Muscheler.

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**European Frame of Reference for Prevention of Sexual and Genderbased Violence in the European Asylum and Reception Sector**

10 December 2010 Ghent University

On December 10th 2010, the European Frame of Reference for Prevention of Sexual and Genderbased Violence in the European Asylum and Reception Sector was presented in Brussels.

1. *Senperforto project*

The participatory research project called 'Hidden Violence is a Silent Rape' (2006–2008), coordinated by the International Centre for Reproductive Health (ICRH) at Ghent University (Keygnaert and Temmerman) indicated that young refugees, asylum seekers and undocumented migrants are extremely vulnerable to sexual and gender-based victimization within European reception centres. Offenders are often close peers but also reception and asylum staff. In more than 90% of the cases (n=332) victimization was not reported to the police.

While presenting the results of the Hidden Violence is a Silent Rape project in many different settings, staff in the reception and asylum sector indicated that they lack the capacity, means and tools to: a) develop preventive measures in a culturally competent and participatory way; b) identify risk and indicative factors for upcoming sexual and gender-based violence (SGBV); and c) respond when SGBV occurs. Data and regulations on SGBV against young refugees, asylum seekers and unaccompanied children remain sparse. Furthermore, neither a code of conduct nor a standard operating procedure exists for professionals in the reception and asylum sector.

With a transnational, multidisciplinary and multisectoral group of 14 partners in Belgium, Greece, Hungary, Ireland, Malta, the Netherlands, Portugal and Spain, we aim to tackle this issue and fill the current gap. We want to address SGBV prevention in the European reception and asylum sector from within by combining the forces of necessary stakeholders in different European Union Member States right from the start. We do this in the project 'Senperforto', which is Esperanto for 'no more violence, without violence'. The Senperforto Project is supported by the European Commission Daphne Fund.

By applying the particularly participatory and crosscutting approach of researching and raising awareness called community-based participatory research (CBPR), we wanted to investigate what the exact knowledge, attitude, practice and needs of both staff and people residing in the European reception and asylum sector are regarding sexual and gender-based violence, in order to develop a needs-, rights- and evidence-based, participatory and gender-balanced European Frame of Reference for Prevention of SGBV in the European Asylum and Reception Sector that is fit for both beneficiaries.

This Senperforto Frame of Reference consists of SGBV Prevention Standard Operating Procedures, a Code of Conduct, a Sensitization Kit and the Make it Work! Training Manual. The Frame of Reference is available in many languages, on CD-ROM as well as on the ICRH website.

The Senperforto Project is a joint research project between academic partners (ICRH-Ghent University, Belgium; IHMT-Universidade Nova de Lisboa, Portugal; NIVEL, the Netherlands; and University College of Dublin, Ireland), non-governmental organizations (NGOs) (Greek Refugee Council, Greece; Jesuit Refugee Service, Malta; Ménedek, Hungary; Red Cross and Sensoa, Belgium) and policymakers (Fedasil, Belgium; UNHCR, Benelux). It covers eight European countries: Belgium, Greece, Hungary, Ireland, Malta, the Netherlands, Portugal and Spain. Ines Keygnaert & prof dr Marleen Temmerman from ICRH-Ghent University are the coordinators of Senperforto.

2. *Senperforto KAP study*

Between november 2009 and June 2010, in the 8 partner countries a Knowledge, Attitude and Practice Survey on sexual and gender-based violence was conducted among professionals working as well as residents living in asylum reception facilities. The initial purpose was to interview 90 persons per country of research. However, due to political and practical reasons this number could not be reached in every country of research. A total of 599 respondents were interviewed of which 57.3% were male and 42.7% female. Belgium 93, Greece 66, Hungary 89, Ireland 94, Malta 91, the Netherlands 38, Portugal 90, and Spain 38)

As for their experiences with sexual and gender-based violence occurring in the reception centre of their work or stay in the last 12 months prior to the interview, respondents had the opportunity to describe 4 cases in detail. A total of 721 violence experiences were reported.

Of the 599 respondents, 43.4% (=260) did not describe a case of violence having happened in the last 12 months. Portugal and Spain are the 2 countries where more than half of the respondents did not report cases – respectively 86.7% and 60.5%.

However 56.6% (n=339) of the respondents did report cases of violence that occurred in the last 12 months prior to the interview. They described a total of 721 cases. These cases were distributed over all countries of research. It is to be noted that the bulk of the cases (89.1%) were reported in 4 of the 8 partner countries, being: Malta (158 cases-26.4% of all reported cases), Belgium (146-24.4%), Ireland (132-22%) and Hungary (102-17%).There were 73 cases (12.2%) reported in Greece, 68 (11.4%)in the Netherlands and 28 (4.7%) in Spain and 14 in Portugal (2.3%).

A violence case can consist of one single type of violence, but often it is a combination of different types. This is also the case for the violence experiences reported in the Senperforto study: the 721 cases consist of 941 different violent acts. Malta (25.4%) and Belgium (22.1%) stand out as countries where the reported cases most frequently consisted of a combinations of different types of violence. These types are: physical violence, emotional-psychological violence, sexual violence, harmful traditional practices and socio-economic violence.

All types of violence but harmful traditional practices occur in all research countries. In total, psychological-emotional violence (42.5%) is the most important form, closely followed by physical violence (41.6%). At country level both types are the most important but with another distribution. Emotional-psychological violence stands out as the most frequently reported form of violence at country level in Belgium (52.4%), Ireland (41.8%) and Portugal (46.2%). For Greece (50%), Hungary (39.4%), Malta (44.4%), the Netherlands (46.0%) and Spain (48.4%), physical violence is the most frequently reported form of violence at country level.

Socio-economic violence and sexual violence are reported in all research countries but to a lesser extent (7.9 and 7.8% of all reported violence acts). Sexual violence was most frequently reported in Malta (26%), Belgium (24.7%) and Ireland (23.3%). Socio-economic violence was most frequently reported in Hungary (28.4%), the Netherlands (23%) and Malta (25.4%). Harmful traditional practices are only noted in Hungary and in Malta and represent a total of only 0.5% of all reported acts of violence.

The perpetrators were predominantly male (73.2%). However in 19.6% of the cases (n=119/721), the perpetrator was a woman and in 5.7% of the cases they acted together. (1.5% was unknown). . The perpetrators are young: the main group of perpetrators aged between 19 and 29 years old (37.2%), this is closely followed by 23.3% of adolescents (13-18) and 23.1% adults between 30 and 39 years old. Half of the perpetrators were asylum seekers (51.6%) and a fifth (20%) were national citizens of the country of research. As for the relation between the perpetrator and the victim: the bulk was a (co-) resident in the centre (45.9%). Professionals providing a service within the reception or asylum sector as perpetrator counted for 21.6%.

A forth of the respondents was personally victimized (24.2%), the other cases were victimizations of peers of the respondents in the reception centre where he/she worked or lived. Slightly more than half of the victims were victimized alone (57%), however 38.4% were victimized in group. Half of the victims were male (50.5%) while 35.8% were female. In 12.6% of the cases the victims were both female and male. The biggest group of victims (45.7%)were young adults (between 19 and 29 years old). The other 2 main groups are adolescents (25.2%) and adults between 30 and 39 years old (25.8%). Two thirds of the victims were asylum seeker, 15.1% was a national citizen, 7.7% were undocumented migrants and 7.4% were asylum seekers.

Given these data of sexual and gender-based violence knowledge, experience and prevention practices within the Reception and Asylum sector of the 8 research countries, we deemed it essential to provide them with practical instruments for Prevention of SGBV in this sector: the Senperforto Frame of Reference.

### *3. Senperforto Frame of Reference for Prevention of SGBV in the European Reception & Asylum Sector*

The Senperforto Frame of Reference aims to enhance the general health and well-being of residents as well as staff who are living or working in European reception and asylum centres. This is done by setting up preventive actions that stem from an emancipative, participatory and human-rights based approach, a gender-sensitive perspective, a positive view on relationships, sexuality and equality and an intercultural dialogue. Senperforto is Esperanto for “no more violence”.

The Senperforto Frame of Reference consists of SGBV Prevention Standard Operating Procedures, a Code of Conduct, a Sensitization Kit and the Make it Work! Training Manual.

1. The Senperforto Standard Operating Procedures (SOPs) are a set of practical tools assisting reception centres in developing comprehensive procedures for prevention of SGBV within the centre, for assisting victims and for referring perpetrators.

2. The Senperforto Code of Conduct is a practical guide for the reception centre, its staff members and residents. It defines the outlines and the content of their commitment in attitudes and behaviour to preventing, combating and responding to every form of SGBV.

3. The Senperforto Sensitization Kit is a culturally competent awareness-raising and sensitization tool fit for any public, but addressing asylum seekers and asylum professionals specifically. The Sensitization Kit consists of foldable flyers containing information, sensitization materials and referral addresses on 12 different themes, ranging from how to enhance your social network and having good relationships to sexual and reproductive health risks and different types of SGBV.

4. The Senperforto Make it Work! Training Manual is a practical hands-on manual with an engaging and non-judgmental approach to sensitive issues such as sexual and reproductive health and SGBV. The Make it Work! Training Manual develops a better understanding of the factors that influence SGBV, increases communication skills on sexual health and SGBV, and stimulates group cohesion within the working group of professionals and residents that are engaged in the prevention of SGBV in their reception centre.

Developing a comprehensive SGBV prevention and response policy is a process that involves discussions and negotiations. The SGBV prevention and response policies and their implementation have to be tailored to each specific reception centre. However, with the hands-on approach of the Senperforto Frame of Reference, you are equipped with the necessary tools to get started.

Notice: The Senperforto Frame of Reference is primarily designed for European asylum or reception centres that wish to develop and implement a comprehensive SGBV prevention and response policy. However, with slight contextual adaptations, it can also be used in any other institutional setting where vulnerable people are cared for and prevention of SGBV is at stake.

The Senperforto SOPs & Code of Conduct are available in Dutch, English, French, Greek, Hungarian, Spanish and Portuguese. The Sensitization Kit is available in those 7 languages as well as in Arabic, Farsi, Somali and Russian. The Make it Work! Training Manual is available in English, and handouts are also available in Dutch, English, French, Greek, Hungarian, Spanish and Portuguese. ISBN: *978-9078128-205*

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VirginiaTech
Invent the Future

**Immune system changes linked to inflammatory bowel disease revealed**

Virginia Tech

Scientists at the Virginia Bioinformatics Institute at Virginia Tech have discovered some of the key molecular events in the immune system that contribute to inflammatory bowel disease. The results, which help researchers move one step further in their efforts to develop new drugs to treat inflammatory and immune-mediated diseases, are reported in the November 2010 edition (http://www.ncbi.nlm.nih.gov/pubmed/21068720) of the journal *Mucosal Immunology* from the *Nature* Publishing Group.

Inflammatory bowel disease starts when the gut initiates an abnormal immune response to some of the one hundred trillion or so bacteria that come into contact with the colon of the human body.

More than 1 million people are affected by inflammatory bowel disease in North America alone and direct healthcare expenses for inflammatory bowel disease in the United States are estimated at more than $15 billion annually.

Earlier mathematical and computational work work (http://www.ncbi.nlm.nih.gov/pubmed/20362587) by the scientists pinpointed a special type of immune cell as a possible target for intervention strategies to fight inflammation-related disease in the gut. The immune cells identified in the earlier work, which are known as M1 or classically activated macrophages, cause inflammation and possess a specific molecule, peroxisome proliferator-activated receptor-gamma, that, when activated, favors a switch to a type of macrophage that reduces the impact of inflammation (alternatively activated macrophage or M2) . The activation of the receptor protein and the anti-inflammatory M2 macrophage switch plays a beneficial role in reducing the severity of the disease in the gut during experimentally induced inflammatory bowel disease.

“We have been able to validate experimentally some of the key events that take place in the regulation of the mucosal immune system when inflammatory bowel disease is triggered in mice,” said Josep Bassaganya-Riera, associate professor of immunology at the Virginia Bioinformatics Institute, leader of the Nutritional Immunology and Molecular Medicine Group in the institute’s CyberInfrastructure Division, and principal investigator. “When we produce mice that lack the peroxisome proliferator-activated receptor-gamma specifically found in macrophages, the severity of inflammatory bowel disease increases significantly. In parallel, we are able to observe the impact of the onset of disease on key inflammation-related genes and other molecules involved in inflammation and metabolism.”

“In this study, we were able to use mouse Affymetrix GeneChips® to examine which genes were turned on and off under disease and non-disease conditions,” said Clive Evans, director of the Core Laboratory Facility at the institute. “This gave us a comprehensive snap-shot of what is happening in the immune system of mice when inflammation-related disease takes hold in the gut.”

“In addition to our observations of what is happening when inflammatory bowel disease is triggered in mice, we showed that peroxisome proliferator-activated receptor-gamma in macrophages is essential for recovery from disease when the drug pioglitazone is used to treat it,” said Raquel Hontecillas, assistant professor of immunology at the Virginia Bioinformatics Institute, and lead investigator of the study. “Our group has dissected the role of peroxisome proliferator-activated receptor-gamma as an internal thermostat for inflammation in other cells involved in gut inflammation such as intestinal epithelial cells and T cells.”

Some of the currently available therapies for the treatment of inflammatory bowel disease in humans are effective in treating the disease but are linked to sometimes-drastic side effects in patients. The researchers hope to use their knowledge of the immune system and specific targets for repurposed drugs and naturally occurring compounds to develop safer alternatives for the long-term management of the disease.

"Our combined computer modeling and experimental validation approach, which is part of the work of our Center for Modeling Immunity to Enteric Pathogens, is already generating important clinical leads that should help us in our quest to deliver better therapies for infectious enteric diseases," concluded Bassaganya-Riera.

The research was funded by award number 5R01AT004308 of the National Center for Complementary and Alternative Medicine at the National Institutes of Health, European Commission grant number 224836, the Virginia Bioinformatics Institute-Fralin Commonwealth Research Initiative grants program, *National Institute of Allergy and Infectious Diseases* Contracts No. HHSN272200900040C and HHSN272201000056C, and funds from the Nutritional Immunology and Molecular Medicine Laboratory.

http://www.ncbi.nlm.nih.gov/pubmed/21068720

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91904&CultureCode=en

**"First light" of remarkable electron microscope**

10 December 2010 Institute of Physics PAS


Tests of the new high-resolution electron microscope TITAN CUBED 80-300 has been just finished at the Institute of Physics of the Polish Academy of Sciences. The microscope is one of the best facilities of such kind in Europe and allows for the comprehensive examination of materials used in nanotechnology and spintronics. Its regular work will start in January 2011.

The high-resolution transmission electron microscope TITAN CUBED 80-300 has been set on work at the Institute of Physics of the Polish Academy of Sciences (IP PAS) after four months of tests and installation works. This scientific facility enables quick and accurate characterization of semiconductor structures used in production of lasers and diodes and all electronic devices based on nanostructures and quantum effects. "Electron microscopy have been the subject of our interest for more than 35 years. TITAN guarantees to carry on our investigation on the highest world level," says Prof. Leszek Sirko, scientific director of the Institute of Physics of the PAS in Warsaw.

High-resolution transmission electron microscopy (HRTEM) is invaluable technique to study nanoscale (10-10 m) properties of crystalline materials such as semiconductors and metals. At these small scales, individual atoms and structure defects can be imaged. "So small objects we are not able to see by use of visible light," explains Kamil Sobczak, PhD student at the Electron Microscopy Group of IP PAS. Instead of beam of light, a beam of electrons is used to "illuminate" the investigated sample. Microscope is build of vertical column, on top of which the electron gun is placed. Below the gun is the system forming electron beam composed of monochromator and electrostatic and electromagnetic lenses. After passing through the sample, the

transmitted electron beam comes through the system of lenses which form a sample's image magnified millions times.

The investigated sample should be very thin (its thickness should not exceed 1 micron) so special techniques of its preparation must be used. An additional equipment – a device for focused ions milling (Focus Ion Beam, FIB) has been bought, which allows for very efficient sample thinning. "At present, sample preparation takes us about one week (with standard techniques). By use of FIB a sample will be ready after a few hours," says Alicja Szczepańska, technologist at the Electron Microscopy Group at IP PAS.

The new microscope is additionally equipped with electron energy losses spectrometer and gives possibility of holographic imaging and investigation in liquid nitrogen temperatures. The facility has electronic optics of very high quality, very stable accelerating voltage and very sensitive image detectors. Unique qualities of the microscope allows to follow processes undergoing in investigated sample, for example when its temperature changes. Such information have a big practical value for technologists. "On the basis of results of microscopic investigations we will be able to inform technologists, which color of light can be emitted by a selected part of investigated device," says Prof. Piotr Dłużewski, head of the Electron Microscopy Group at the Institute of Physics of the PAS.

The new microscope will be used by many scientific groups from Poland and abroad and many commercial companies. It will also give an educational possibilities for young scientists and students.

Project "Analytical High Resolution Electron Microscope for Nanoscience, Nanotechnology and Spintronics" has been granted by European Union in frame of Operational Programme Innovative Economy to support infrastructure of leading scientific institutions (action 2.1). European grant covers 85% of costs, the rest was covered by the Ministry of Science and Higher Education of Poland.

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91877&CultureCode=en

**Beyond Bars: Index on Censorship and English PEN celebrate writers' fight for free expression**

SAGE Publications

Despite threats of violence, imprisonment and death, writers around the world continue to fight to make their voices heard. The latest issue of *Index on Censorship* pays tribute to one of the world's longest running campaigns for free expression, English PEN's Writers in Prison Committee (WiPC). Founded in 1960, the WiPC supports and protects writers facing persecution around the globe.

Contributors to Beyond Bars – including award-winning authors Margaret Atwood, Sir Tom Stoppard and William Boyd – highlight the vital role writers can play in supporting their colleagues. As Tom Stoppard writes:

"When it comes to the fate of individuals no one, not even a writer, needs to be useless. Political prisoners are less vulnerable when they are kept in our view and known to be so."

The issue also features articles by writers who have themselves been the victims of persecution, including celebrated Mexican journalist Lydia Cacho. Arrested and threatened after exposing an international paedophile ring, she speaks out about the "double-edged sword" of working in the media spotlight:

"Acts of aggression are intended to silence us, wear us out, or distract our attention from what's really important. Prizes and accolades are converted into shields to protect and forums to express the messages others are trying to conceal."

The issue emphasises the real danger in expecting writers to have a political focus too, leading to another kind of censorship altogether. What is absolutely essential is that writers are able to work in a landscape that allows ideas to flourish – and that no writer is silenced. "You can take the guts out of the investigative journalists, both figuratively and literally, but so far no one has been able to completely suppress the human urge that's at least as old as the Book of Job: the need to tell," Margaret Atwood writes.

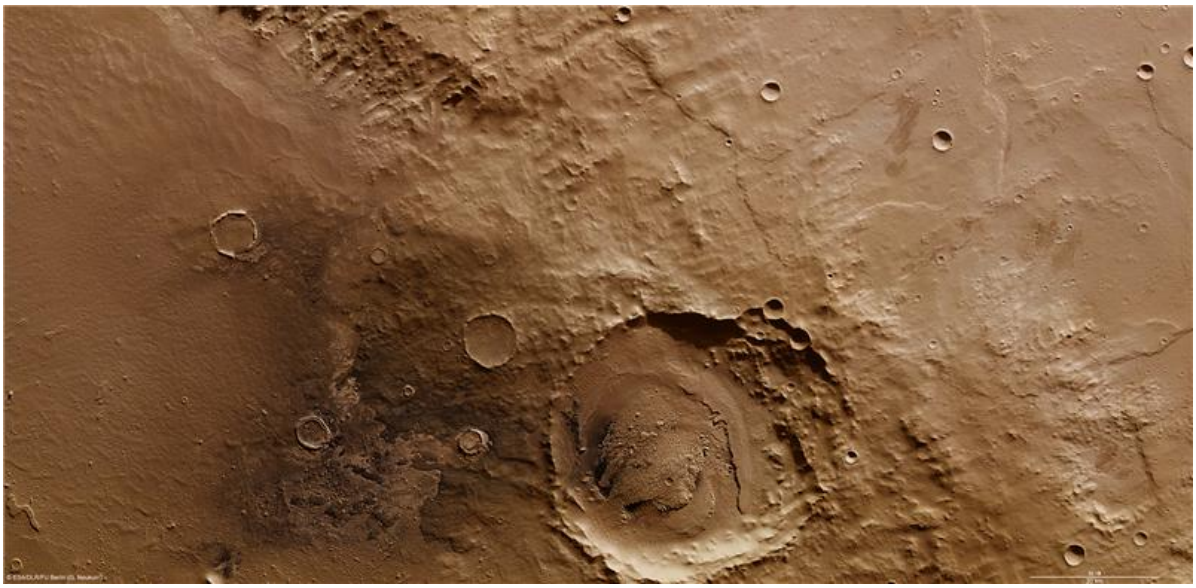
Beyond Bars also highlights 50 key cases the WiPC has championed, including imprisoned Nobel laureate Liu Xiaobo, who is due for release in 2020.

For further information search for #beyondbars on Twitter or visit:

http://www.indexoncensorship.org/beyondbars

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91886&CultureCode=en

**Wind and water have shaped Schiaparelli on Mars**



European Space Agency

The small crater embedded in the northwestern rim of the Schiaparelli impact basin features prominently in this new image from ESA's Mars Express. All around is evidence for past water and the great martian winds that periodically blow.

Schiaparelli is a large impact basin about 460 km in diameter located in the eastern Terra Meridiani region of the equator of Mars. The centre of the basin lies at about 3°S/17°E and is named after the Italian astronomer Giovanni Schiaparelli (1835–1910). Although he also studied Mercury and Venus, he is best known for his observations of the Red Planet.

During the 'Great Opposition' of 1877, when Mars passed close to Earth, Schiaparelli mapped the planet, perceiving a number of straight dark lines across the red surface. He assumed that these were natural water-filled channels and used the equivalent Italian word, 'canali'.

However, other astronomers thought he meant canals, meaning artificial irrigation and transportation routes, which led to a few astronomers, and a large number of the general public, believing that they had been created by intelligent Martians.

Now we know that Schiaparelli's 'canali' were illusions created by the comparatively poor telescopes of the time and there are no water-filled channels on Mars today. Nevertheless, there is evidence in this new picture that water was once present in this region of the planet, perhaps in the form of a lake.

This image was taken on 15 July 2010 by the High-Resolution Stereo Camera of ESA's Mars Express.

The scene shows a small part of the northwestern area of the Schiaparelli basin with the crater rim, the crater interior and parts of the surrounding highlands. Evidence for water can be seen in the form of dark sediments that appear on the floor of Schiaparelli, resembling those deposited by evaporated lakes on Earth.

The interior of Schiaparelli has been modified by multiple geological processes, including the fall of ejecta blasted upwards by the initial impact, flows of lava to create the smooth plains, and watery sediments. Box 1

shows part of these sedimentary deposits. Also in the crater floor, smaller impact craters have been partially flooded and filled.

The sediments forming the smooth plains in Box 2 have been modified by erosion, either by wind, water or both to form sharp contours such as the skinny plateau at bottom left. In other places, material has been deposited by the wind to form hills and dunes.

The prominent crater in Box 3 is 42 km across and rests on the inner rim of Schiaparelli. The interior of the smaller crater is filled with sediments that appear to form a terrace in the northern part and a delta-like structure near the centre. The latter seems to be partially composed of rounded light-coloured mounds. Dark wind-borne material has accumulated in the southern portion of the crater.

http://www.esa.int/esaSC/SEMEEYOR9HG_index_0.html

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91868&CultureCode=en

**Mutual trust that creates meaningful relationships contributes to rehabilitation**

Nordic School of Public Health

*Mutual trust that creates meaningful relationships contributes to rehabilitation in the transition of returning to work. This is demonstrated in a thesis at the Nordic School of Public Health authored by Christina Norman, who will defend her thesis on December 2, 2010.*

The thesis Co-operation between welfare agencies and provision of welfare services by voluntary organizations as strategies for rehabilitation and employment is a contemporary analysis of parts of the Swedish welfare system and is based on two studies.

The first study describes cooperation between different public welfare agencies organized in a cooperative team, the other study focuses on a partially member-managed model for working life oriented rehabilitation, the so called "Clubhouse model" (the Fountain House Movement).

Both studies are connected by discussions on the concept of mutual trust.

"Throughout, trust turns out to be the most important component for establishing meaningful relationships that in themselves contribute to rehabilitation and recovery", says Christina Norman.

http://www.nhv.se/Normaneng

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91865&CultureCode=en

**Boxing—Bad for the Brain**


Deutsches Aerzteblatt International

Up to 20% of professional boxers develop neuropsychiatric sequelae. But which acute complications and which late sequelae can boxers expect throughout the course of their career? These are the questions studied by Hans Förstl from the Technical University Munich and his co-authors in the current issue of *Deutsches Ärzteblatt International* (Dtsch Arztebl Int 2010; 107[47]: 835-9).

Their evaluation of the biggest studies on the subject of boxers' health in the past 10 years yielded the following results: The most relevant acute consequence is the knock-out, which conforms to the rules of the sport and which, in neuropsychiatric terms, corresponds to cerebral concussion. In addition, boxers are at substantial risk for acute injuries to the head, heart, and skeleton. Subacute consequences after being knocked out include persistent symptoms such as headaches, impaired hearing, nausea, unstable gait, and forgetfulness. The cognitive deficits after blunt craniocerebral trauma last measurably longer than the symptoms persist in the individual's subjective perception. Some 10–20% of boxers develop persistent neuropsychiatric impairments. The repeated cerebral trauma in a long career in boxing may result in boxer's dementia (dementia pugilistica), which is neurobiologically similar to Alzheimer's disease.

With regard to the health risks, a clear difference exists between professional boxing and amateur boxing. Amateur boxers are examined regularly every year and in advance of boxing matches, whereas professionals subject themselves to their fights without such protective measures. In view of the risk for injuries that may result in impaired cerebral performance in the short or long term, similar measures would be advisable in the professional setting too.

http://www.aerzteblatt.de/v4/archiv/pdf.asp?id=79379

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91859&CultureCode=en

**Medicinal treatment for depression is ended prematurely**

Nordic School of Public Health

*Swedish women's use of antidepressants is twice as high as that of Swedish men. However, among both female and male new users, one fifth fills only one prescription.*
*"This can be an indication of choices being made to end treatment before the recommended time," says researcher Karolina Andersson Sundell at the Nordic School of Public Health.*

Depression is expected to constitute the second largest source of global burden of disease after heart disease by the year 2020. The consequences for society and individuals are lowered quality of life, social isolation, decreased intellectual capacity as well as an inability to carry out activities of daily living. Additional consequences are significantly affected health levels, an increased need for institutionalized care along with an increased risk of suicide.

A register study of young adults who purchased at least one antidepressant in 2006 has been carried out by Karolina Andersson Sundell, Mika Gissler and Max Petzold of the Nordic School of Public Health and Margda Waern of the University of Gothenburg.

The study shows that between 4 to 13 percent of Swedes aged 20-34 use antidepressants. Almost twice as many users are women. Furthermore, 2.5 percent also use another mood stabilizer. Among those who use antidepressants, every tenth also purchases antipsychotics. Many furthermore only purchased their antidepressant medication once, indicating that the drug was not used optimally – the minimum duration of treatment recommended is six months after the depression has passed.

*Patients make this choice independently*

"What we need to do now is to monitor this for a longer period of time to see if they return and purchase antidepressants again, at a later stage. We currently lack knowledge regarding the reasons for why only one purchase is made, meaning additional studies are required. Previous international research however indicates that patients often make this choice independently and seldom inform their prescription provider why they decided to stop taking the medication," says Andersson Sundell.

The results indicate an elevated mortality rate among both men and women using antidepressants in combination with mood stabilizers. The use of lithium did however not follow this pattern.

*Increased mortality was seen*

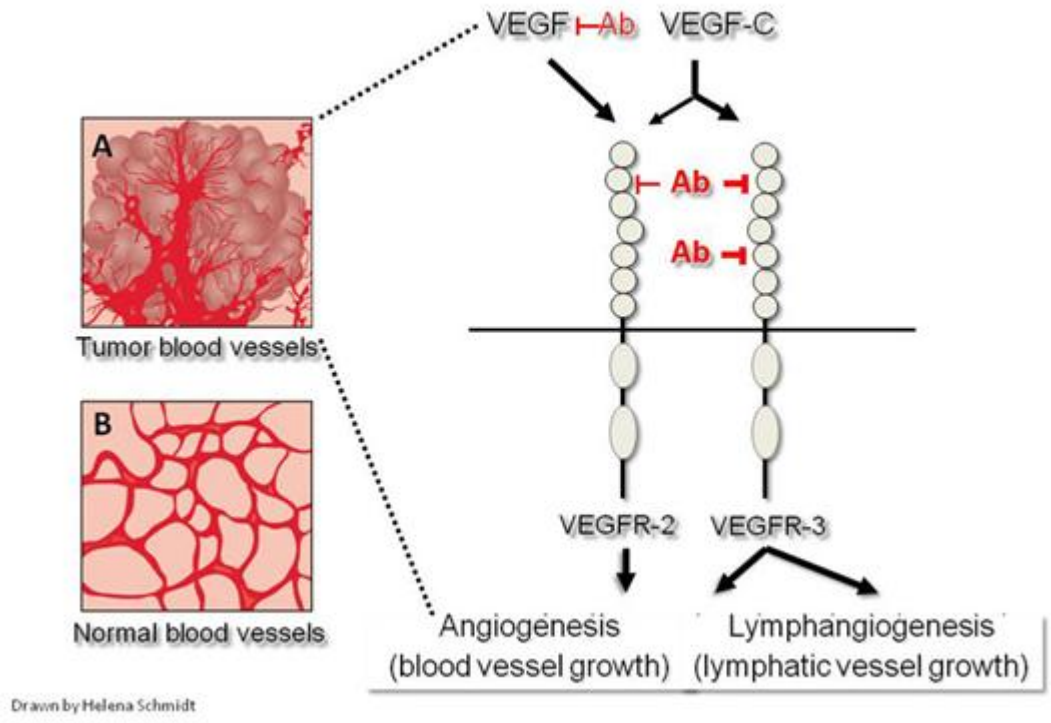
"One possible reason is that lithium users receive better follow-ups," says Andersson Sundell. Increased mortality was also seen among the group of individuals who filled prescriptions for both antidepressants and antipsychotics.
"Further studies are needed to map the reasons for the elevated mortality rates," says researcher Karolina Andersson Sundell at the Nordic School of Public Health.

The causal connection between medication use and a higher rate of illness, as well as that between the use of multiple types of medication and even higher rates of illness are factors to consider in this context, but the researchers nevertheless see significant tendencies in the study.

http://www.nhv.se/depressionmedication

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91856&CultureCode=en

**A double block of blood vessels to starve cancerous tumors**




Helsingin yliopisto (University of Helsinki)

According the researchers at the University of Helsinki, Finland, a novel strategy of blocking the growth of blood vessels with antibodies should result in improved treatment of cancerous tumors.

The growth of new blood vessels from pre-existing vasculature is called angiogenesis. In adults, angiogenesis occurs only during wound healing and menstrual cycling, but is abundant and harmful in cancerous tumors and the old-age eye disease frequently leading to blindness called age-related macular degeneration (AMD).

Without the formation of new blood vessels, tumors cannot grow beyond a small size due to lack of oxygen and nutrients. Inhibition of angiogenesis is used in the treatment of cancer and AMD, but not all cancer patients respond, while others become refractory to therapy.

Academy professor Kari Alitalo and co-workers at the University of Helsinki, Finland, have previously shown that antibodies directed towards vascular endothelial growth factor receptor (VEGFR)-3, found on the surface of endothelial cells lining vessels, can inhibit lymphatic metastasis by 50-70% in preclinical tumor models. Furthermore, antibodies that inhibited the growth factor VEGF-C from binding to the VEGFR-3 suppressed angiogenesis.

However, the trouble with this type of inhibitors is that they work poorly in high growth factor concentrations, when the growth factor easily outcompetes the inhibitor. Also the delivery of drugs into tumors is hampered by erratic blood flow and high tumor pressure, which may prevent sufficient amounts of the inhibitor from reaching its target within the tumor.

The novel type of VEGFR-3 blocking antibody has an unprecedented mechanism of action, which was effective even at very high concentrations of the VEGF-C growth factor. Importantly, the authors showed that combined use of antibodies blocking growth factor binding VEGFR-3 dimerization provided not only an additive, but rather a synergistic inhibition.

"The new dimerization inhibitor unveils a biologically meaningful rationale for suppressing angiogenesis in tumors that could outperform traditional competitive inhibitors of angiogenesis in tumor therapy. These findings should translate into improved anti-angiogenic and anti-lymphangiogenic tumor therapies", says Professor Alitalo.

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**Evolutionary arms race between smut fungi and maize plants**

Max-Planck-Gesellschaft

Max Planck scientists decode maize parasite genome

Fungi are a major cause of plant diseases and are responsible for large-scale harvest failure in crops like maize and other cereals all over the world. Together with scientists from the Helmholtz Zentrum in Munich, Regine Kahmann, from the Max Planck Institute for Terrestrial Microbiology in Marburg, and Jan Schirawski, who is now based at the University of Göttingen, analysed the genetic make-up of *Sporisorium reilianum*, an important maize parasite. Based on a comparison with the genome of a related fungal species, they succeeded in identifying new genes that play an important role in maize infestation. (Science, December 10, 2010)

The smut fungi *Ustilago maydis* and *Sporisorium reilianum* are parasites that attack maize plants. *Ustilago maydis* causes a disease known as boil smut or common smut, which is characterized by large tumour-like structures on the leaves, cobs and male flowers in which the fungus proliferates and produces spores. *Sporisorium reilianum* also attacks maize plants; however, it infects the entire plant and its symptoms become manifested only in the male and female flowers. For this reason, it is also referred to as maize head smut.

Little has been known up to now as to how these pathogens cause disease. Four years ago, a team of scientists headed by the Marburg group succeeded in decoding the genome sequence of *Ustilago maydis*. They demonstrated that the genes, for a large number of completely new proteins secreted by the fungus, are arranged in groups on the chromosomes in so-called gene clusters. These proteins control the colonisation of the host plant.

Similar and yet different

The researchers were initially only able to demonstrate the presence of these proteins in *Ustilago maydis*. “However, we found it hard to imagine that these proteins, which play such a crucial role in maize infestation, should only be present in the genome of a single smut fungus. For this reason, we also sequenced the genome of *Sporisorium reilianum*,” explains Regine Kahmann from the Max Planck Institute in Marburg. Over 90 percent of the proteins secreted by *Ustilago maydis* also exist in *Sporisorium reilianum*. However, many of these proteins differ significantly between the two species and are therefore difficult to detect at the gene level. “Surprisingly, however, almost all of the genes of the two organisms are arranged in the same order. As

a result, we were able to superimpose the two genomes like blueprints and display the differences in this way," says Kahmann.

The scientists discovered 43 so-called divergence regions, in which the differences in the two sets of genes are particularly significant. These included all of the gene clusters identified four years ago, whose genes play an important role in the infection of the host plant. In addition to this, four out of six randomly selected divergence regions influence the strength of *Ustilago maydis* infection, and surprisingly, one of these does not contain genes for secreted proteins. "This shows that additional, thus far undiscovered molecules control the relationship between the fungus and the plant," comments Jan Schirawski.

Evolutionary struggle between maize and fungus

Therefore, the genes that differ most strongly between the two fungi are in all likelihood those that play an important role in the infestation of the maize plant. The different life styles of *Ustilago maydis* and *Sporisorium reilianum* presumably resulted in the development of species-specific gene variants in these fungi over the course of evolution, e. g. to suppress the plant's immune response. The maize plants, in turn, modified the target molecules of these fungal proteins. Maize plants apparently form at least one protein to counteract each of the proteins released by the fungi. "What we see here are the signs of an ongoing struggle between the defending plant and attacking parasite. The variety of the weapons of attack and defence used is the product of an arms race between the plant and the fungus. Each modification on one side is countered by an adaptation on the other," explains Schirawski. With the help of the molecules they discovered on the basis of the differences between the two fungi, the Marburg-based researchers have the long term hope that it will be possible to develop new strategies for disease control of these and related plant parasites.

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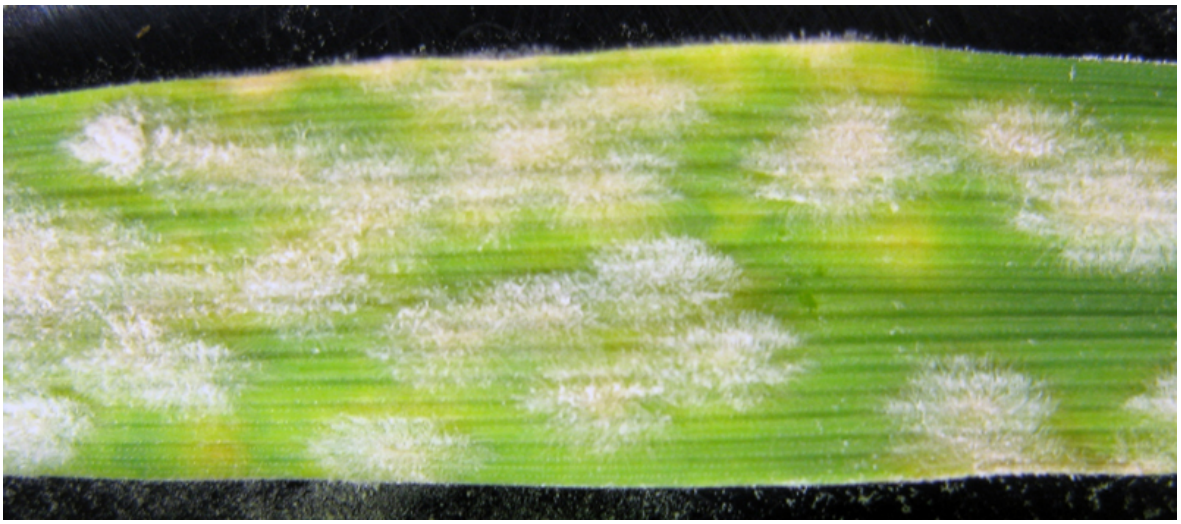
**Powdery mildew at an evolutionary dead end**



Max-Planck-Gesellschaft

The fungal pathogen has only those genes left that are necessary for its parasitical existence

The size of a genome tells us nothing about the comprehensiveness of the genetic information it contains. The genome of powdery mildew, which can destroy entire harvests with its fine fungal threads, is a good example of this. Although the pathogen has almost 120 million base pairs, and therefore one of the largest genomes of the sac fungi, at barely 6,000, its gene count is far lower than that of comparable species. It has lost many of the genes required for separate metabolism found in other fungi. Thus, from a genetic perspective, powdery mildew is stuck in an evolutionary dead end from which it is unable to liberate itself. (Science, December 10, 2010)

Based on the comparison of fungal genomes, Ralph Panstruga from the Max Planck Institute for Plant Breeding Research in Cologne and his colleagues from an international research consortium discovered that powdery mildew forfeited a large part of its genetic complexity in the course of evolution. The considerable size of the mildew genome is largely due to so-called “jumping genes”. These genes introduce new sequences into the genome and repeatedly mix up the genetic material by inserting and deleting themselves, causing errors as a result. Due to these changes, the powdery mildew fungus gained a considerable number of new base pairs, but it also lost a lot of genes as their reading frames were interrupted by the insertion of the jumping genes.

As the international consortium of scientists succeeded in demonstrating, the plant pathogen lacks 99 genes that enable independent life, yet are still found in baker’s yeast, another sac fungus. Therefore, powdery mildew cannot fix nitrogen, harness energy from alcoholic fermentation or produce certain metabolic products from inorganic compounds. As a parasite, powdery mildew does not require these synthesis processes; it obtains everything it needs from the host plant. Panstruga explains: “It can do without these genes. However, the price it pays is being forced to adhere to a particular way of life: parasitism. It has no way back to independent life. This is precisely what Dollo’s Law states: once lost, the very same genetic complexity can never be regained. That’s why extinct species cannot be re-established from the available genomes.”

Powdery mildew also lacks many of the genes necessary for attacking the plant cell. For example, it only produces a few transport proteins; other plant diseases produce an entire collection of these proteins. They use

these to infiltrate toxins into the plant cell or to pump the plant's immune defence proteins out of the cell so that they no longer pose a threat. Powdery mildew also forms very few enzymes that can be used to perforate the wall of the plant cell wall and thereby gain entry to it. "The powdery mildew fungus obviously lacks the genetic equipment to launch a broad attack on the plant cell. Instead, its strategy is to slip into the plant unobtrusively. It tries not to give the plant immune system any opportunity for a defensive reaction. This also suits its parasitic way of life. Powdery mildew is not interested in the destruction of the host plant. What it wants is the subtle and enduring subjugation of its host", says Panstruga.

The mildew pathogen colonizing barley uses just four percent of its genetic armoury for this subjugation. The Cologne-based scientists only identified 248 genes that could possibly be used for such a task. The comparison with other mildew species – for example pea or Arabidopsis mildew – revealed that the three species share only seven of these genes. All of the others are found only in the barley mildew. This exclusivity shows that its genetic equipment developed with a view to establishing a parasitic existence in close association with the relevant host plant. The other mildew species have clearly found other genetic solutions.

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91832&CultureCode=en

**Scientists: The fire in Israel is a typical example of climate change effects in the Mediterranean**

Helmholtz Centre For Environmental Research - UFZ

The fire disaster in the Carmel Mountains near Haifa is a typical example of climate change effect and a taste of the future, says Dr. Guy Pe'er, one of the authors of Israel's first report to the UN on climate change. Ten years ago, Dr. Pe'er and other Israeli scientists collated knowledge about the effects of climate change for Israel. They warned already in the year 2000 of expected climatic fluctuations, heat events, decreased rainfall and delayed late winter rainfall, all of which would lead to increased risk of intense forest fires.

According to "Israel's National Report on Climate Change", prepared by Pe'er and other members of Ben-Gurion University of the Negev on behalf of the Israeli Ministry of the Environmental Protection, the frequency, intensity and extent of the fires would increase due to the prolongation of droughts, increase in water evaporation and an increased frequency of intense heat waves. At a warming of 1.5 degrees by the year 2100, which is by now considered a conservative scenario, models predict the desert to expand northward by 300 to 500 kilometers to the north. Mediterranean ecosystems, such as the one occurring in the Carmel Mountains, would thus disappear from Israel. Forest fires in the Carmel mountain range in northern Israel was preceded by eight months of drought and occurred during a heat wave with temperatures around 30ºC. Normally, first rainfall should have come in September or October, and the maximal daily temperature at this time of year should be around 15-20ºC.

The Carmel mountain range, northern Israel, rises to 546 meters above Sea Level. The combination of high rainfall (average of 800 mm per year), mountainous landscape and little human-pressure have resulted in rich and diverse vegetation, including Israel's largest natural pine forest. Therefore, large parts are nowadays protected within National Parks and Conservation Areas.

Dr. Guy Pe'er, currently a fellow at the Helmholtz Centre for Environmental Research (UFZ), Leipzig, has witnessed three forest fires in the year 1989 where large areas of the Carmel mountains were burnt, penetrating the outskirts of his native city of Haifa. "Following the fire I spent over a year studying the recovery process of the vegetation and the Mesopotamian fellow deer at the reintroduction centre at the Carmel forest. It was there that I've learned that fires are something natural and nature can recover if no further disturbances occur." Guy Pe'er is nevertheless overwhelmed by the intensity and extent of the fire: the largest fire in 1989 has destroyed an area which was ten times smaller than the current one.

The worst forest fire ever in the history of Israel has spanned a total area of 5000 hectares, taken the lives of 42 people and burned 250 houses down. Damages are estimated at more than 55 million €. Israel has since then been engaged in heavy debates on responsibility: how did the government, the ministers and the fire-brigade contribute to this failure? Guy Pe'er holds a different opinion, suggesting that the discussion should involve the longer and more substantial causes of this fire, namely climate change. "It's a matter of our consumption, our society and habits. We consume more than we need and more than Earth can sustain, and by that we bring about climate change and risk our own future. Can we behave as responsible humans and change our habits?" says Pe'er. From the perspective of the Israeli conservation biologist the international politics should reflect this incident onto the ongoing UN conference on Climate Change in Cancun, and ensure that its decisions will finally lead to the mitigation of climate change. Because climate change is not fiction: Israelis these days have got a glimpse of what may awaits the coming generations.

http://www.ufz.de/index.php?en=20837

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91703&CultureCode=en

**Always on the bright side**

Albert-Ludwigs-Universität Freiburg

What makes cleavers always stay on top of other plants, bringing them a sun-exposed location advantageous for fast plant growth?

This question has been studied in a cooperation between the Plant Biomechanics Group of the University of Freiburg and the Functional Morphology and Biomechanics Group of the University of Kiel. The upper and lower surfaces of the leaves are covered with small hooks and interlock efficiently with different contact surfaces. That way cleavers can climb on host plants using the leaves as climbing organs. But owing to a mechanism functioning like a double ratchet cleavers stay on the bright side above the leaves of other plants but slip past them if the leaf is underneath them. The structures underlying this mechanism have also been studied in the project. The leaf hooks of the upper and lower leaf surfaces differ in orientation, distribution, structure and mechanical properties. In accordance with these differences, friction properties of leaves depend on the direction of the applied force and differ significantly between both leaf surfaces, resulting in the ratchet mechanism.

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**Massive gene loss linked to pathogen's stealthy plant-dependent lifestyle**

Virginia Tech

An international team of scientists, which includes researchers from Virginia Tech, has cracked the genetic code of a plant pathogen that causes downy mildew disease. Downy mildews are a widespread class of destructive diseases that cause major losses to crops as diverse as maize, grapes, and lettuce. The paper describing the genome sequence of the downy mildew pathogen *Hyaloperonospora arabidopsidis*, which attacks the widely studied model plant *Arabidopsis thaliana,* is the cover story of the Dec. 10, 2010 edition of the journal *Science*.

In the paper, the sequence of *H. arabidopsidis* is compared with other fully sequenced genomes of destructive plant pathogens to shed light on the differences in the ways microbes interact with their host and how those differences evolve. The payoff could be new ways to investigate how these pathogens wreak havoc and, in the long-term, finding how to prevent billions of dollars of losses for farmers growing crops across the globe.

Downy mildew pathogens are so highly specialized for parasitizing plants that they can no longer survive away from their hosts. However, they are close cousins of pathogens such as the Sudden Oak Death pathogen *Phytophthora ramorum*, which can attack hundreds of forest species but can also survive away from its hosts by feeding on dead plant matter. Comparisons of the genetic sequence of *H. arabidopsidis* with other related plant pathogens such as *P. ramorum* have revealed a massive loss of genes related to the microbe's plant-dependent lifestyle.

"Some plant pathogens like *H. arabidopsidis* must keep their host alive throughout the infection cycle in order to survive," said Brett Tyler, professor at the Virginia Bioinformatics Institute at Virginia Tech and one of the lead authors of the study. "Others, including *Phytophthora* species that destroy soybean and potato crops as well as oak tree forests, keep plants alive for part of the time before killing and devouring the plant tissue. Now that we have the genome sequence for an obligate parasite member of this family of destructive

pathogens, we can use that information to zero in on common genes that could be targeted to create new, widely effective disease control strategies."

Downy mildew and *Phytophthora* pathogens are oomycetes, fungal-like organisms that have evolved from marine algae. The availability of multiple genome sequences for oomycete plant pathogens is an important step in allowing scientists to build a picture of the host-pathogen evolutionary arms race.

"Many plant pathogens contain large families of related genes that serve as powerful weapons but can also trigger equally powerful immune responses in the plant," commented John McDowell, an associate professor in Virginia Tech's Department of Plant Pathology, Physiology, and Weed Science and one of the project's leaders. "Our comparisons across multiple genomes revealed that many of these gene families have been reduced in size or completely discarded in *H. arabidopsidis*. This evolution towards stealth helps explain why this mildew and its relatives are widely distributed and cause diseases on many important crops."

The *H. arabidopsidis* genome sequence reveals large numbers of effector proteins, the molecules that invade plant cells to suppress plant immunity. It also reveals widespread reduction in the number of genes related to degradative enzymes and other molecules linked to the metabolism of nitrogen and sulfur, which suggests that *H. arabidopsidis* has dispensed with many genes required for life away from the plant, instead focusing on genes that help it to stealthily take control of host cells. In fact, almost 7000 of the predicted genes in the sequence had no counterpart in the genome sequences of its less-refined *Phytophthora* relatives.

The massive gene loss that is evident in the *H. arabidopsidis* genome will provide many clues on the evolutionary adaptation necessary for a pathogen to become fully dependent on a plant host. A complete understanding of host-pathogen interactions should lead to the development of novel means of protecting crops from losses in yield caused by disease. It could also help to identify new targets for pathogen control and help in the development of novel disease-resistant varieties.

In addition, several downy mildew pathogens are listed as potential bioterror threats to agriculture in the United States. Understanding how these pathogens attack crop plants should enable preventative measures to be put in place.

The project was a collaboration involving scientists at the College of Agriculture and Life Sciences at Virginia Tech, United States, the Genome Center at Washington University, United States, The Sainsbury Laboratory, United Kingdom, the Sequencing Centre at the Wellcome Trust Sanger Institute, United Kingdom, the University of Warwick, United Kingdom, and the Virginia Bioinformatics Institute at Virginia Tech, United States. The work was supported by funds from the Agriculture and Food Research Initiative of the United States Department of Agriculture's National Institute of Food and Agriculture, and by the Emerging Frontiers program of the National Science Foundation.

Baxter L, Tripathy S, Ishaque, N et al (2010) Signatures of adaptation to obligate biotrophy in the *Hyaloperonospora arabidopsidis* genome. *Science* vol. 330: issue 6010.

Read more about the Hyaloperonospora arabidopsidis sequence:
https://www.vbi.vt.edu/archive/pdf/news/2010/101202-info-hyaloperonospora-arabidopsis-sequence.pdf

http://www.sciencemag.org/content/current

http://www.alphagalileo.org/ViewItem.aspx?ItemId=91664&CultureCode=en

**Illegal file sharers 'Robin Hoods of the digital age'**

Portsmouth, University of

Many illegal file sharers believe they are the 'Robin Hoods of the digital age' and are motivated by altruism and a desire for notoriety, according to new research which analyses why people illegally download digital media.

The research by Joe Cox, from the University of Portsmouth Business School, is the first study to distinguish between the characteristics, motivations and behaviours of different types of file sharers. It is published in the academic journal, Information Economics and Policy.

Mr Cox used Finnish national survey data, which captured file sharing habits, socio-economic status and attitudes towards legal and illegal file sharing of 6103 respondents from across a range of income brackets. Ninety-five per cent of the respondents were male and the average age was 28.

File sharing, the transfer of files from one computer to another over a network, allows a number of people to make exact copies of the same file.

It is hoped that this research into people's actions related to illegal file sharing activity, will inform future policy-making.

"Although it is difficult to measure the true extent of how illegal file sharing has affected the creative industries, I do believe it is a significant threat in terms of loss of employment and revenues," said Mr Cox.

"Some file sharers see themselves as masked philanthropists – the Robin Hoods of the digital age. They believe their activities shouldn't be considered illegal, which means finding the most appropriate form of deterrence and punishment is extremely difficult."

The government's current plan to tackle illegal file sharing and internet piracy is the Digital Economy Act, which aims to see persistent illegal file sharers disconnected from the web by their Internet Service Providers (ISPs).

The Act was due to come into force in January 2011 but is now under judicial review after TalkTalk and BT successfully appealed against it.

Mr Cox separates file sharers into two groups – 'leechers' and 'seeders'. Leechers are those who download digital media illegally from other parties, but who are not explicitly making content available in return. Seeders are those who have acquired the material in the first instance and are making it available to leechers.

He said: "It's a fascinating area to research because the seeders who are sharing the material appear to have little obvious gain and are certainly not doing it for any financial reward.

"My research shows they are motivated by feelings of altruism, community spirit and are seeking recognition among other members of the file sharing community. I think it's likely some benefit is also derived from a feeling of 'getting one over on the system' too.

"Seeders seem to consider the expected cost of punishment to be minimal, which is largely due to the low perceived likelihood of detection. It's as if they believe the peer esteem they'll generate from their infamy will outweigh any of the costs associated with their activities."

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